Practical Computing

90p October 1984
Volume 7 Issue 10

ai

Artificial Intelligence and Fifth Generation computing

Amstrad CPC-464 – today's best buy?

David Levy on programming for games

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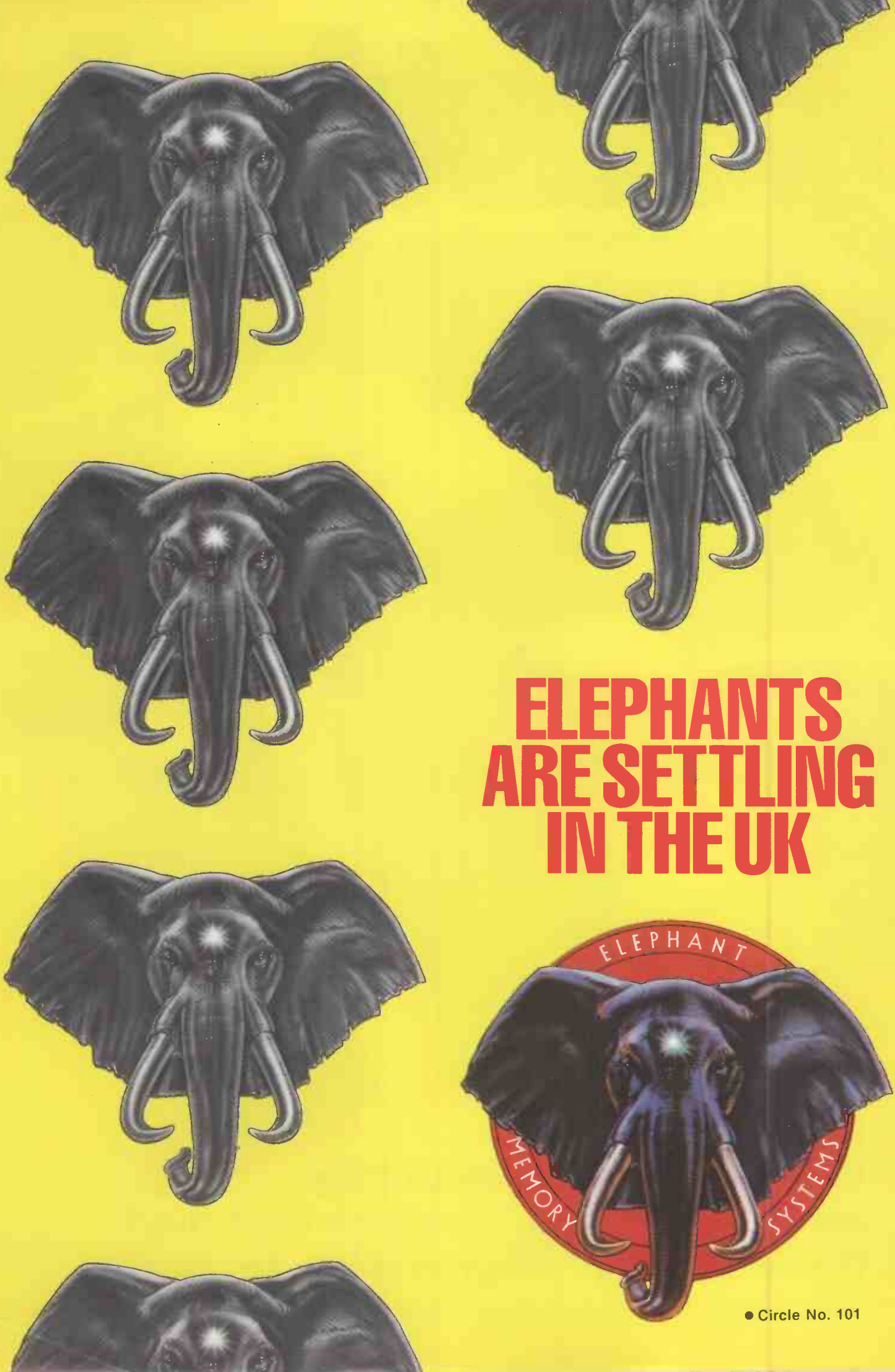

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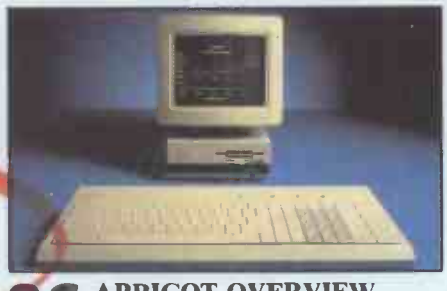
>LIST

PRACTICAL COMPUTING OCTOBER 1984

>NEWS

>FEATURES

>REVIEWS



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4

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

Optimism

THE HIGHLIGHT of the October issue of *Practical Computing* five years ago was the public launch of Prestel. We devoted nine pages to "The Data World of Tomorrow", with explanations of obscure, new jargon words such as viewdata, teletext, IP and telesoftware.

"The start of the full public service of Prestel", we said, "is an event which may well, from the future, seem as crucial in the history of our civilisation as, say, the opening of the first railway line or the first circumnavigation of the globe. Prestel and what it brings eventually will transform our methods of communication and through them all the ways in which we work and live."

It has since become obvious that Prestel cannot sustain such inflated hopes. The system is just not powerful enough. However, the general tenor of the remarks is sound. We are in the middle of an information revolution which will affect the way we work and live, and we can be optimistic about the changes it will bring.

But all was not sweetness and light even back in 1979. We noted that then, as now, "in the real world there is a good deal of doom and woe." Then, as now, "people are digging their fingers and toes into the dirt as their familiar piece of industrial landscape slithers inexorably over the edge and into the chasm of history."

Also back in 1979 microcomputer firms were going out of business. "The long-predicted weeding-out process is now in full swing among many established companies in the microcomputer business . . . . In recent months, a number of pioneers have run into financial difficulty and have been forced into bankruptcy. Digital Group and Imsai are still doing business, but have been forced to reorganise under court supervision . . . . The Grim Reaper has laid his scythe to Processor Technology, maker of the famous Sol system, and one of the first companies to manufacture S-100 boards as accessories for the Altair computer."

Names like Imsai, Sol, Altair and Exidy will be strange to many readers, but they were the Acorns and Sinclairs of the day. At the time, the idea of their disappearance seemed to portend catastrophe. The moral is simply that no microcomputer company is indispensable.

Also, despite all the comings and goings of Ohio Scientific, Osborne, Victor, Camputers, Dragon and the like, there has been a remarkable continuity over the last five years. The October 1979 issue of *Practical Computing* carried advertisements for Apple, Commodore, Comart, Cromemco, Rair, Research Machines, Tandy and other micros. Icarus was selling Superbrains and Personal Computers Ltd was selling the Apple II.

The remarkable difference between now and 1979 is in attitudes to microcomputing. The major change has come from the major corporations like IBM, DEC and ICL. For example, IBM no longer thinks micros are toys — or if it does, it would no longer say so in public.

Both the public and the government now take microcomputing seriously. In 1979, no doubt, the popular view was that the readership of *Practical Computing* consisted of just a few cranks with their heads in the asteroid belt. Now there is a micro in almost every school, and in a large and growing proportion of homes and offices. The readership of *Practical Computing* may still consist of just a few cranks, but they arew the ones who are changing the world.

In the end it's not the computer companies that matter, nor the magazines, it's the users. And that is why there is still every reason for optimism.

5 Years ago...

The 16-bit microcomputer is here at last as the Zilog Z-8000 Development Module proves. It will aid the user in evaluating and developing hardware and software for Z-8000 microprocessor-based products.

It features a Z-8002 processor, 2K word EPROM monitor, 16K words of RAM, dual series interfaces, 32 programmable I/O lines with hand-shake control, four programmable eight-bit counter/timers, jumper-selectable CPU clock rates and wire-wrap area to allow addition of custom interfaces or special applications.

Memory can be expanded by adding 16K RAM and 2K EPROM components.

The board accommodates a wide range of applications, and communicates with the outside world through two RS-232 interfaces. The monitor program, contained in 4K of EPROM, provides the necessary debugging commands, I/O control and host interface for the Z-8000 Development Module.

Prices and availability on request from Zilog dealers.

PC Volume 2 Issue 10

SPOT THE DIFFERENCE

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THE DATABASE SYSTEM
THAT SAVES TIME & MONEY
IN APPLICATION DEVELOPMENT
FOR
SINGLE USER SYSTEMS
RUNNING UNDER
CP/M, CP/M-86, MS DOS, PC DOS
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DATAFLEX
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THAT SAVES TIME & MONEY
IN APPLICATION DEVELOPMENT
FOR
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RUNNING UNDER
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The words might be different, but to Dataflex it makes no difference which type of system you use. Dataflex is simply a very good relational database development package, no matter what.

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- ☐ **at least 10 open files***
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- ☐ **255 fields per file**
- ☐ **4K byte record length**
- ☐ **64K records per file**
- ☐ **Record locking** 16 bit systems
- ☐ **On-line interactive file maintenance, file update and data entry**
- ☐ **Global file operations**
- ☐ **Multi-user, multi-file applications**
- ☐ **Comprehensive report generator**

So whether it's PC, network or multi-user, start with Dataflex... it's the relational database that moves with computers that move with the times.

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Editorial standards

MUCH OF the current plethora of computer magazines are of dubious value. Especially worrying is the influence that a particular magazine can have on the sales potential of a product through a good or bad review.

I regularly purchase *Practical Computing* and also the U.S. magazine *Byte*. The April 1984 issue of *Byte* contained an editorial statement from Phil Lemmons entitled "A Call for Ethical Standards for Personal Computer Magazines". I am sure you have access to this issue.

In brief the eight subheadings were:

1. No "editorial" discounts for *Byte* staff members.
2. No expense-paid trips.
3. No fat speakers' fees.
4. Disqualification from stories because of stock ownership.
5. An author's connections must be clear.
6. No favouritism to advertisers in editorial coverage.
7. Editors determine the editorial themes.
8. No privileged relationships with companies in the field.

Will you as editor of a leading U.K. computer publication, make a similar series of declarations in your magazine? If you were able to do so, I believe you would earn still further respect in what is becoming a rat-race market.

N H Day,
Nottingham.

● **The editor replies:** Along with all U.K. computer magazines we are guilty on counts 1 and 2. Unlike many other magazines, we are innocent on counts 3 to 8 inclusive. Is this good enough? What do readers think?

We accept discounts on equipment for magazine use because it helps with software reviews and for everyday office use. Does anyone think we have been unduly kind to, say, the Commodore 64 because our system was supplied half-price? Was our Sinclair QL review more believable because we paid full price for a production machine, rather than review a "sample" picked by the manufacturer?

Screen hazards

MY ENQUIRY concerns the safety of video monitors. I have been using an ex-Video Genie EG-101 green screen monitor for a number of years. It still provides an acceptable display and is currently in use with our recently acquired Advance 86 machine.

However, a notice which I have found stuck to the tube concerns me: "X-RAY WARNING — shielding of this cathode ray tube for X-ray radiation may be needed to protect against possible danger of personal injury from prolonged exposure at close range." My major concern is that of possible endangerment of the health of our two young daughters whom we actively encourage to "play" with the keyboard.

The monitor case is, of course, plastic and I can see no additional shielding of the tube face. I am minded to mount a sheet of 6mm. plate glass in front of the tube, or even scrap the monitor altogether.

I have read *PC* for four years but do not recall whether anything has been printed directly on this subject. I believe the safety of VDUs for commercial use is monitored, but how much is known of the safety of monitors supplied for home and small business use? Are certain manufacturers more safety conscious than others? Do the higher voltages in RGB monitors render them more hazardous than monochrome?

Can *PC* perhaps offer any reassurance?

Paul Backhouse,
Burnley,
Lancashire.

● **The editor replies:** Help! Do any readers know the answers to these important questions? There have been many allegations that VDUs are a health hazard, but the subject is contentious. The Health and Safety Executive has published a Guidance Document on the Use of Visual Display Units, HMSO £5, but it is unsatisfactory. The HUSAT Research Centre at Loughborough University is investigating the field. HUSAT's Brian Pearce — author of *Health Hazards of VDTs* published by John Wiley — is giving a one-day course for managers in London on 11 October and 1 November. It is called "Working with VDUs: Problems and Solutions" and costs £139.15 including VAT. Contact Humane Technology, P O Box 2, Quorn, Leicestershire LE12 8EG.

BBC graphics

IN THE Feedback columns of the June issue of *Practical Computing*, S J Steward reports a problem with the graphics window capability, VDU24, of the BBC Micro. The problem as stated was that after using VDU 29 to change the graphics origin while using the default window, a subsequent VDU24 command is ignored.

This is true in certain circumstances, but the problem has a logical explanation and an easy solution. As the accompanying demonstration program shows, the VDU24 command to set a graphics window takes the current graphics origin as its bottom left-hand corner. This is not necessarily the same as the bottom left of the screen. Also, if the graphics or text window goes off screen, then the window is ignored and the default window, the whole screen, is used instead.

The solution is to make sure that the graphics origin is set to the bottom left of the screen before the VDU24 command is used. VDU26 will do this. The problem will thus be solved if

```
VDU24,x1;y1;x2;y2;
```

is replaced by

```
VDU26,24,x1;y1;x2;y2;
```

G M Abernethy,
Norwich.

dBase input checking

MIKE LEWIS'S input-validation technique based on the Type ( ) function — see September issue, page 46 — is certainly "a little clumsy" as he suggests. For one thing, it creates unnecessary extra memory variables, which are unwelcome when the limit is 64. The word "SORT" in the example as printed is of course a misprint for "STORE".

Mike Lewis's first approach is the correct one: string the OK values together into a single variable and test the input value for inclusion or non-inclusion. The trick is to sandwich the test value between a pair of

(continued on next page)

```
 10 MODE1
 20 VDU24,0;0;400;400;   :REM Set graphics window
 30 GCOL0,129            :REM Set background = red
 40 CLG                  :REM Clear graphics area to
                             show window
 50 A=GET                :REM Wait for keypress
 60 VDU26                :REM Set default windows
 70 VDU29,640;512;       :REM Set graphics origin to
                             middle of screen
 80 VDU24,0;0;400;400;   :REM Same window as above
 90 GCOL0,130            :REM Set background = yellow
100 CLG                  :REM Show window
110 A=GET
120 VDU26
130 VDU29,1000;1000;     :REM Set graphics origin so
                             window will go off screen
140 VDU24,0;0;400;400;   :REM Same window
150 GCOL0,131            :REM Set background = white
160 CLG                  :REM Show window
```

BBC graphics.

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.

(continued from previous page)
separators, choosing the same separators you are using in the OKCodes string.

Something along these lines:

```
STORE 'zLDNzMANzGLAz
   BHMzYRKzEDNz' to OK
   CODES
store '  ' to dist
do while .not. 'z' + dist + 'z' $
OKCODES
10,10 say 'District' get dist
   picture '!!!'
read
enddo
```

Note that OKCodes is topped and tailed by the separators.

This demonstrates the principle, but the technique even allows you to choose the otherwise dangerous space character as separator, with the added advantage that OKCodes can be displayed on the terminal if a crib is needed.

Chris Bidmead,
London NW3.

PFS bug

ONE OF MOST sold data file-management systems in the lower price category must be the PFS — but now a word of warning. There is a fatal bug, either in the manual or in the Apple II version of the program, which every user should be aware of.

The manual, which is one of the best I have ever seen, fails to mention that while it is possible to redesign the filing form so that items can be moved to different places, you are damned if you try to transfer the first field to such a position where it is no longer the first. Temptation to break this rule may be great, especially when it is possible to have 50 items per screen and 32 screenfuls per form. One cannot always tell beforehand which fields are those which will be updated most often.

If one of those fields happens to be the 1,600th, you need 31 Ctrl-Ns to reach the last screen of the record and an additional 49 Shift-Right Arrows to reach the last field. Multiply that by the number of records you want to update. If you have several floppies with an identical structure, it would be much easier to redesign the form structure so that the field most often visited will be the first, do your updating and then undo the structural change if necessary.

PFS allows that to be done and you will save time, and all seems to be fine. The horror of it is that your file is corrupt. The majority of forms may be OK, but now and then you will meet forms which have partially changed their information with some other forms.

I have never met this phenomenon when doing a redesign of a form, when the first field, that of the primary search, has been left as it is. Perhaps seasoned users of DBMSs know that the primary key is holy and untouchable — if it really is in other file-management systems. But PFS is purported to be suitable for novices, and I cannot understand why the publisher of the PFS failed to mention this idiosyncracy.

Pauli Heikkinen,
Pori,
Finland.

Commodore disc danger

ACCORDING to the Commodore 1541 disc drive manual, the sample programs issued with the drive, the word-processing package Easyscript and all other published material that I have investigated, an already existing file on a disc may be overwritten by a file of the same name by using the Save and Replace command

```
SAVE "@FRED",8
```

```
Formatting.
 OPEN 1,8,15,"N0:programme name,ID":CLOSE1
Scratch.
 OPEN 1,8,15,"S0:programme name":CLOSE1
Rename.
 OPEN 1,8,15,"R0:programme name":CLOSE1
Initialise.
 OPEN 1,8,15,"I0:programme name":CLOSE1
Validate.
 OPEN 1,8,15,"V0:programme name":CLOSE1
```

Commodore disc danger.

What is omitted by the aforementioned documentation is the information that using this command may destroy other files on the disc by overwriting them with the contents of Fred.

When challenged with this Commodore replied as follows: "There is a problem with the Save@ command. The command seems to overwrite existing records on a disc if the new program is longer than the first. The only way to overcome this problem would be to delete the old file first and then re-save or save the new file under a different name and then erase the old file and rename the new one."

A number of new disc commands were also supplied by Commodore. They are listed here as they are not described in the disc manual and do slightly simplify the rather tedious save and replace sequence described.

Commodore seems to be unconcerned both with the inconvenience caused by this procedure and by the fact that the problem has to be discovered by the user. In my case the cost was several files, resulting in a great deal of wasted time and effort.

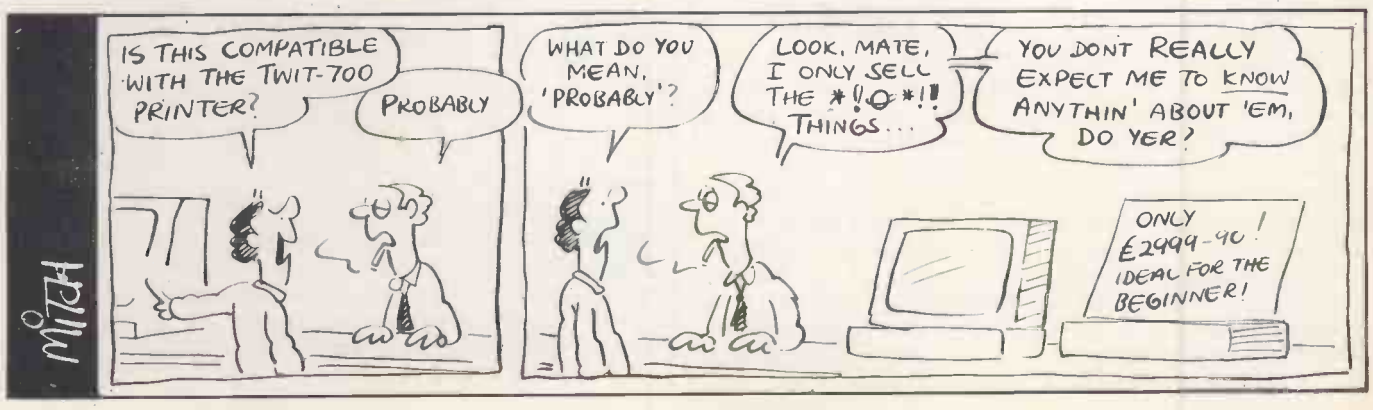
There is no promise of an updated drive manual or firmware fix for the problem. Buyer — and disc user — beware!

D J Morgan,
Broadstone,
Dorset.

Micros in schools

I WILL BE visiting the U.K. in November and the Continent in December on a fact-finding mission about the uses of computers in education. If there is any teacher who has developed an interesting use for the computer at any school level and would like to share this with me, I would be very interested to have a look at it. I would also be happy to discuss what we are doing in my country. Interested teachers should write to me at Ballarat.

Richard Morrish,
Department of Computer Studies,
Institute of Catholic Education,
PO Box 650,
Ballarat 3350,
Australia.



ACT Pulsar 'File Transfer'

It's easy to get the impression that the differences between micros are there to tie you down. How do you upgrade from 8-bit Apple to today's 16-bit micros, or copy files between different 16-bit machines, without hours or even days of laborious data re-entry – and all the dangers that entails?

The answer is Pulsar File Transfer. It puts Apple, Sirius, Apricot and IBM straight onto the same wavelength, transferring file type, text, binary or graphic information directly at up to 9,600 bits per second.

With the correct combination of Pulsar File Transfer packages you have access to complete software freedom between IBM-PC, Sirius and Apricot and instant transfer of data from Apple. Multiple files can be sent or received with a single command, while an in-built error-checking facility guarantees absolute accuracy.

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9

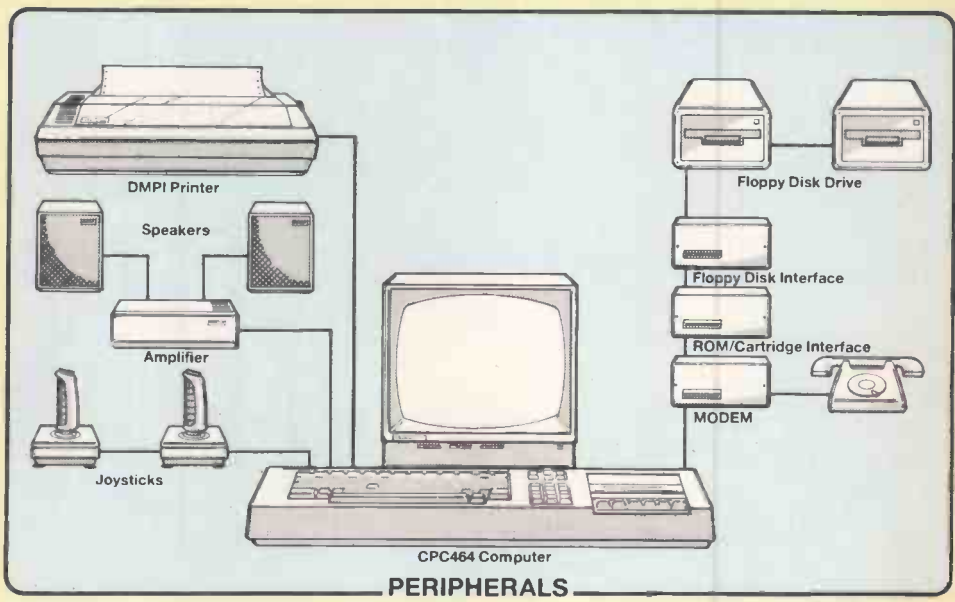
After everything that's been said in praise of Amstrad's CPC464, is there anything to add?

Plenty.

The CPC464 is an enthusiast's dream come true.

Few applications are beyond its capabilities, with its sophisticated features, complete expansion bus connector for sideways ROMs, serial interfaces, disk drives and modems.

No wonder the press is in raptures over it.



The CPC464 system.

It comes complete and ready-to-go. Here's what you get for that incredibly low price.

64K of RAM (42K available), 32K of ROM, colour monitor or green screen VDU, typewriter style keyboard, integral cassette data recorder and a very fast extended BASIC.

The CPC464 offers you high resolution graphics, 80 column text display, up to 8 text windows plus a graphics window and a palette of 27 colours.

Not to mention a 3-voice, 7-octave stereo output you can feed through a hi-fi amplifier and speakers.

Now we think you'll agree, that's some system.

CPC464 green screen VDU (GT64)

Low cost disk drive.

An inexpensive floppy disk system is available which includes CP/M* (giving you the option to access 3000 proven programs) and LOGO with its famous educational applications.

Optional disk drive DDI-1 including interface CP/M* and LOGO £199.95

£239
Computer complete with green screen VDU (GT64)

£349
Computer complete with colour monitor (CTM640)

CPC 464 complete with monitor and datacorder

Printer port.

The CPC464 has a built-in standard parallel printer interface which offers you the facility to provide permanent reference of program listings, letters, invoices, anything that requires 'hard copy'.

Optional 80 column dot matrix printer DMP-1 operates at up to 50 characters per second. Combined with the CPC464, it offers a high performance text processing system for only £199.95.

Joysticks. Power supply modulator.

You can bring those arcade games stunningly to life with the optional joystick controller which has a socket for a second stick.

The optional power supply and modulator enables the CPC464 to be connected to any home colour TV.

Amsoft. Fast growing software.

The high quality software takes full advantage of the CPC464's high specification and speedloading capability. Which means even complex programs can be loaded quickly.

A range of software is already available. And it's growing rapidly.

Educational programs, business applications and arcade games are all designed to utilise the CPC464's impressive graphics, sound and processing abilities.

Amstrad Club Membership.

Whether you're interested in commercial applications or you're a games fanatic, you'll want to join the Club.

Members enjoy immediate benefits like the privilege card, Club binder, regular magazine, competitions for valuable prizes and contact with other Amstrad users.

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PC2

Start collecting now.

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Pulsar is part of ACT, Britain's leading 16-bit business micro company.

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12

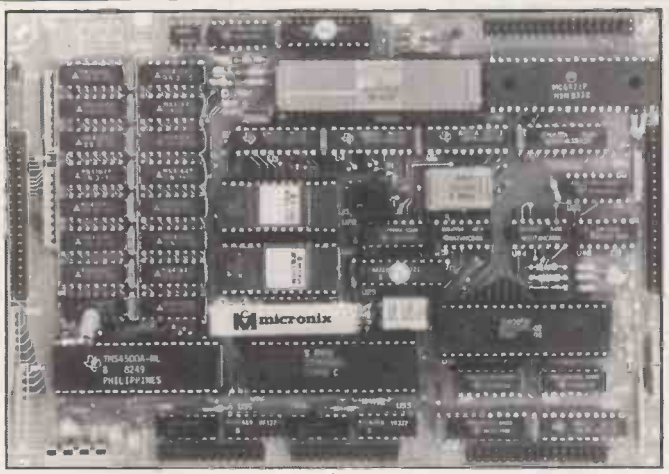
Comart supermicros

COMART has launched a range of multi-user systems based on the 80286 and 80287 processors from Intel, the latest in the 8080 family, and a step beyond the 80186.

The entry system CP-2202 offers 256K RAM, with two 5.25in. 800K floppies. The cost is £2,995. The 20Mbyte version costs £4,695, and the 40Mbyte version £5,695. Common to them all are four serial ports and one parallel. It is possible to upgrade the system to 12 and three respectively.

Other options available include memory expansion to 1.75Mbyte and cartridge back-up. The entry systems runs single-user Concurrent CP/M, and the hard-disc version multi-user Concurrent CP/M.

For more information on these systems contact Comart Computers Limited, Little End Road, Eaton Socon, St. Neots, Huntingdon, Cambridgeshire PE19 3JG. Telephone: (0480) 215005.



Micronix micro

MICRONIX has produced a single-board micro based on the Motorola 68008, the chip at the heart of the Sinclair QL. The board is only 8in. by 5.75in., but boasts 128K RAM expandable to 512K, two parallel ports and two serial RS-232 ports.

The on-board floppy-disc controller can run up to four drives, which may be 5in., 3.5in. or 3in. A system monitor provides full debug facilities, I/O control, single-line assembler and disc read/write routines.

The board costs £199 plus VAT in kit form, and £499 made-up. Included in the price is OS-9/68000, a real-time multi-tasking multi-user operating system similar to Unix.

Micronix also intends to release a fully assembled system, offering two 1Mbyte 3.5in. floppies, 256K of RAM and two expansion slots in a unit measuring some 4in. high and about a foot square. The price, excluding monitor and keyboard, will be about £1,500.

Details from Micronix Computers Ltd, Suite 2, 26 Charing Cross Road, London WC2. Telephone: 01-240 0213.

A general-purpose interface system for the BBC, Apple II/IIe and Commodore 64 is available from 3D Digital Design and Development. There are eight analogue inputs, four analogue outputs and two eight-bit digital ports. The analogue sampling rates are 28kHz, and analogue voltages may be generated at 25kHz; the analogue lines have full 12-bit resolution. The GPIS costs £700 plus VAT, and is available from 3D Digital Design and Development, 18/19 Warren Street, London W1P 5DB. Telephone: 01-387 7388.

Microway adaptor

PRINTER INTERFACE adaptors are available from Interface Systems, allowing printer output to be translated from RS-232 format to Centronics and vice versa, as well as from IEE to either RS-232 or Centronics. With these Microway adaptors.It is possible to use a micro with any type of standard printer.

The adaptor simply sits between the computer and printer, and comes with all the appropriate cabling. The cost is £78 plus VAT. Details from Interface Systems, Interface House, 17 Eversley Road, Bexhill-on-Sea, Sussex TN40 2HA. Telephone: (0424) 225683.

Viewdata packages

PRISM has announced a range of viewdata packages for IBM PC, Sirius, Apple and BBC microcomputers. Each system comprises a Prism modem, interface cable and the relevant viewdata software. For the BBC Micro it comes on a ROM, while IBM, Sirius and Apple versions are on disc; a comms card is also supplied for the Apple II.

The package allows access to Prestel, Micronet 800 and other viewdata services. In addition, a file-transfer facility allows a file to be passed between the various machines supported.

The cost for the IBM and Sirius machines is £259 including VAT, £120 for the Apple and £89.95 for the BBC. Prism Microproducts Ltd, 18/29 Mora Street, City Road, London EC1V 8BT. Telephone: 01-240 1042.

(More news on page 15)

Hardware shorts

● Research Machines Ltd has announced Winchester options for the 380Z micro. The 10Mbyte version costs £2,467 and the 20Mbyte version £3,080. These prices do not include educational discounts. Details on (0865) 249866.

● DEC's Microvax 1, a 32-bit micro featuring Vax architecture, is available from Rapid Recall at prices starting at £8,900. More information on (0494) 26271.

● A clock-calendar card designed for the Apple IIc's Prodos operating system is available from P&P Micro Distributors. It also works with DOS 3.3, Apple Pascal and CP/M. The price is £129 plus VAT. Information on (0706) 217744.

● LSI has given its Octopus micro a graphics system that allows up to four planes, 16 colours and four grey levels. The system comes with 64K of RAM and costs £395. More on (04862) 23411.

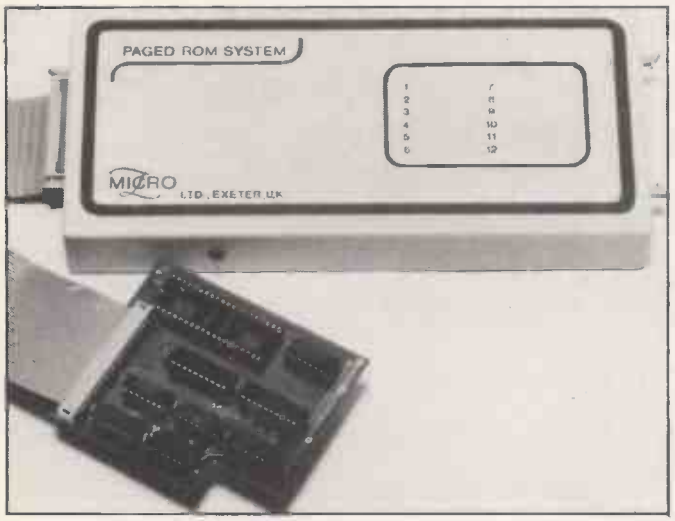
● Seriall is a general RS-232 serial interface card for the Apple II, II+ and IIe. The 27 formatting commands are compatible with 35 of the most popular printers. Seriall costs £129 plus VAT. Information is available on (0706) 217744.

● A Spectrum disc interface for the Hitachi 3in. drive is available from Statcom. The complete drive and interface costs £245, and the interface alone £75. More information on (0256) 64187.

● The ZVM-124 is a monochrome monitor for the IBM PC from Zenith. The 12in. amber screen costs £128 plus VAT. Call (0452) 29451.

● Acorn continues with its plans to take over the world with the opening of a production plant for BBC Micros in Ireland.

● Mitsubishi has produced a 5.25in. floppy which stores data in the same way as an 8in. drive. The cost will be around £160. Details on (0923) 770000.



Acorn ROM boards

DOING THINGS with BBC ROMs seems to be all the rage. Two products invite you to replace the 6502 chip in the BBC Micro with internal boards. A ribbon cable then connects to an external circuit board with the capacity to take several ROMs or RAMs.

Apex from Watford Electronics uses both the 6502 and 8271 sockets, and allows up to 15 ROMs to be plugged in internally. External daughter cards connect via the ribbon cable, and can hold 16 ROM and RAM devices each. The cost is about £60. Details can be obtained from Watford Electronics, 33-35 Cardiff Road, Watford, Hertfordshire WD1 8ED. Telephone: (0923) 40588.

Micro-Z Ltd produces an external sideways ROM extension, also plugging into the 6502 socket. It costs £59.95 including VAT. Micro-Z is at PO Box 83, Exeter, Devon EX4 7AF. Telephone: (0392) 73662.

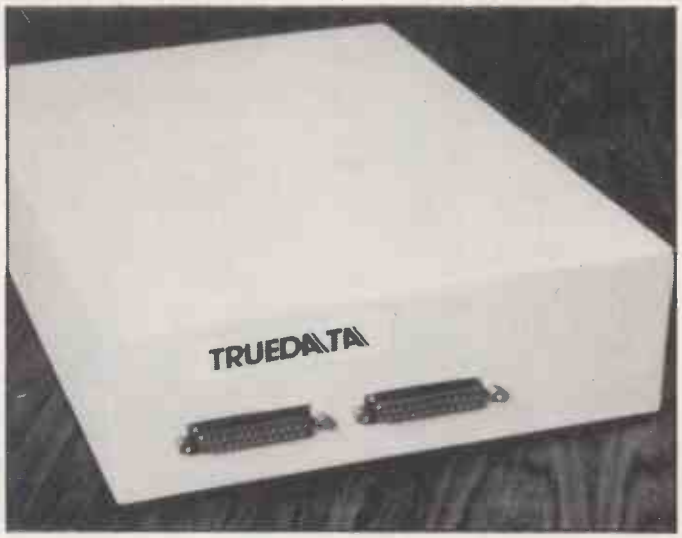
The Acorn Electron has not been forgotten either: Broadway Electronics has a sideways ROM card which allows up to four ROMs to be plugged in. The device connects to the Electron's extension port. The cost is £29.95 including VAT. Broadway is at Aston Road, Bedford, MK42 0LJ. Telephone: (0234) 58303.

Mini-Telex Mark 3 uses a Tandy 100 portable together with an acoustic coupler and a rechargeable power pack providing about 20 hours operation to offer a portable telex and data-capture terminal. The 24K unit costs £1,300 and is available from Direct Data Entry Ltd, Dower House, 18 Green Balk Lane, Lepton, Huddersfield, West Yorkshire HD8 0EW. Telephone: (0484) 606090.

Modem Scrambler

AS MODEMS become more common the danger of data theft increases. To combat this, DNCS has produced a data scrambler which encrypts data before it is fed into the modem. A similar device is used at the receiving end to decrypt the transmitted information.

The device will work with any asynchronous modem at data rates of up to 19,200 baud. The cost of the unit is £365. It is available from DNCS, Truedata House, Green Lane, Heywood, Manchester OL10 2DY. Telephone: (0706) 67567.



BBC thermal printer

A DOT-MATRIX thermal printer for the BBC and Acorn Electron computers has been produced by Phi Mag Systems Ltd. The unit uses the Centronics port, and prints nine- by five-dot characters over 40 columns.

The PhiPrint costs £99 plus VAT and is available from Phi Mag, Tregoniggie Industrial Estate, Falmouth, Cornwall TR11 4RY. Telephone: (0326) 76060.

Cricket and the Apple

THE CRICKET is a voice synthesiser combined with a six-channel music system for the Apple IIe and IIc. It uses the Texas Instruments 5220 speech chip to produce what is described as a "natural female voice"; a robotic voice is also available.

The music capabilities include six simultaneous channels of music and sound. An on-board clock provides automatic dating of Prodos files, and can be used in conjuction with the music, sound and voice facilities.

The Cricket runs under Prodos on the IIc, but requires an extended-memory 180-column card as well as a serial card to work with the IIe. It costs £149 plus VAT and is available from P&P Micro Distributors Ltd, Todd Hall Road, Carrs Industrial Estate, Haslingden, Rossendale, Lancashire BB44 5HU. Telephone: (0706) 21744.

Sanyo disc upgrade

THE SANYO MBC-550 micro can now be upgraded to the specification of the MBC-555. The add-on second disc unit also includes three software packages supplied as standard with the twin-disc machine. The upgrade kit costs £299 plus VAT. Details on (0923) 46363.

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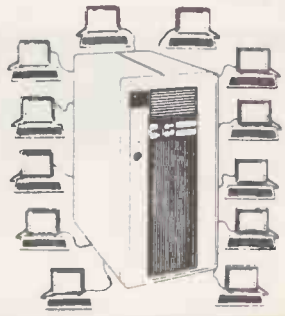

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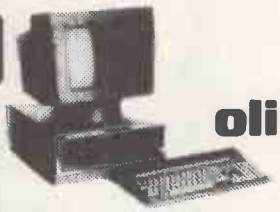

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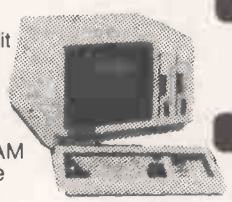

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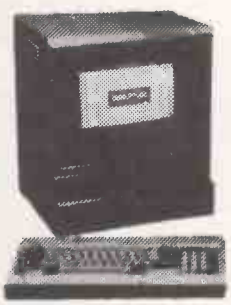

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Einstein was created by Tatung, one of the world's leading electronic companies, and given the capacity and the remarkable capabilities to compete with computers costing far more.

Its simplicity of operation will appeal to the first time buyer and to businessmen who don't want to lose staff to expensive and time-consuming training courses. At the same time its operating system is both powerful and sophisticated to satisfy the most advanced requirements.

For those who have outgrown their existing primitive machine, the speed and capacity of the 500K built-in disc drive will make all the difference. And for the small businessman, the ability to store and retrieve all information in seconds will be as important as Einstein's built-in flexibility, which allows the system to grow as the business develops.

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● Circle No. 109 †CP/M is a trade mark of Digital Research Inc.

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17							
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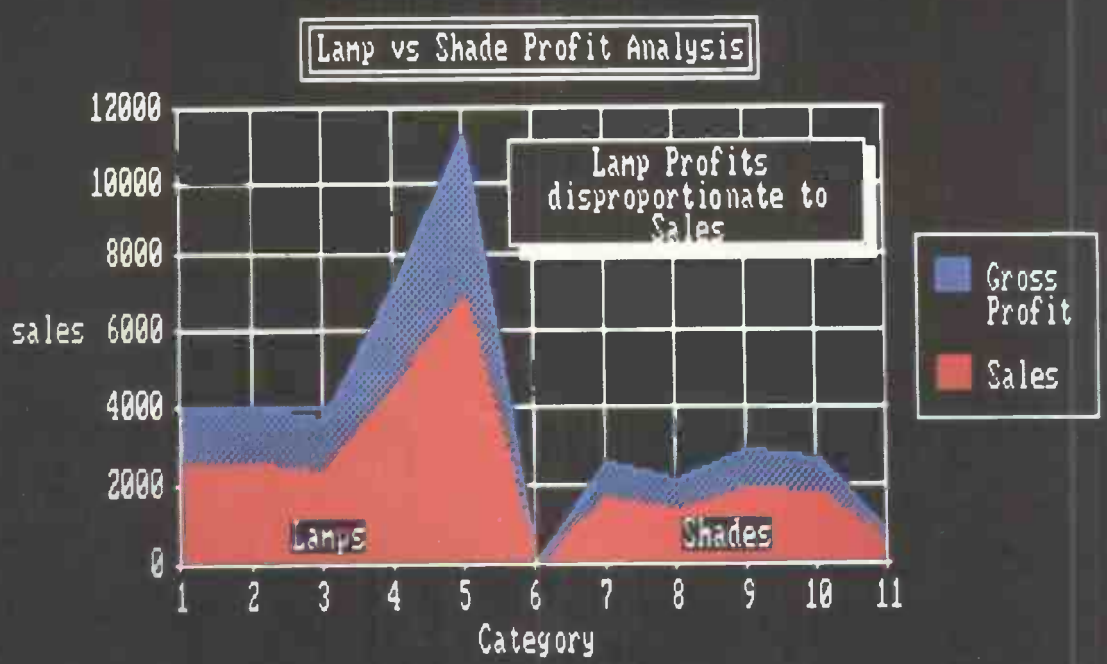

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MICROWARE

20

IBM launches 80286-based PC

IBM has announced two more additions to the PC family, both designated AT — Advanced Technology — along with a new version of PC-DOS and the Xenix implementation of the Unix operating system. Further new announcements cover networking and multi-tasking for all versions of the PC using DOS version 2.0 or higher.

The AT is the first IBM micro to go beyond the Intel 8088 microprocessor. It uses the state-of-the-art Intel 80286 chip, an extended virtual memory version of the 8086 which can address 3Mbyte of RAM. Only 256K and 512K of RAM is supplied with the floppy and hard-disc versions of the AT, but this can be increased later.

A further advantage of the AT models is their increased disc-storage capacity. The 5.25in. floppy-disc drive now holds 1.2Mbyte, while the hard disc, if fitted, holds 20Mbyte. This compares with 360K floppies and 10Mbyte hard discs in the PC/XT range.

Both models have eight free expansion slots on the main board, and a new 84-key keyboard. The extra key is marked System Request, which is a posh way of saying "Help".

A new version 3.0 of PC-DOS is supplied to take advantage of the extra facilities of the AT models. DOS 3.0 also works with existing IBM PCs. The AT models are claimed to be compatible with most current PC software and hardware, but to run programs two to three times faster.

IBM has also announced multi-user, multi-tasking and network capabilities.

The IBM PC Xenix operating system, which is Microsoft's version of Unix, allows both multi-user operation and multi-tasking on the AT models. Two additional terminals can be added to share the 80286.

For the IBM PC owner who wants a multi-tasking capability, IBM has announced a new program called Topview, which Phil Estridge, the PC division's boss, describes as "a key foundation for future applications".

Topview enables the user to run several programs at once, and to Cut and Paste data between different applications. It is also mouse-compatible. Topview runs on almost all versions of the IBM PC, including the Portable Personal Computer and the 3270PC. It requires 256K of RAM, double-sided discs and PC-DOS versions 2.0, 2.1 or 3.0. It will cost $149.

Topview is claimed to be compatible with many existing IBM PC programs, including the Assistant packages — which are IBM versions of the PFS range — and Displaywrite, Multiplan, VisiCalc and various languages such as Basic, Cobol, Pascal and Fortran. A Topview programmers' kit will also be made available.

The announcement of Topview suggests that PC-DOS is likely to remain a single-tasking system for some time to come. The early pre-announcement of Topview could be partly to try to counter any inroads into the PC market being made by Digital Research's multi-tasking CP/M-86 operating system.

Finally, IBM has launched a low-cost networking system to link up to 72 IBM PCs, XTs, ATs and Portables using coaxial cable. Each PC needs its own Network Adaptor, which fits into an expansion slot and comes with a 9ft. cable. A Network Translator Unit is then required, providing ports to link up to eight PCs.

All these announcements have been made by IBM's Entry Systems Division in Boca Raton, Florida. The products have not been announced by IBM United Kingdom Ltd, and so are not yet available from IBM dealers in the U.K.

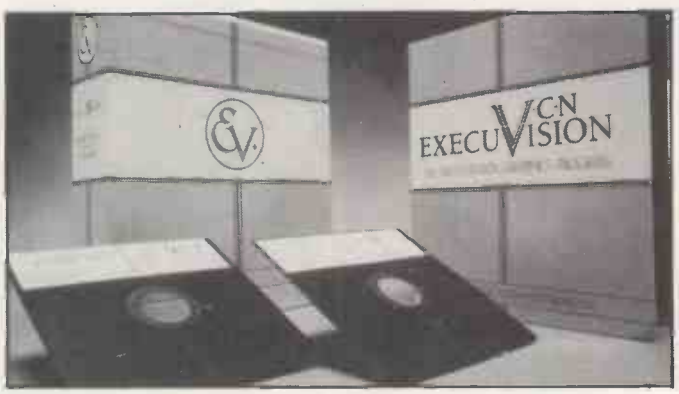
IBM fixes Junior

AS A RESULT of less than overwhelming sales in the U.S. IBM has announced a proper full-stroke keyboard for the PCjr. It will be supplied as standard on new machines, and all existing PCjr owners will get the upgrade free.

Also, the PCjr can now be expanded to a maximum of 512K of RAM, which will allow it to run more of the large programs written for the IBM PC. The price has been reduced, and a single-disc system now sells for $999. This is cheaper than the Apple IIc, which offers less disc storage than the PCjr.

The idea of free upgrades is not new within IBM. People who bought their 1.0 version of Easywriter were given version 1.1. free when the original program was found to be faulty.

Wouldn't it be nice if the idea of free upgrades caught on with companies like, say, Acorn? There must still be a few users of Basic 1 and the 0.1 operating system who could benefit.



Now anyone can produce high-quality presentation slides using VCN-Execuvision on an IBM PC with graphics capabilities. The program allows you to create charts, graphs, etc., add lettering in 10 typefaces, and try 64 colour schemes. There are 10 library discs which provide photographs and drawings you can add to your slides, with full Cut and Paste facilities. The VCN system is available from IBM authorised dealers, including Pete and Pam.

Cheap and Easy

SCORPION COMPUTING has launched a five-module integrated accounts package, Easy Junior, which costs only £295. the package includes sales, purchase and nominal ledgers, stock control and invoicing.

Easy Junior joins two existing Scorpion packages, easy and Easy Plus. All three are written in Level II Cobol.

Contact Scorpion Computing Ltd, Scorpion House, High Street, Hartley Wintney, Hampshire. Telephone: (025126) 3706.

Sidekick

WITH SIDEKICK you can have several handy desk-top functions without buying an integrated windowing package. It sits in RAM and provides a notepad, calculator, calendar and auto dialler.

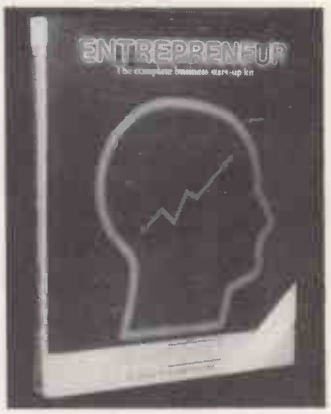
Contact Altor Ltd, Brechin House, 801 Govan Road, Glasgow G51. Telephone: 041-445 5130.

Package tour?

IF YOU WANT to build your own expert system you can now use the M1 from Framentec of Monaco. M1 is written in Prolog and offers an expert systems shell with backward chaining and certainty factors. The price is high at $12,500, but includes a four-day training course which is held, naturally, in Monaco.

Contact Framentec Monaco, 74 bd. d'Italie, MC 98000, Monaco. Telephone: 93-30.11.09.

Entrepreneur business education



ENTREPRENEUR is one of the Brainpower range of self-education programs aimed at people already running or thinking of starting a small business. Available for the 48K Spectrum and the Commodore 64, Entrepreneur consists of a 100-page educational book and two programs.

The book and the teaching program explain business and accounting concepts. The applications program helps you produce cash-flow forecasts, balance sheets and profit and loss accounts.

Other titles in the range include: Project Planner, for the BBC and Commodore 64, which explains critical path analysis; Forecaster, also for the BBC and Commodore 64, explaining time series and causal analysis; and Numbers at Work, which covers everyday business numeracy, explaining things like depreciation, VAT and PAYE calculations.

The Spectrum titles each cost £14.95 including VAT, and are supplied on cassette. Commodore 64 and BBC versions cost £19.95 on cassette and £4.95 on disc. Contact Triptych Publishing Ltd, Sterling House, Station Road, Gerrards Cross, Buckinghamshire SL9 8EI. Telephone: (0753) 889988.

Xchange bundled with BBC upgrade

PSION'S Xchange integrated software package is to be offered bundled with the Graduate, Torch's IBM PC compatible upgrade for the BBC computer.

The £945 VAT-exclusive price of the top-of-the-range Graduate model G-800/2, with 256K of RAM, 8088 processor and twin discs, includes Psion's linked spreadsheet/word-processing/database/business-graphics package. Xchange is reviewed on page 99 of this issue; it is not bundled with cheaper Graduate systems.

The Graduate is really a second computer with two free IBM PC compatible card slots. It attaches to the BBC through the 1MHz bus. Details from Torch Computer Ltd, Abberley House, Great Shelford, Cambridge CB2 5LQ. Telephone: (0233) 841000.

The twin-disc Graduate comes with Psion's integrated suite.

Commodore Z-80 cross-assembler

SUPERSOFT is launching a Z-80 cross assembler running on the Commodore 64. Called Mikro-80, it lets you assemble Z-80 op codes rather than the Commodore 64's native 6502 instruction set.

The Commodore 64 with disc drive is already widely used as a low-cost development system by machine-code programmers writing for other 6502-based machines. Supersoft hopes that with Mikro-80 it will appeal to people developing software for the Spectrum, Amstrad and MSX machines too.

Cross-development is popular because for efficient commercial programming you really need a system with disc drives, which most target systems presently lack. It also makes it easier to use a common set of routines across several target machines.

Mikro-80 will cost around £50 plus VAT. For further details contact Supersoft, Winchester House, Canning Road, Wealdstone, Harrow, Middlesex HA3 7SJ. Telephone: 01-861 1166.

Making Mac music

PROFESSIONAL COMPOSER is the equivalent of a word processor, but handles musical scores rather than ordinary text. Running on the Apple Macintosh the program exploits its high-resolution graphics to display the full range of music symbols on the screen.

You can copy and move passages, transpose parts, add lyrics and create piano reductions. Finished scores can be printed out. The price is £429 plus VAT.

Details from P & P Micro Distributors Ltd, Todd Hall Road, Carrs Industrial Estate, Haslingden, Rossendale, Lancashire BB4 5HU. Telephone: (0706) 217744.

(More news on next page)

Shorts

Open Access, the integrated package reviewed in September's *PC* is now available for the ACT Apricot. The package, which includes spreadsheet, word processing, three-dimensional graphics, diary and communications functions, has until now only been available for the IBM PC. The price of all versions is £450 plus VAT. Contact ACT (Pulsar) Ltd. Telephone: 021£455 7000.

Menugen is a utility for CP/M and MS-DOS micros which lets you hide the operating system from the end-user behind a set of customised menus. Running programs and executing operating-system commands can then be carried out by less-skilled users. Menugen costs £30 plus VAT. Contact Microft Technology Ltd, 45A Radnow Walk, London SW3 4BP. Telephone: 01-352 7876.

Sagesoft has added payroll to its range of accounting applications. The payroll program, which can typically handle about 150 employees, runs on most CP/M and MS-DOS systems. The price is £195 plus VAT, with maintenance available for £50 per year. Details from Sagesoft Ltd, NEI House, Regent Centre, Gosforth, Newcastle upon Tyne NE3 3DS. Telephone: (091 284) 7077.

WordStar with pictures

DOODLE is a graphics package which can be used on its own or with WordStar to produce illustrated reports or other mixed text and graphics output. Running on the Apricot, Sirius and IBM PC, Doodle is aimed at the general office market rather than the specialist CAD user.

Doodle pictures are created on-screen with the cursor-control keys and a Logo-like command language. To merge pictures into an existing document you write special Doodle dot commands, resembling WordStar dot commands, into your word-processor files. Doodle then generates the finished picture/text output on a dot-matrix printer or plotter.

Doodle cost £665 plus VAT. Epson, ACT and most other common printers are supported, as is an optional graphics tablet. Details from Trilex International Marketing Ltd, 57 Church Street, Staines, Middlesex TW18 4XS. Telephone: Staines 63771.

Spectrum Logo

SPECTRUM LOGO, previewed in May's *Practical Computing*, is now in the shops. Logo was developed to provide an easy way for children to get to grips with programming computers, and the Sinclair version comes in a boxed set which includes two books and the software on cassette. The price is £39.95 including VAT.

Shorts

The Snowball keyboard trainer is now available for the Apricot and BBC computers. Apart from basic touch-typing skills, the program aims to build up your typing speed. Another version of Snowball, biased more towards commercial typing, is available for the IBM PC, Sirius and other MS-DOS machines. Supplied on disc, Snowball costs £25 plus VAT on the BBC and Apricot computers, or £89 for the full commercial versions. Contact Microguide Ltd, 14-16 Low Pavement, Nottingham NG1 7DL. Telephone: (0602) 585282.

MSX Viewdata from Kuma Computers gives you the ability to access information services like Prestel and Telecom Gold with an MSX home computer. You use the package in conjunction with Kuma's RS-232 interface card, which costs £99.50, and a modem, which is available for about £70. MSX Viewdata itself is £19.95 including VAT, and comes on cassette. Contact Kuma Computers Ltd, 12 Horseshoe Park, Pangbourne, Reading, Berkshire RG8 7JW. Telephone: (07357) 4335.

Data encryption

DATAWRIGHT'S data encryption package is a CP/M utility program which lets you protect confidential data files. You enter a password of at least 12 characters and the program then scrambles the file using the American Department of Commerce private key data encryption method. You might want to do this, for example, before transmitting a file over a phone line or in other circumstances.

Pricing is not yet finalised but will be below £100. Versions of the package will be announced later for 16-bit machines. Contact Datawright Ltd, 23-25 New Street, Lymington, Hampshire SO4 9BH. Telephone: (0590) 77001.

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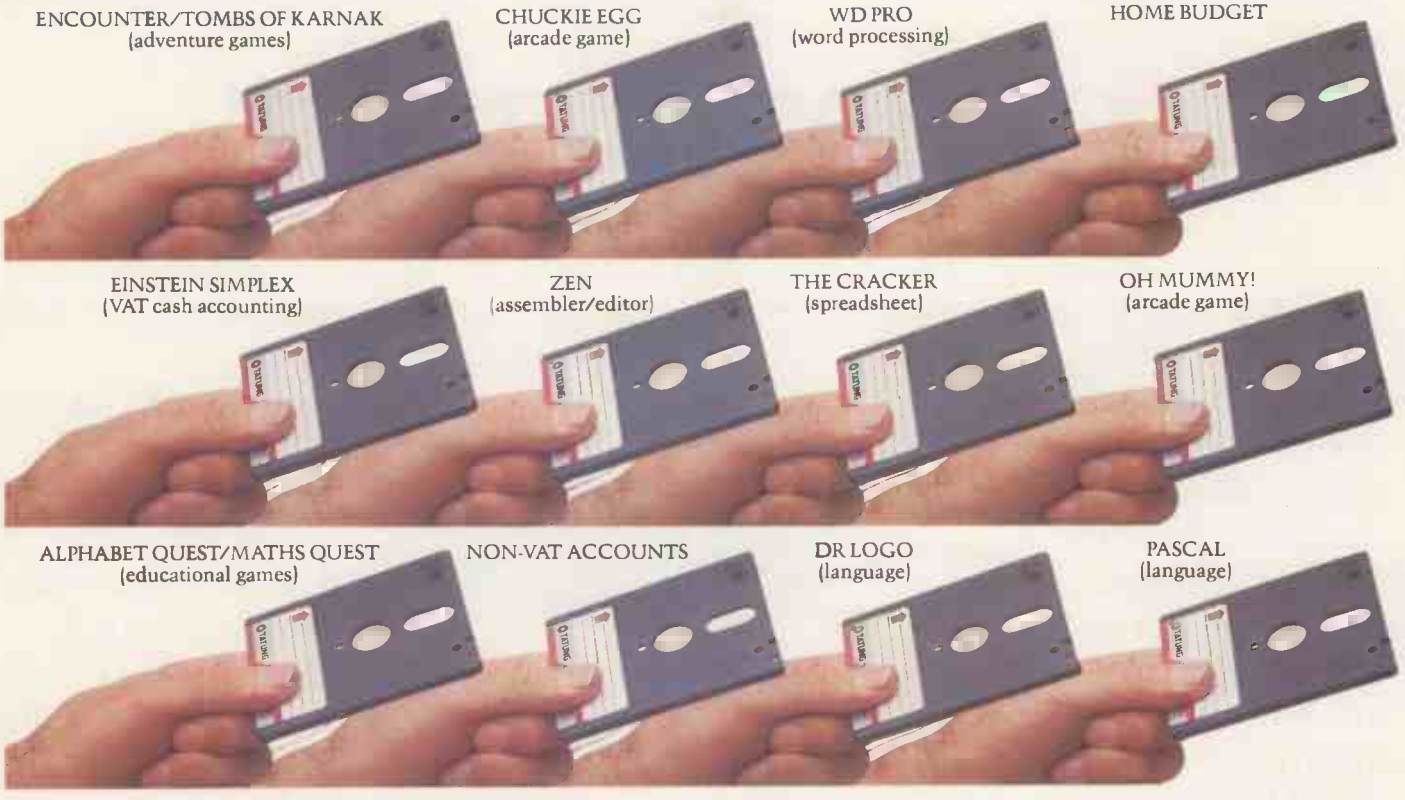

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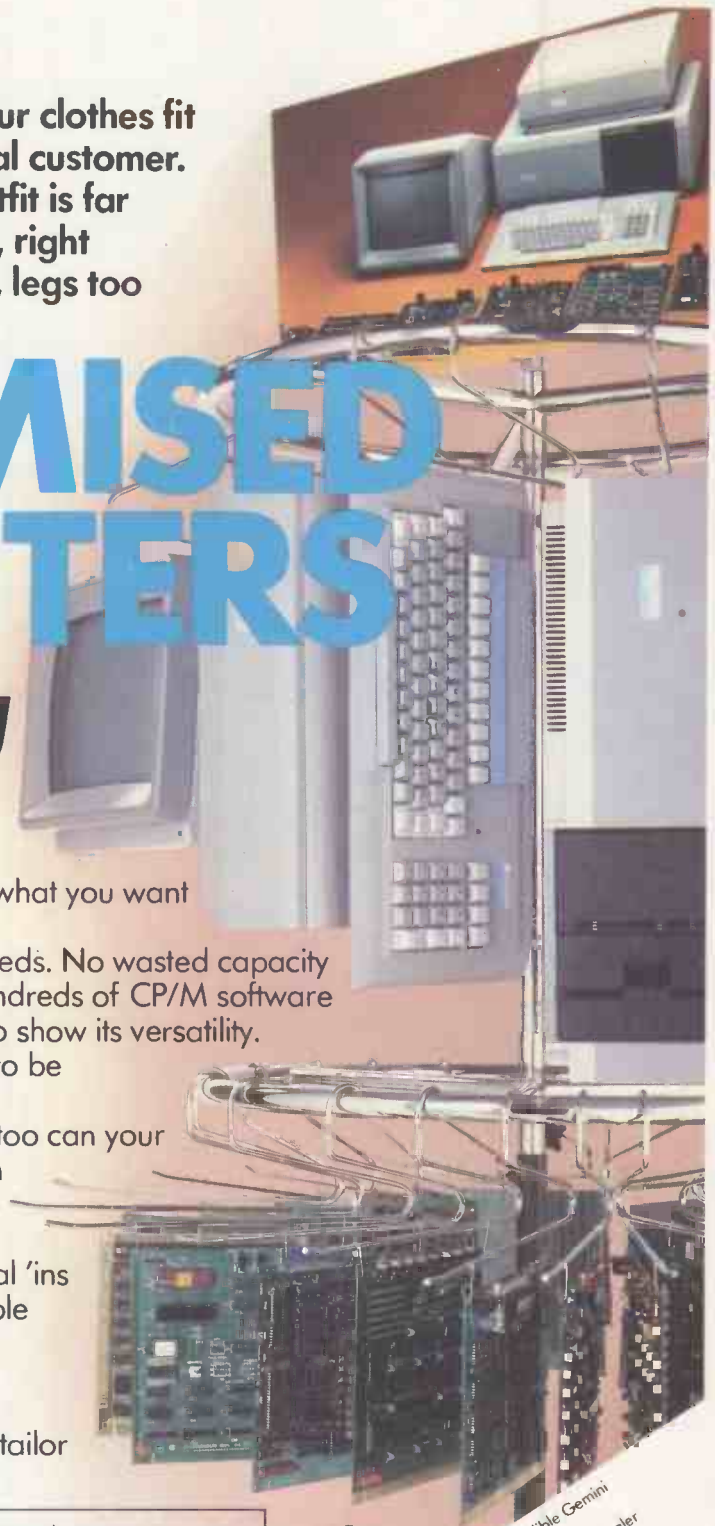

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Bad Apples crushed

APPLE has acted firmly to stamp out competition from Far Eastern suppliers who have been flooding world markets with cheap micros based on the Apple II.

Typical of these is the Unitron 2200, reviewed in *Practical Computing's* March 1984 issue, which has now been withdrawn by the U.K. distributor, Chiltern Electronics. The Unitron retailed at £389 — less than half the cost of an equivalent Apple system. It was well made and included in the price a Z-80 second processor and disc interface, together with a separate keyboard with numeric keypad.

However, the Basic interpreter was byte-for-byte identical with the Applesoft ROMs and the monitor ROM differed only in the copyright message and screen display. The disc-interface section of the motherboard clearly infringed Apple's Disk II interface patent, while the manual contained illustrations which were copied photographically from the Apple II reference manual.

Although this case has been settled out of court, the facts are very similar to the Wombat lawsuit which has just been decided in Australia. A former Apple distributor started to import the Wombat, an Apple II compatible made in Taiwan.

The Wombat was a 6502-based machine with a Basic interpreter and monitor in ROM. These ROMs were virtually identical to Apple's Applesoft interpreter and Autostart monitor ROMs, right down to the embedded initials of the authors, and were obviously copied from the Apple product.

The problem was that copyright law in Australia, as in England, was enacted before computers were commonplace. The judge in the first trial decided that a law which was designed to protect literary works could not be used to protect computer programs. This decision, which reversed what had been accepted up till then, caused consternation round the world and gave rise to statements that new laws would have to be introduced to protect computer programs.

However, civil law is pragmatic and adapts to meet changing circumstances. When Apple filed an appeal, the decision was reversed, prompting sighs of relief from places far beyond Australia's shores.

The current legal position in Australia after the Wombat decision is that copyright protection extends to computer programs, both in source code and in object code form. Decisions of Australian courts are not binding on an English court, but the systems of law are the same and English courts would be likely to follow it when similar circumstances arose in this country.

An additional aspect of the Wombat case is that the distributor, Computer Edge, was also sued under the Australian Trade Practices Act. It was argued the distribution of computers advertised as being Apple-compatible, together with copies of the Apple Reference Manual, would constitute an offence since it would imply endorsement by Apple. The Australian Court rejected this view.

However, in the United Kingdom there have been several cases in which trading standards officers have successfully prosecuted sellers of counterfeit products under the Trade Descriptions Act.

All change at Atari and Commodore

LAST YEAR a terrible price war was fought in the home microcomputer market. Texas Instruments, Timex and Mattel between them sustained huge losses on micros and were driven out of the market.

Coleco lost a lot of money and even more credibility, and Apple's profits dropped by 75 percent. Atari lost around half a billion dollars but hung on.

The executioner was Commodore's Jack Tramiel, and his main weapon was the Commodore 64. In the U.K. we saw its price drop from £340 to a discounted price of around £180. That made it cheaper than even a Sinclair Spectrum raised to meet a similar specification.

This year Jack Tramiel is starting another price war. The major difference is that now he is playing for Atari, a corporation he recently acquired from Warner Brothers.

No one really knows why Tramiel left Commodore in the first place. However, Tramiel built the company up from a typewriter repair shop into a billion-dollar corporation. After 30 years work, no one thinks he was happy to go.

Following Tramiel's departure, other top Commodore staff were soon leaving. They include the acting vice-president of U.S. operations Donald Richard, marketing vice-president Myrrdin Jones, systems-engineering director Bill Miller and the director of materials in charge of U.S. chip making and computer assembly. Roy Thomas. Others include various members of the Tramiel family itself.

Jack Tramiel.

Commodore even started a lawsuit against Atari over four engineers who switched sides and won an injunction to prevent them disclosing confidential information. But whatever the force of the law, it is probably the case that the new Atari knows Commodore inside out — rather better, possibly, than Commodore currently knows itself.

The current Atari top management comprises Jack Tramiel as chairman and chief executive officer, with Leonard Schreiber — who left Commodore in May — as vice president. The other three top managers are Tramiel's sons. Sam Tramiel is the president, Leonard Tramiel is in charge of software, and Gary Tramiel is in charge of collecting unpaid debts — which reportedly stand at around $400 million.

Now Tramiel has fired the first shots in the next price war. Previously Atari products were always priced above Commodore ones on the grounds that they were better. That is not how Tramiel works. He just wants to be cheaper.

In the U.K. this has meant immediate price cuts, with the 600XL down from £159.99 to £99.99, and the 64K 800XL from £249.99 to £199.99. The disc drive, colour printer and letter-quality printer have all had £100 lopped off their prices. This brings the price of an Atari 600XL plus disc drive and letter-quality printer to under £500. Goodbye Coleco Adam!

Sotware prices have also been slashed. Cartridges that once sold for £34.95 are now £9.99 to £14.99. Dealers are already discounting disc-based software, with £160 ViciCalc packages going for £49.95.

Tramiel's strategy seems clear. Currently Commodore claims about 45 percent of the world home-micro market to Atari's 15 percent. Tramiel will aim to make this 30:30. He stands a chance because the Atari still runs about twice as much software as the Commodore 64, and the Atari software is better.

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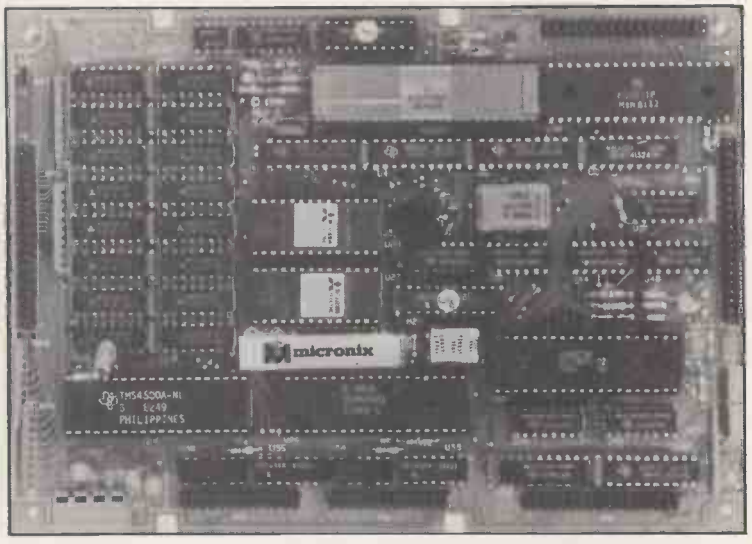

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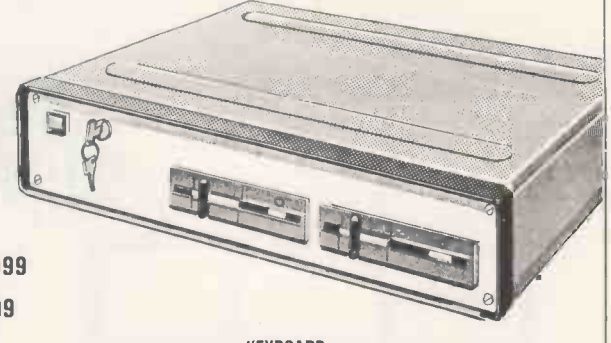

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A LITTLE MAP TO HELP YOU THROUGH THE MICRO-COMPUTER MAZE

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However, making sense of a large number of similar sounding claims and actually locating this elusive combination can often prove to be next to impossible.

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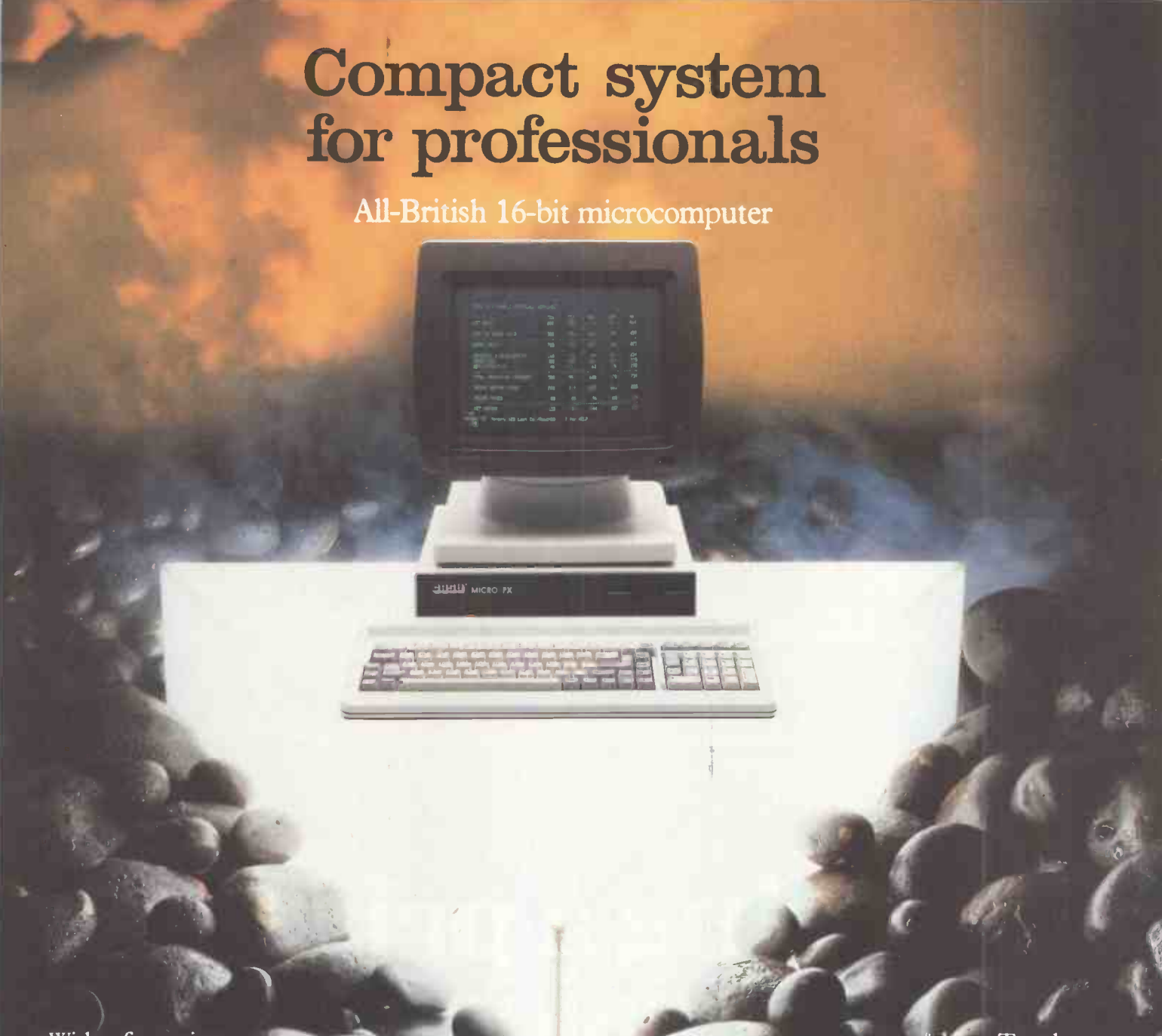

With a foot print just 12 inches square, the Casu Micro PX is one of the most compact 16-bit microcomputers available. Equipped with the enhanced 80186 processor, it is one of the first British designed and manufactured microcomputers to feature Concurrent CP/M 86, Version 3.1.

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The Products of Logical Evolution...

Modems win approval

Glyn Moody reports on the stringent tests required by British Telecom.

MODEMS used to be pretty rare birds in the micro world, but since the liberalisation of British Telecom they have gradually been filtering through the approval procedure. With the increasing numbers, prices have dropped to levels where many people are contemplating hooking up their micro to the outside world.

Buying a modem has become easier in recent months now that the rules covering the labelling of devices are being applied more strictly. By law, every modem and every advertisement for a modem must bear either a green label stating that it is approved for connection to the BT network, or a red one stating that it is not. Micros containing a built-in modem must be similarly marked. Any device that is not approved may not be connected to the public network, and it is an offence to do so.

Until October 1983, all testing and certifying of equipment was carried out by BT itself. Now there is an independent body, the British Approvals Board for Telecommunications, BABT, which handles all such applications. Part of the British Electrotechnical Approvals Board, BABT is a non-profitmaking organisation set up to handle the approvals procedure of equipment designed to be connected to the BT network.

As well as detailed technical information on the modem, several sample products must be sent to BABT for analysis. The testing is farmed out either to the British Standards Institution or to BT laboratories. While the product is undergoing tests, a visit is made to the factory to ensure that the production models correspond to the samples. If foreign manufacturers wish to sell their modems in the U.K. a factory inspection is still necessary.

The tests made on the equipment are of two kinds. First the general electrical safety of the modem has to be checked. Then there are more involved investigations of the way the equipment will interact with the BT network. For example, the voltages sent down the lines must not be too high and the frequencies used should not interfere with BT operations.

Assuming that a modem passes all the tests, and that the visit to the production line proves satisfactory, a certificate of approval is awarded. The certificate must be renewed annually, and although another factory visit will be carried out for this, it is not necessary to resubmit a modem once it hs been approved provided there have been no substantial changes. Apart from general consultation during the testing period, there is also an appeals procedure in the event of an application being turned down, which has not as yet been used.

The whole process of approval can take anything from two to six months, and sometimes longer. Approval costs start at about £2,000 and can go up to more than £3,000 for a full auto-dial modem. Most of the price consists of costs incurred at the testing stations since BABT takes only a standard 12.5 percent and £200 for the certificate fee.

All modems sold in the U.K. must carry "approved" or "prohibited" stickers.

If you are about to buy a modem there are two checks you can make to ensure that it is approved. First, the green approval sticker should be present. Each approved modem is also given a number of the form

F/nnnn/3/x/nnnnn

where n is a digit and x a letter. The current letter for 1984 is e.

Every modem must be covered by these procedures; this applies to modems supplied in a kit form as well. Since it is unlikely that you are going to pay £2,000 to have your personal modem approved, most self-assembled models will be illegal. Other points to watch for in modem advertisements are statements that the modem uses BT approved parts, which is quite different from full approval. Similarly, second-hand old-style BT modems have not gone through the approval procedure and so are not approved.

In the past criticisms have been levelled at the approvals procedure both for its cost and delays. This is partly the result of the more lax nature of the micro world where you just build your machine, comply with a few basic safety rules and sell it. Naturally enough, BT is wary of letting all and sundry plug into its network. Delays in approval are partly caused by the poor documentation of submitted modems, and partly by bottlenecks at the testing stations, where currently there is a waiting time of about six to eight weeks.

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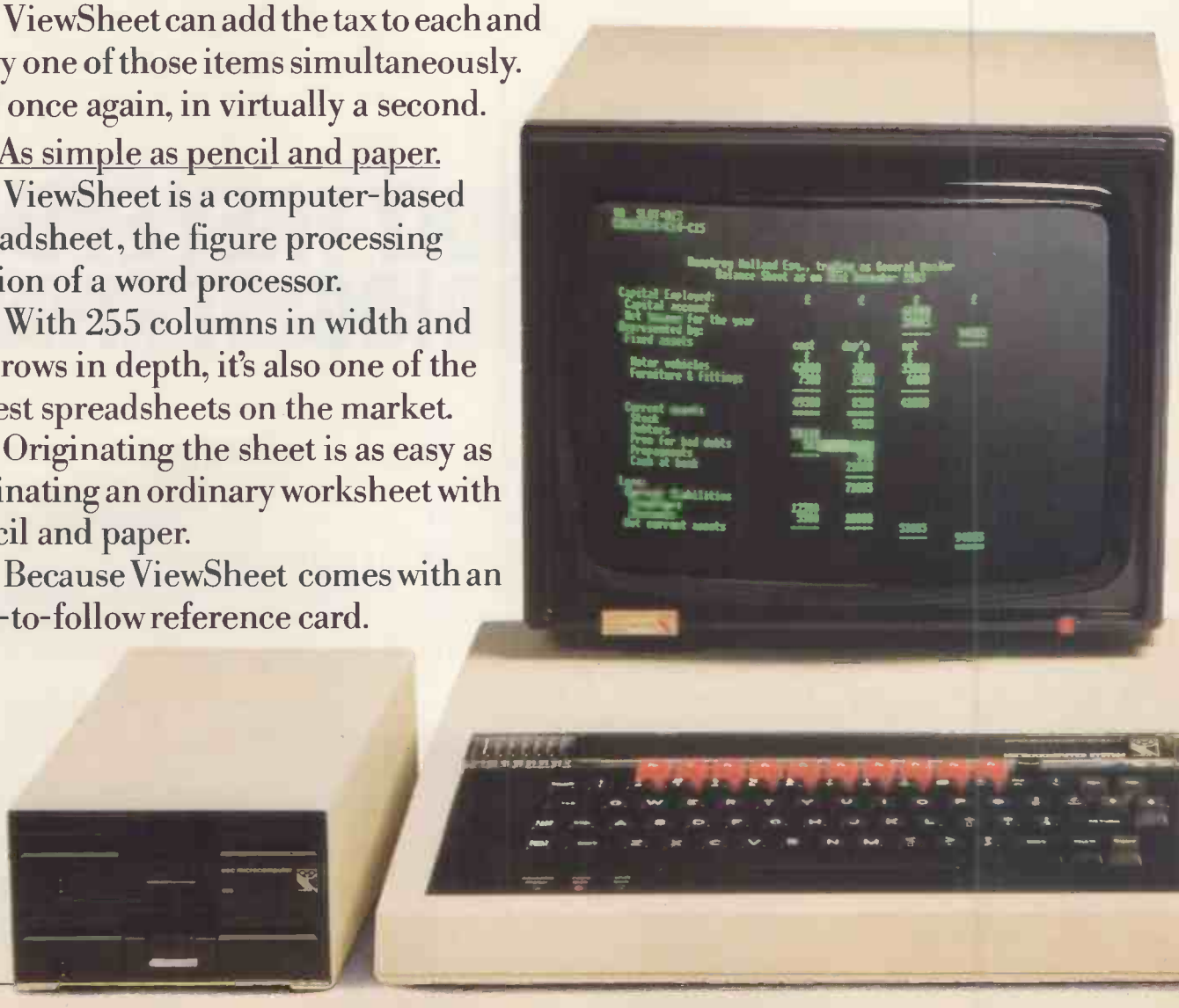

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Investment – bond redemption yield, equity price to earnings ratio estimates
Compound Interest – payments, present value, capital appreciation, savings
Depreciation – straight line, reducing balance, lifetime estimate, depreciation charge schedule, book value schedule

SCIENCE

Physical Constants – Planck, electron mass, electron charge, Rydberg, Gravitation, Avogadro, speed of light, sound. Gas constant, permeability, permittivity, earth radius, Bohr radius, Astronomic unit, etc.
Conversion Factors – UK to MKS etc.
Formulae – LC circuit, Lenses, Bohr energy levels, Larmor, plasma, etc.
Integration Under a Curve
Least Square Fit
Solution of Polynomial Equations

UTILITY

LOG, ALOG, LN, SQRT, EXP, SIN, COS, TAN, ATN, ABS, INT, DEG, RAD, MOD, MIN, MAX, FAC, SGN, ROUND, MEAN, STDEV, PI, RND, RAND, ENG, FIX, POWER FUNCTION AND COPY.

MATHEMATICS

Bessel – functions
Polynomials – solutions of equations
Matrices – solution of matrix equations, Eigenvalues
Integration – under a curve
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Statistics – mean, standard deviation, Chi-squared

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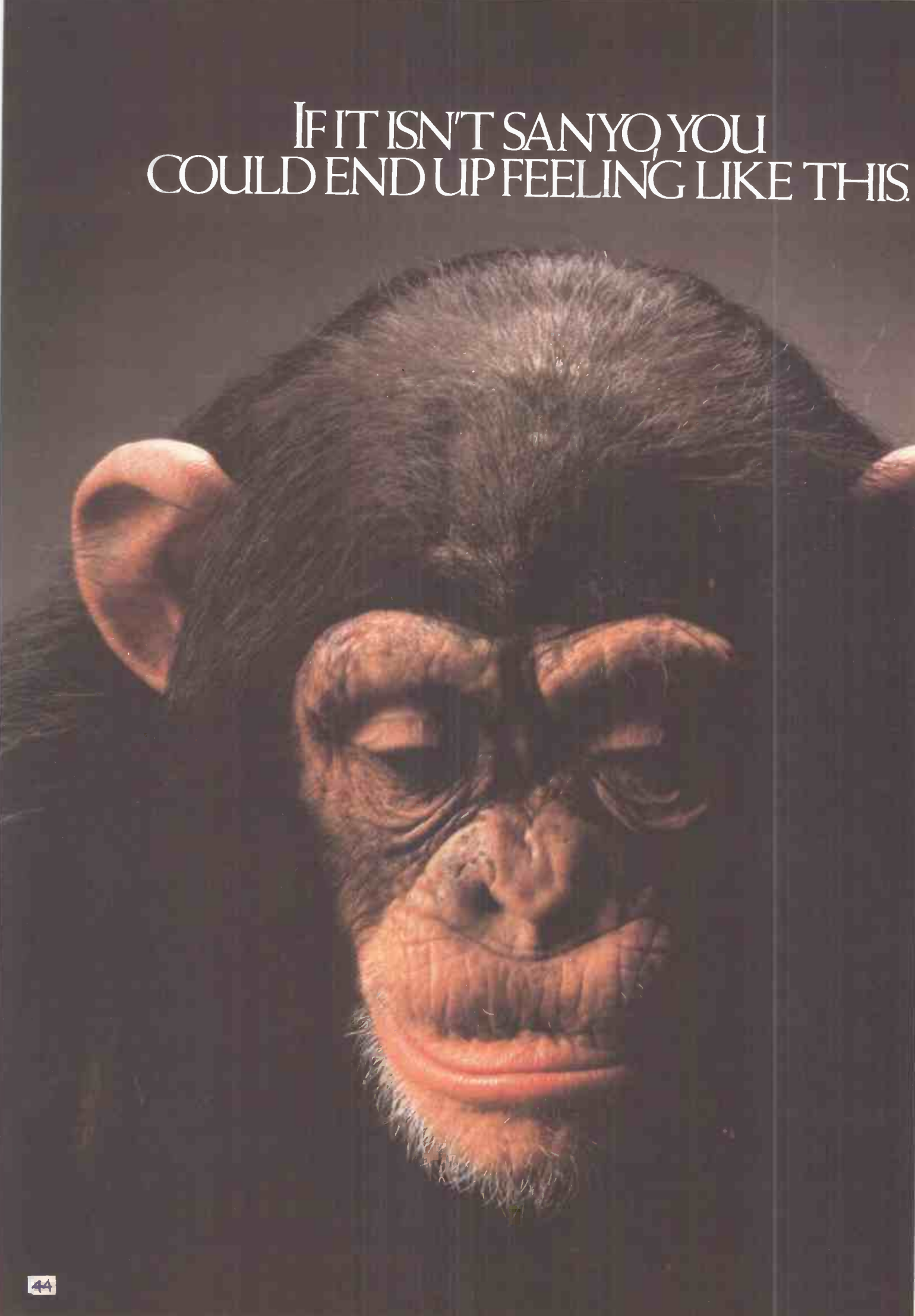

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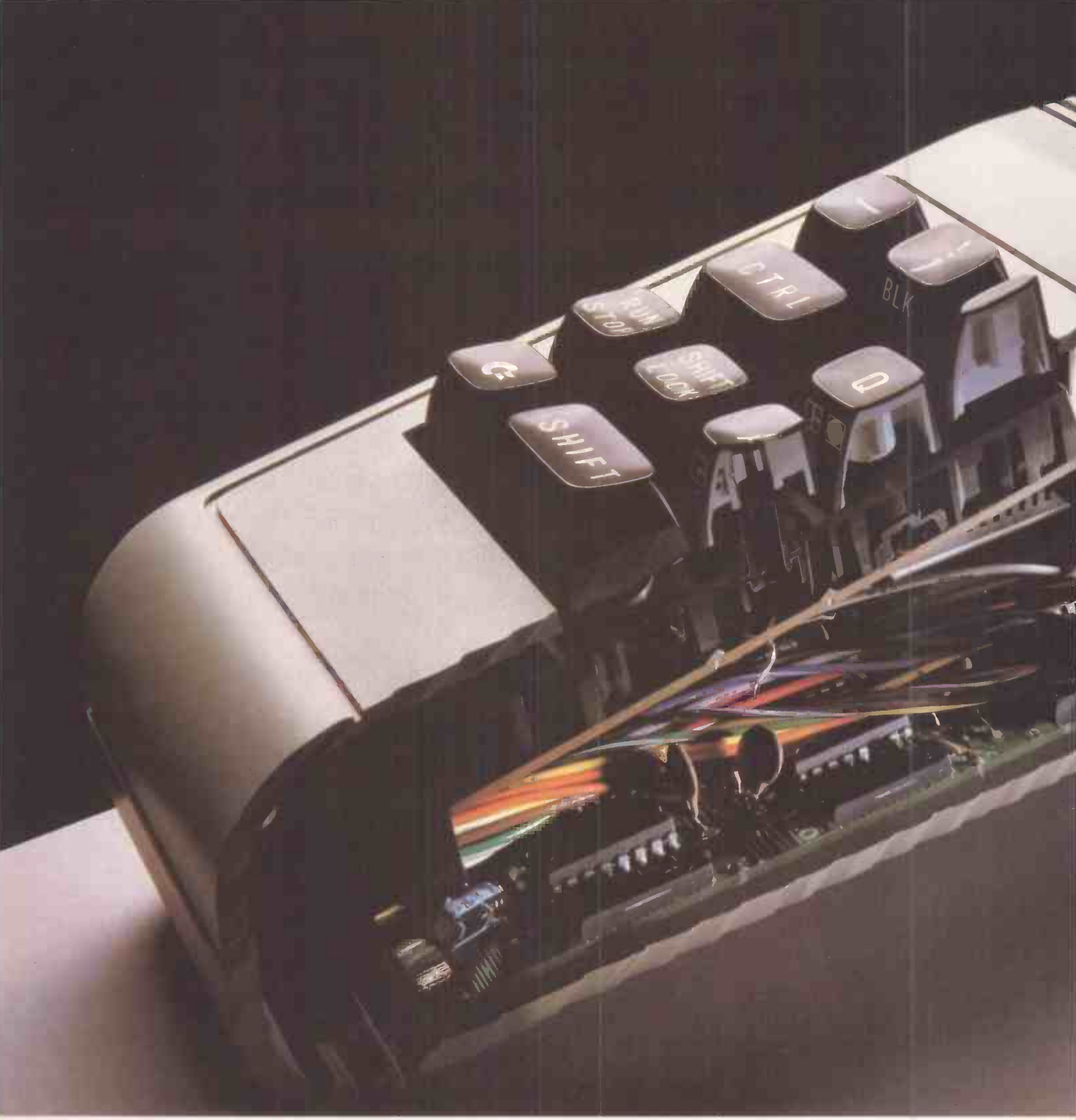

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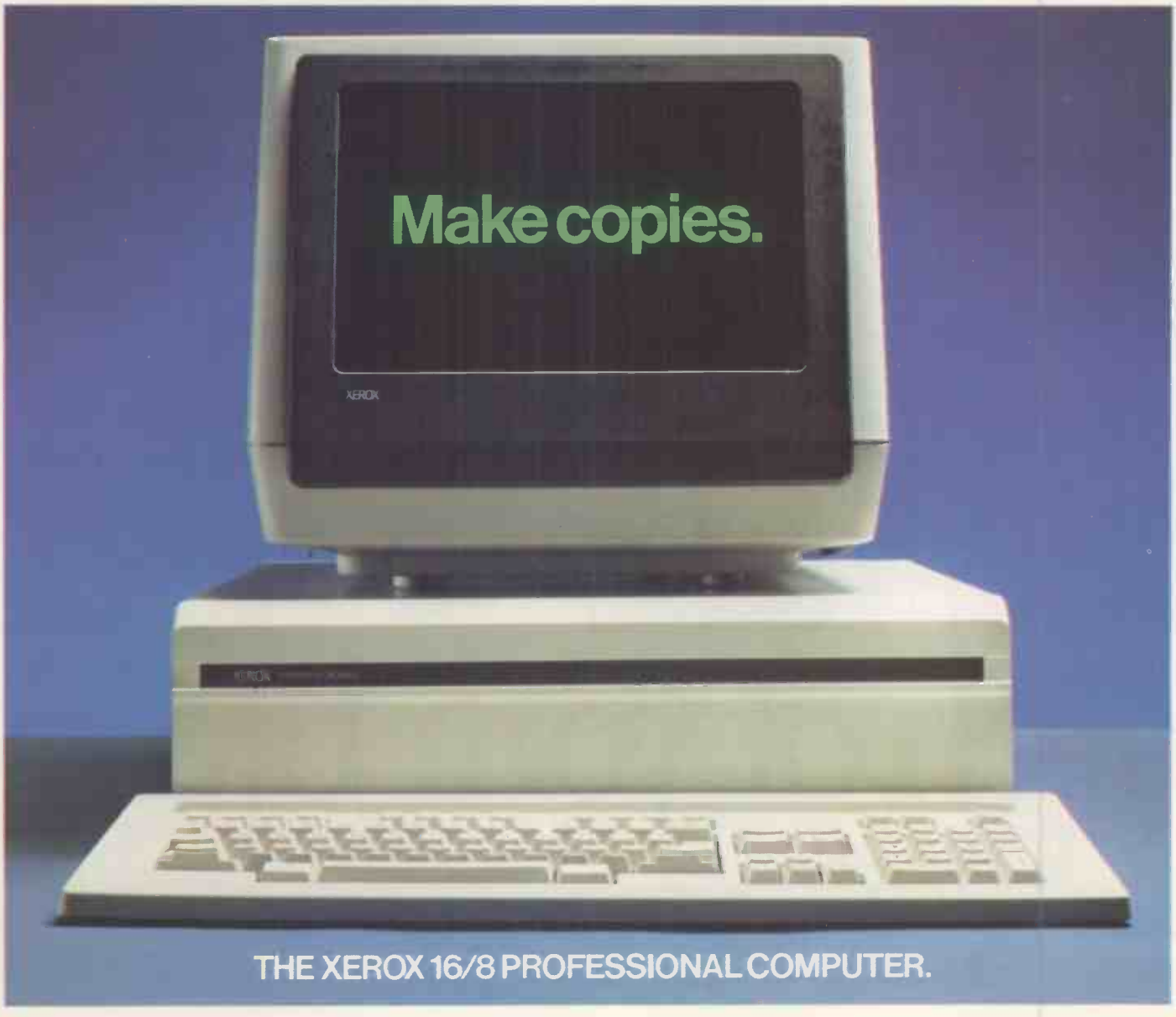

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by Mike Lewis

Fewer screen headaches

A standard layout for configuration files can simplify the often complex procedure of installing a new piece of software.

NOWADAYS you can get computer screens, not only in all sizes and colours, but also with a bewildering variety of cursor positioning, highlighting and editing functions. In theory, this should make it easier for programmers to produce attractive displays.

But the control codes that drive these functions are notoriously incompatible, so you have a major headache every time you want to transfer your program to a different type of screen. This is why mass-market products like WordStar and Supercalc need a lengthy install procedure to get them running on a particular computer or terminal.

Cursor positioning is one of the more widely used of the screen functions. All modern computers and terminals recognise a code that causes the cursor to be positioned at an absolute location on the screen. These codes nearly always include an escape character — hence the term "escape sequence" — as well as values to indicate the desired row and column numbers. Table 1 shows how they can vary from one system to another; this list covers only a fraction of currently available screens, so you can gather the size of the problem.

If you want to use cursor positioning in your program you have two problems. First, you need a hardware-independent function within the language that will move the cursor to any specified location. Secondly, you must have a simple method of giving this function the escape sequences or other codes that are applicable to the actual screen being used.

Many languages, particularly dialects of Basic, include commands for positioning the cursor. Applesoft's VTab and HTab are typical examples. Unfortunately, these dialects are invariably specific to a particular machine, which defeats the whole object. If you are using MBasic, CBasic or most versions of Pascal you will have to write your own cursor function.

The function will need two arguments: the row number and the column number. For the sake of consistency, I suggest that you always present the row number first, and that rows and columns are numbered

(continued on next page)

Proposed standard layout

The configuration file is a comma-delimited ASCII text file that is used to store escape sequences for the commoner screen functions. The file contains one line for each function. Each field within a line represents one character within the escape sequence. A line contains as many fields as is necessary to fully define the sequence, except the first line, which contains a fixed number of fields.

Each field is a decimal number. Each field, except the last one in each line, is followed by a comma. Lines are delimited according to the conventions of the operating system; for example, with a Carriage Return followed by a Linefeed in CP/M.

Line 1 — Direct cursor positioning. Fields 1 to 4 lead-in characters; fields 5 and 6 intermediate characters; fields 7 and 8 final characters; field 9 row number offset; field 10 column number offset; field 11 is 0 if row before column, otherwise non-zero

Line 2 — Clear from current cursor position to end of line, without moving the cursor

Line 3 — Clear from current cursor position to end of screen, without moving the cursor

Line 4 — Insert row at current cursor position, causing all subsequent rows to scroll down one line. The cursor moves to the first column of the inserted row

Line 5 — Delete row at current cursor position, causing all subsequent rows to scroll up one line. The cursor moves to the first column of the same row

Line 6 — Switch highlighting on

Line 7 — Switch highlighting off

	Lead-in chars.		Final chars.	Offset		Row first	Clear to end line		Clear to end screen	
Hazeltine	126	17		−1	−1	No	126	15	126	24
ADM-31	27	61		31	31	Yes	27	84	27	89
Superbrain	27	89		31	31	Yes	27	126 75	27	126 107
Res. Machines	22			31	31	Yes	27	89	27	30
Perkin Elmer	27	88	28 89	31	31	Yes	27	73	27	74
Adds Regent	27	89		31	31	Yes	27	75	27	107
DEC VT	27	89		31	31	Yes	27	75	27	74
Zentec Zephyr	27	0		31	31	Yes	27	84	27	89
IBM 3101	27	89		31	31	Yes	27	73	27	74
Kaypro	27	61		31	31	Yes	24		23	
Epson QX-10	27	61		31	31	Yes	27	84	27	89

This table shows codes for direct cursor positioning, clear to end of line, and clear to end of screen. For cursor positioning, the sequence is: lead-in character(s), row or column number plus offset, intermediate character(s), column or row number plus offset, final character(s).

As it happens, none of these cases includes any intermediate characters. The row comes first in every case except for the Hazeltine. All values are in decimal. In the documentation for some of these screens, the offset is shown as 32, rather than 31 as listed here, because the row and column numbers are counted from 0 instead of 1.

Table 1. Escape sequences for some popular screens.

(continued from previous page)

from 1 rather than 0. Ideally, the function will simply move the cursor for you, then exit.

In Microsoft Basic, functions cannot do things; they can only return a value. In this case, the function should return the required escape sequence, which you subsequently print immediately before the message.

Most cursor-positioning sequences consist of a series of lead-in characters, followed by the row number, followed by the column number. Sometimes there are further characters between the row and column numbers or even at the very end of the sequence.

In most cases, the row and column values are relative to an offset, typically 32; sometimes this offset is 0 or even −1. Sometimes the row comes first, sometimes the column. All these details must be known to the cursor-positioning function.

An easy way of getting these details into your program is to read them from an ASCII text file. If you defined the values as constants within the program, you would have to either recompile or resort to a messy patching process every time you wanted to move the program to a different screen. Most non-technical users can create a text file with a text editor; better still, you can supply a menu-driven program to create it for all screens whose escape sequences you happen to know.

A suggested layout for this configuration file appears in the text box. It is a comma-delimited file, so it can easily be read by means of Basic Input statements or their equivalents in other languages. All codes are represented by decimal numbers to help non-technical users.

To bring the whole thing together, take a look at the program extract in listing 1. It shows a straightforward routine to read and validate the configuration file, followed by the definition of a function for generating the cursor-positioning string. For simplicity, I have omitted the other editing and highlighting functions. The coding in listing 2 demonstrates the use of the cursor function, and provides a quick test that all is well.

The rather clumsy function definition in line 3220 is necessary because Microsoft Basic only permits functions to be defined as single expressions. It is necessary to cater for the possibility that the column number will precede the row number, without the use of an If statement. The second parameter of each of the two Left$ functions will resolve to either zero or a high number, set arbitrarily to 32, depending on the setting of Flag%. Thus the row value will be generated either before or after the column value.

The Error command that appears several times in the main program causes an immediate branch to the error-handling routine, and so is equivalent to Goto 10000. Avoiding Gotos in this way should be an aim of every Basic programmer.

Listing 1.

```
2000 '*****************************************************************
2010 '  Part of a program that uses a configuration file to determine  '
2020 '  screen codes for direct cursor addressing                      '
2030 '                                                                 '
2040 '  Variables used:                                                '
2050 '          LEAD$   Lead-in string          INTER$  Inter. string  '
2060 '          TERM$   Terminating string      FLAG$   Row/col flag   '
2070 '          ROFF%   Row offset              COFF%   Col offset     '
2080 '*****************************************************************
2000 '
3010 '          Routine to read the configuration file
3030     ON ERROR GOTO 10000
3040     OPEN "I",1,"CONFIG.DTA"
3050     LEAD$="":
         FOR I%=1 TO 4:
                 INPUT #1,I$:
                 IF I$<>"" THEN
                         IF VAL(I$)>=0 AND VAL(I$)<=255 THEN
                                 LEAD$=LEAD$+CHR$(VAL(I$))
                         ELSE
                                 ERROR
3060     NEXT I%                                    'Lead-in string
3070     INTER$="":
         FOR I%=1 TO 2:
                 INPUT #1,I$:
                 IF I$<>"" THEN
                         IF VAL(I$)>=0 AND VAL(I$)<=255 THEN
                                 INTER$=INTER$+CHR$(VAL(I$))
                         ELSE
                                 ERROR
3080     NEXT I%                                    'Intermediate string
3090     TERM$="":
         FOR I%=1 TO 2:
                 INPUT #1,I$:
                 IF I$<>"" THEN
                         IF VAL(I$)>=0 AND VAL(I$)<=255 THEN
                                 TERM$=TERM$+CHR$(VAL(I$))
                         ELSE
                                 ERROR
3100     NEXT I%                                    'Terminating string
3110     INPUT #1,I$:
         IF VAL(I$)<-1 OR VAL(I$)>231 THEN
                 ERROR
         ELSE
                 ROFF%=VAL(I$)                      'Row offset
3120     INPUT #1,I$:
         IF VAL(I$)<-1 OR VAL(I$)>175 THEN
                 ERROR
         ELSE
                 COFF%=VAL(I$)                      'Column offset
3130     INPUT #1,I$:
         IF VAL(I$)=0 THEN
                 FLAG%=0
         ELSE
                 FLAG%=-1                           'Row/column flag
3160     ON ERROR GOTO 0: CLOSE 1
3190 '
3200 '          Define the function that positions the cursor
3210     WIDTH 255
3220     DEF FNRC$(R%,C%)=LEAD$+LEFT$((CHR$(R%+ROFF%)+INTER$),(FLAG%+1)*32)+
             +CHR$(C%+COFF%)+LEFT$(INTER$+CHR$(R%+ROFF%),(FLAG%*-32))+TERM$
3300 '                  rest of program
3310 '                  ...     ...     ...
10000 ' Error routine
10010    PRINT "Program incorrectly installed": END
```

Listing 2.

```
5000 '*****************************************************************
5010 '  A small routine to test the cursor-positioning function.       '
5020 '  This should print a large X in the middle of the screen        '
5030 '*****************************************************************
5040 '
5050     PRINT STRING$(24,10)                       'Clear the screen
5060 '
5070     COL%=29
5080     FOR ROW%=1 TO 24:
                 PRINT FNRC$(ROW%,COL%);"*";FNRC$(ROW%,81-COL%);"*"; :
                 COL%=COL%+1:
         NEXT ROW%                                  'Print the X
5090 '
5100     PRINT FNRC$(1,1): END                      'Reposition cursor
```

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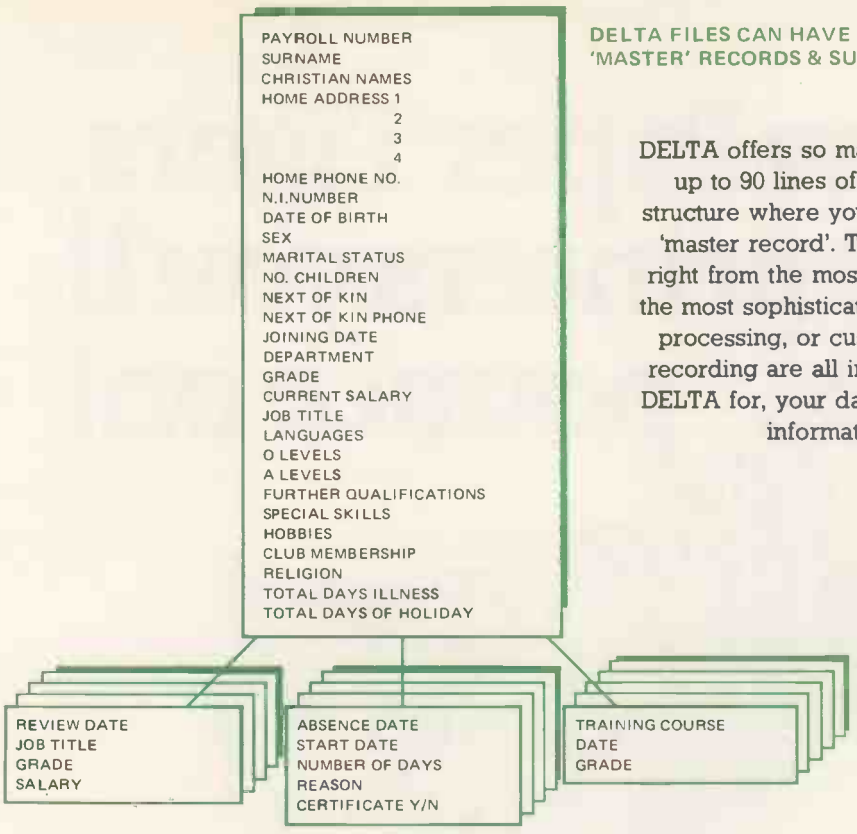

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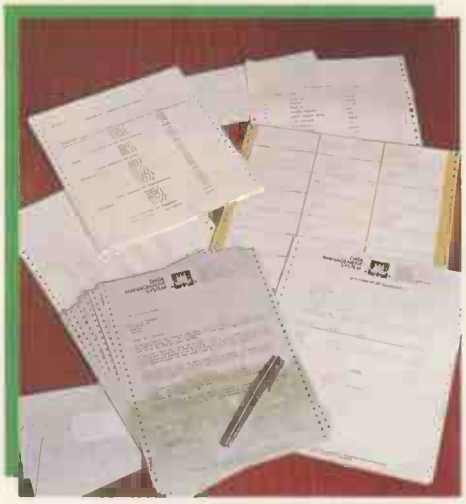

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by Ray Coles

Make way for 256K

THE CURRENT de facto standard for read/write memory components used in personal computers is the 64K bit NMOS dynamic RAM in a 16-pin plastic package — but not for long.

Historically speaking, advances in semiconductor processing technology have resulted in the introduction of new memory devices with four times the capacity of their predecessors every three to four years. This trend started with the first practical semiconductor RAM of 16-bit capacity in the early sixties. By the early seventies massive 1Kbit MOS dynamic RAMs were the norm, followed rapidly by devices sporting 4Kbits, then 16Kbits and, by 1980, 64Kbits. An extrapolated plot of this exponential growth rate predicts that we are now overdue for the next stage, 256Kbits. But we will not have long to wait.

Already 256K DRAM technology has been developed, and ready in the wings is an army of eager manufacturers awaiting the optimum moment to unleash a torrent of silicon on to an unsuspecting world. The waiting game is a test of nerves. The lead manufacturers are still making hefty profits from the almost insatiable demand for their existing 64K products, a market they are quite happy to remain in until forced to move on. In 1983 the market for 64K parts was worth around $1 billion, and depending on the time scales for the launch of 256K parts, it should peak in 1985 to 1986 at between $2 and $3 billion with up to a billion devices shipped.

Higher quality

The Japanese gave American manufacturers quite a pasting at the 64K level. They stole as much as 60 percent of the total DRAM market by not only offering lower prices but also providing, at least to start with, higher quality. Many analysts have predicted a similar upset at the 256K level, and it certainly appears that the Japanese had their chips ready before most of the competition. But the pre-emptive strike has not yet materialised because no one, least of all the Japanese, wants to spoil the 64K fun.

However, this game of chicken cannot last much longer and already many manufacturers are selling samples of their 256K chips at a premium price to get the system designers interested. The real fun will start when one of the contenders takes the bold step of dropping prices to a level competitive on a cost per bit basis with current 64K parts, and backs this up with a capability for high volume shipment. This will probably happen before the end of 1984.

With personal computers based on 8/16-bit microprocessors such as the Intel 8088 selling by the million, a large potential market for 256K devices already exists. As the gradual trend towards full 16- and 32-bit machines based on microprocessors with huge appetites for memory, like the Intel 80286 and the Motorola 68010, gets underway the 256K DRAM will become essential. Potential suppliers now include Motorola, Intel, Mostek, Micron and Texas Instruments in the U.S.A., Inmos in Britain, and the awesome line-up of NEC, Toshiba, Hitachi, Oki and Fujitsu in Japan.

Not that the transition to 256K technology has been easy for the semiconductor manufacturers. To squeeze 262,144 separate and functional bit cells on to a sliver of silicon measuring only about 6mm. square is an extremely difficult thing to achieve in volume production at low prices. Many fundamental physical barriers loom dangerously close.

The physical size of the chip cannot be increased very much over that used in 64K devices if the resulting device is to fit into its package and be potentially cheaper. So the size of the individual active devices and their interconnections has to shrink. For the current 64K generation, line widths of 2.5 microns to 3 microns are the norm; for the 256K generation this is reduced to 1.5 microns to 2 microns, with alignment to 0.75 microns or better. The basic optional lithographic process used to print the chip layout on the silicon wafer reaches the limits of its capability with this sort of resolution, and an eventual solution based on electron beam or X-ray lithography is not ready yet for mass production applications.

Soft errors caused by alpha particle hits from the decay of radioactive contaminants in the package material were a problem even with the geometries used for 64K devices. At the 256K level, it has been necessary to retain a similar size of gate storage capacitance to that used in the 64K generation because anything less would present a soft error problem. But to retain the required capacity per bit of 50 femtofarads — 50×10^{-15} farads — in a smaller cell has meant thinning the gate oxide insulator down to only 20 nanometres thick.

Even after such problems were overcome it still appeared that the 256K devices would have a lower manufacturing yield per wafer due to randomly distributed faulty bit cells. To keep yields up so that prices can come down, manufacturers have incorporated spare cells which can be patched in following production line tests or selected dynamically while the memory is operating.

Most manufacturers have opted for the former approach, and use electrical pulses or lasers to blow fuses which connect up spare cells. Micron Technology has taken the latter approach and stores 12 bits of data for every eight written, requiring an increase in memory size of 50 percent. The additional four bits are used to store a check word which is compared with the other eight bits during readout. If single-bit errors are present, the internal circuitry recreates the troublesome data bit so that the user remains unaware of the problem.

Cost problems

The advantage of the Micron technique is that it can correct both hard errors and soft errors, whether due to manufacturing problems or to subsequent alpha particle hits. The disadvantage may turn out to be a difficulty in keeping costs down when the expected price war heats up in two to three years time.

Another innovation likely to play an important part in the 256K DRAM market will be the use of low-power CMOS technology rather than the NMOS currently used for most 64K parts. For example, the recently announced Intel 51C256 device uses an advanced 1.5 micrometre CHMOS process. It can offer microwatt stand-by power consumption in addition to high speed access times of 150 nanoseconds and random defective element replacement by electrically programmed fuse selection during manufacture.

A number of component distributors are now claiming to have 256K devices available, and some are even taking the unusual step of predicting the price erosion which will occur over the next year. So hang on to your hats as here we go again.

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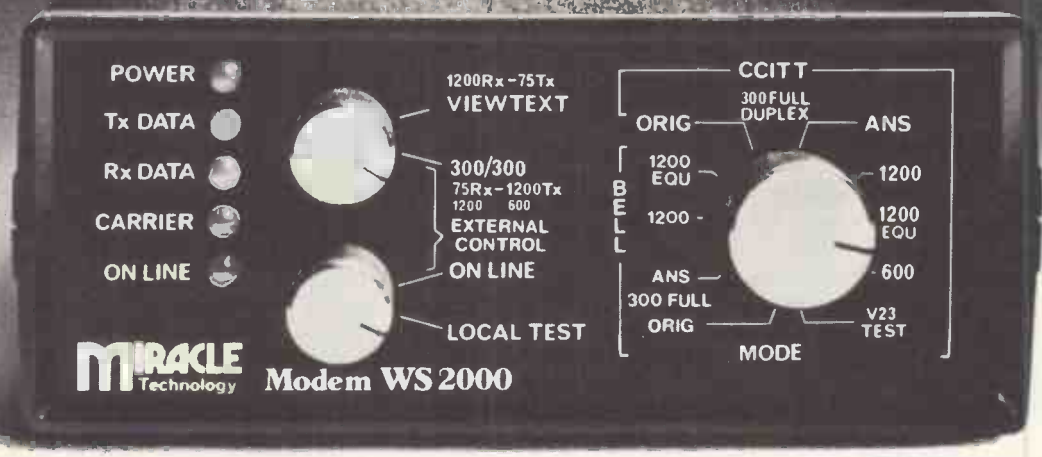

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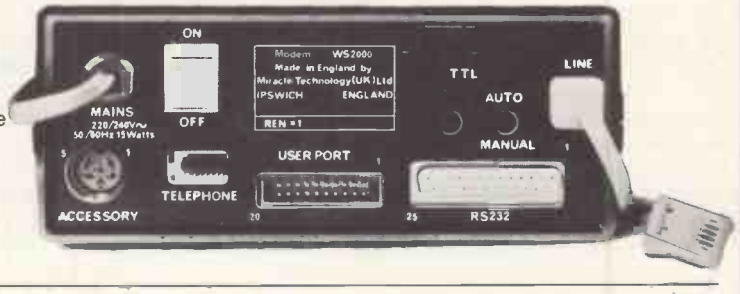

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by John Hooper

Keypad input

WITH THE NUMBER of pocket computing devices increasing rapidly, and the advent of push-button phones connected to Prestel-like networks, there is pressure for keyboards simpler than a full alpha-numeric keyboard yet still capable of out-putting all, or most, of the same characters. In Specification 2,128,384 Badru Nasiruddin discloses that a simple keyboard can be based on something like a push-button phone pad provided with some letter combinations.

Mr Nasiruddin suggests using 10 numeric keys doubled up with ABC, DEF and so on, together with Erase coupled to a "." key with both "," and "/", a space key and a letters/figures toggle. The extra feature Mr Nasiruddin suggests arises when you use a key in a mode where it has more than one function — in letter mode, for example, the ABC key can be A, B or C. In such a simple case the particular function chosen may be selected by the number of rapid presses given to the key. In this example, one press gives A, two B and three C.

Continuous dots

Nowadays it is quite common for reasonably good-quality output to be obtained from a dot-matrix printer by causing the print head to oscillate up and down, the wires in the head striking at each end of the oscillation. The two lots of

(continued on next page)

Getting a British Patent

British Patents are granted by the State, as represented by the Comptroller-General and the staff of the Patent Office, upon an application for the Patent complying with the requirements of the Patents Act 1977 and the relevant rules.

You file the appropriate forms, and pay the fees. The application is then examined by the Patent Office to see whether there appears to be any reason why the patent should not be granted. If there is none, or if any of the apparent reasons can be shown not to apply, then the Patent is granted. However, few patents are granted until two or three year after the application is made.

Stage 1 of the process is the preparation of the necessary documents and their filming at the Patent Office. Although only a description of the invention and an indication that a patent is wanted is all that is needed to secure a filing date, the full documentation is daunting. First there is the application form, then the Patent specification which describes the invention and defines the monopoly sought. Next there is the declaration of inventorship which says who the actual inventor is, as opposed to the applicant, and the request for a novelty examination and search which asks the office to search for any relevant Prior Art that might invalidate the application. Finally there is the request for substantive examination asking the Patent Office to consider in detail the patentability of the invention.

The various forms are formalities, and can be completed by anyone who can fill in an Income Tax return. However, the Specification is the key document, which needs a skilful hand to draft it since the future of the patent rests on its adequacy. It describes the invention, in the context of the problems of the Prior Art, both in broad terms relating to the concepts involved and in detailed and specific terms as appropriate to an actual embodiment. Most importantly, it defines the invention, and in so doing defines the essential features, or the boundary, of the monopoly the applicant wishes granted.

Stage 2 is reached about six months after a filing date has been secured, when the Patent Office issues the report of the result of the novelty examination and search. In a few cases this will say merely that the invention defined has been compared with the known Prior Art, and no relevant documents could be found that might destroy its patentability. In most cases, however, the report cites a number of relevant documents as disclosing something that anticipates the defined invention. But at this time these citations are made without further comments as to their specific relevance.

At this point the applicant does not have to refute the relevance of the citations. But upon the basis of their existence, the applicant usually decides whether to proceed with the application, and whether to modify the invention's definition to avoid being anticipated. If the citations are very bad, then the application can be abandoned. However, it will be published unless withdrawn before the publication preparations are complete, usually about 15 months after filing. Otherwise, the invention may be redefined in any way based upon the original disclosure.

Stage 3 follows when the Patent Office issues the substantive examination report. It is now that the examiner reconsiders the relevance, if any, of the citations, and sometimes performs a supplementary search to find new citations. The examiner then provides arguments as to why the citations are relevant, and why they render the defined invention either anticipated or so nearly so that the difference is entirely obvious. Also the examiner may object that the wording of the specification is unclear, or that parts of it are contradictory.

All such points must be dealt with before the application can be allowed and a patent granted. Allegations of lack of novelty or of obviousness must be refuted, perhaps coupled with a redefinition of the invention. The Specification must be made clear, understandable and consistent throughout. Then the patent is granted, and the specification republished in its final form to show the public not only what it is that is patented and they are not to do, but at the same time how to utilise the invention once the Patent expires.

Stage 4 is the payment of the annual renewal fees to keep the patent in force. This starts the fifth year after the filing date, and continues, at the patentee's choice, up to the 20th year. Any time the fees are not paid then the Patent lapses, never, save in very special circumstances, to be recovered. On the 20th anniversary the Patent expires come what may.

Patents progress

(continued from previous page)
strikes produce vertically overlapping dots to give the effect of a full-impact strike. Also it is common for the paper feed to be stopped altogether to allow a second line to overprint the first, possibly with a fractional lateral displacement, and further enhancing the print quality.

However, in Specification 2,131,747 Citizen Watch proposes that stopping the paper should be abandoned and that the print head should vary its lateral speed across the paper. For draft output the lateral speed will be high all the time, but for letter quality the speed will be much lower. So a doubly struck character is the same two characters, only slightly displaced because the print head moved relatively slowly between the two.

You could alternate between slow and fast print-head movement; slow between the two characters making up each pair, and fast between adjacent pairs.

Technicolor syntax

Some home computers check each program line for syntax as it is entered, either refusing to accept an incorrect line or in addition indicating the error believed to exist. In Specification 2,131,986 Mattel puts forward the idea of a colour coding scheme, usable with the majority of micros plugged into a home television set.

As each statement is entered it is checked for syntax. It is then displayed with its correct portions coloured according to their nature, keywords, functions, array variables and so on. The incorrect portions, if any, are left uncoloured. For example, during input the display is black on white. But after the checking process has been effected correct keywords are shown black on blue, correct variable names are black on green, and correct arithmetical expressions are black on tan.

If the system can determine that an apparently erroneous statement might, if part of the statement were omitted, become correct, then if the line is re-entered unchanged it will make the correction, and accept the line with the nonsense part deleted.

Double-engined

The concept of a micro using two processors, one to handle I/O work and one to get on with program execution, is well known. Tycom, in Specification 2,127,190, take this further and puts forward a computer design in which one processor, permanently built into the machine, deals with I/O. A second processor, which is replaceable, looks after the program.

The I/O or base processor should give the computer some limited performance on its own, and the two communicate at a fairly high level, so when you update your second processor from a 6502 to a Z-80, and then to a 8086, very little needs changing within the machine and you can simply change CPUs.

Nose lighter

Nowadays even a pair of spectacles can conceal the hand of the computer. In Specification 2,127,993 Hoya Lens suggests that lenses be matched by their thickness to chosen frames so as to be the lightest and strongest possible.

Hoya Lens constructs the contour map of lines of equal thickness defining the lens, and then overlaps it with the outline of the frame. Thus the relative thickness of the lens periphery where it will be supported by the frame is identified. Then the minimum and maximum absolute lens thickness can be calculated. In this way the best possible lens can be ground.

Translation saver

In Specification 2,131,582 and the related 2,131,583 Sharp proposes that a translation computer should not throw away the user's typed-in effort if a translation cannot be found. Instead, the device should store the input, allowing some part of it to be marked as significant and checkable as against word roots, and others to be translated separately.

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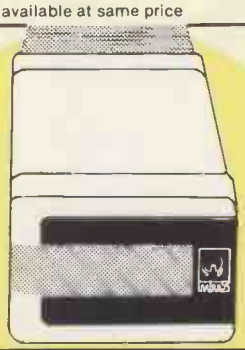

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Don't be fooled — these diskettes are brand new and come with our normal full money-back guarantee. They are mostly on hub ring labelled or unlabelled BASF, Dysan, Rhone Poulenc, Memorex etc where the boxes have had the cellophane removed. We are even supplying them in a FREE SEE 10 library box!! At these prices you can't lose — Hurry!

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Sub Total exc VAT
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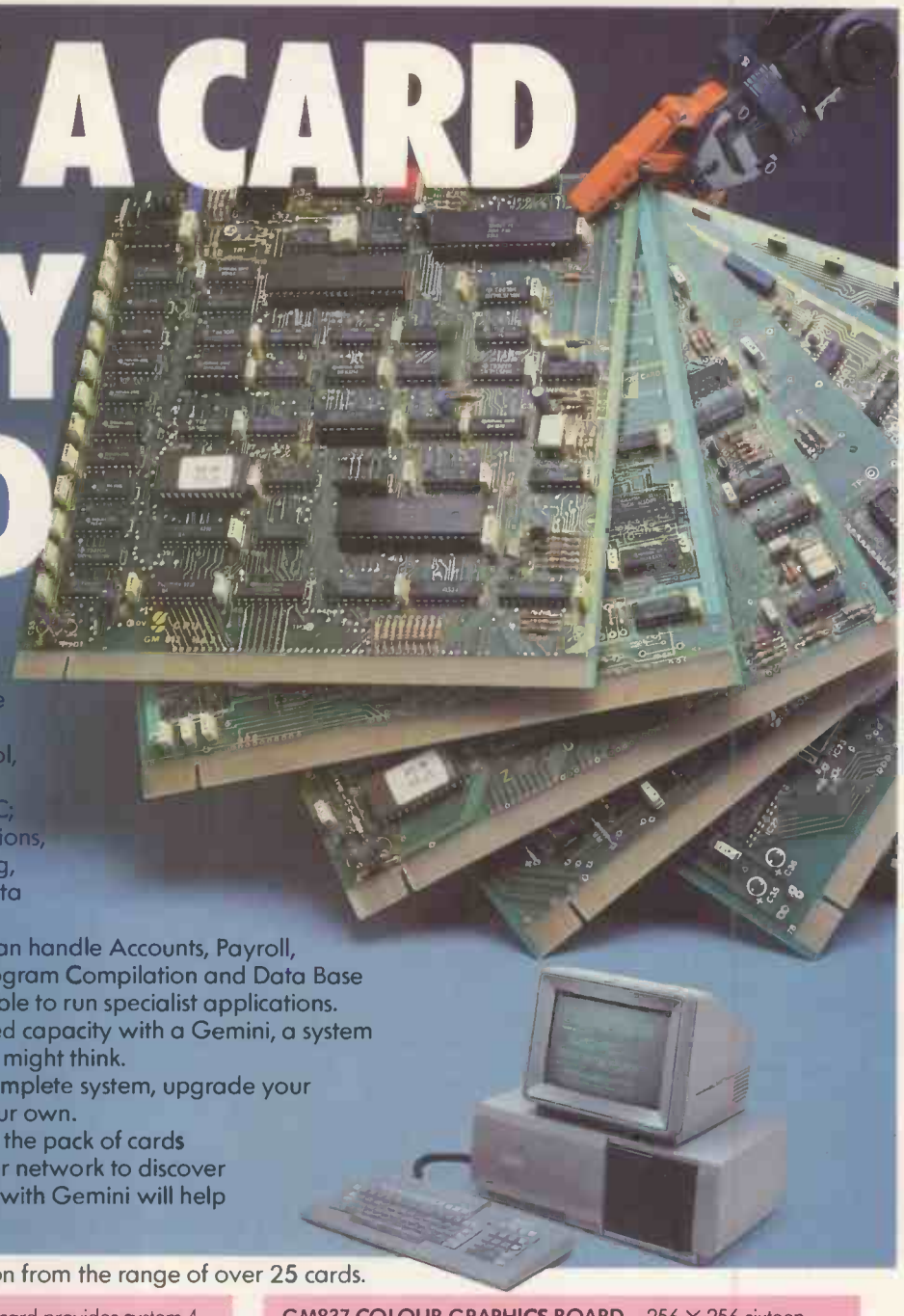

Every card's a winner. The versatile 80-Bus system can be used for a host of applications: Process Control, Batch Counting, Robotics, Colour Graphic Displays, CAD/CAM, CNC; In Manufacturing, Telecommunications, Instrumentation, Laboratory Testing, Security Systems, Plant Control, Data Collection and Distribution.

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GM813 CPU/64K RAM BOARD – This card provides system 4 MHz, Z80 CPU, 64K user RAM and both serial and parallel I/O.

GM811 CPU BOARD – An industrial standard 4 MHz, Z80 controller board with parallel and serial I/O together with a variable Bytewide memory capacity.

GM888 CPU BOARD – A new card featuring the Intel 8088 processor to provide a dual processor system.

GM832 SVC BOARD – Provides conventional 80 x 25 or 40 x 25 screen format together with graphics capability. Includes full keyboard support and overseas character sets.

GM862 256K RAM BOARD – Supports both page mode and extended addressing facilities and can be used with all of the Gemini CPU cards.

GM833 512K RAM-DISK BOARD – Provides 'psuedo disk' facility in a MultiBoard system.

GM829 FDC/SASI BOARD – Combines floppy disk controller and SASI board supports up to four floppy disk drives plus Winchester controller cards.

GM837 COLOUR GRAPHICS BOARD – 256 × 256 sixteen colour graphics display. Output to either PAL UHF or RGB.

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GM848 SERIAL I/O BOARD – Utilises two Z80A SIO chips providing four synchronous/asynchronous serial channels with software selectable baud rates.

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>NEXT MONTH

>PRINTERS AND PLOTTERS

New technologies like ink jets and lasers are bringing new excitement into the printer market. We will be looking at the whole field of printers and plotters in the special section of the November issue. And we are compiling a guide to budget printers for every application, from low-cost thermal printers for home use to letter-quality models for the office.

>REVIEWS

Two new Commodore micros have been launched this month, and we already have samples on the test bench. The Commodore 16 and Plus/4 show major improvements over the Vic-20 and Commodore 64. Don't miss our report on how they perform.

The Tatung Einstein is a British-made machine aimed at the educational/small business/luxury home market. We will be testing it alongside its Japanese rival the Sharp MZ-700. We are also road testing the IBM Personal Portable, to see how it compares with its Compaq rival. Plus ... are there real performance-quality music synthesisers for the BBC?

>AND MUCH MORE..

Typesetting from your micro can save you time and money, and this is just one of the practical applications we will be covering. There will be special programming features for popular micros, news, regular columns, lots of free software in Open File, and finally ... "Tree Search by Scouting" — no not woodcraft, but part 2 of David Levy's important new programming tutorial. Don't miss it!

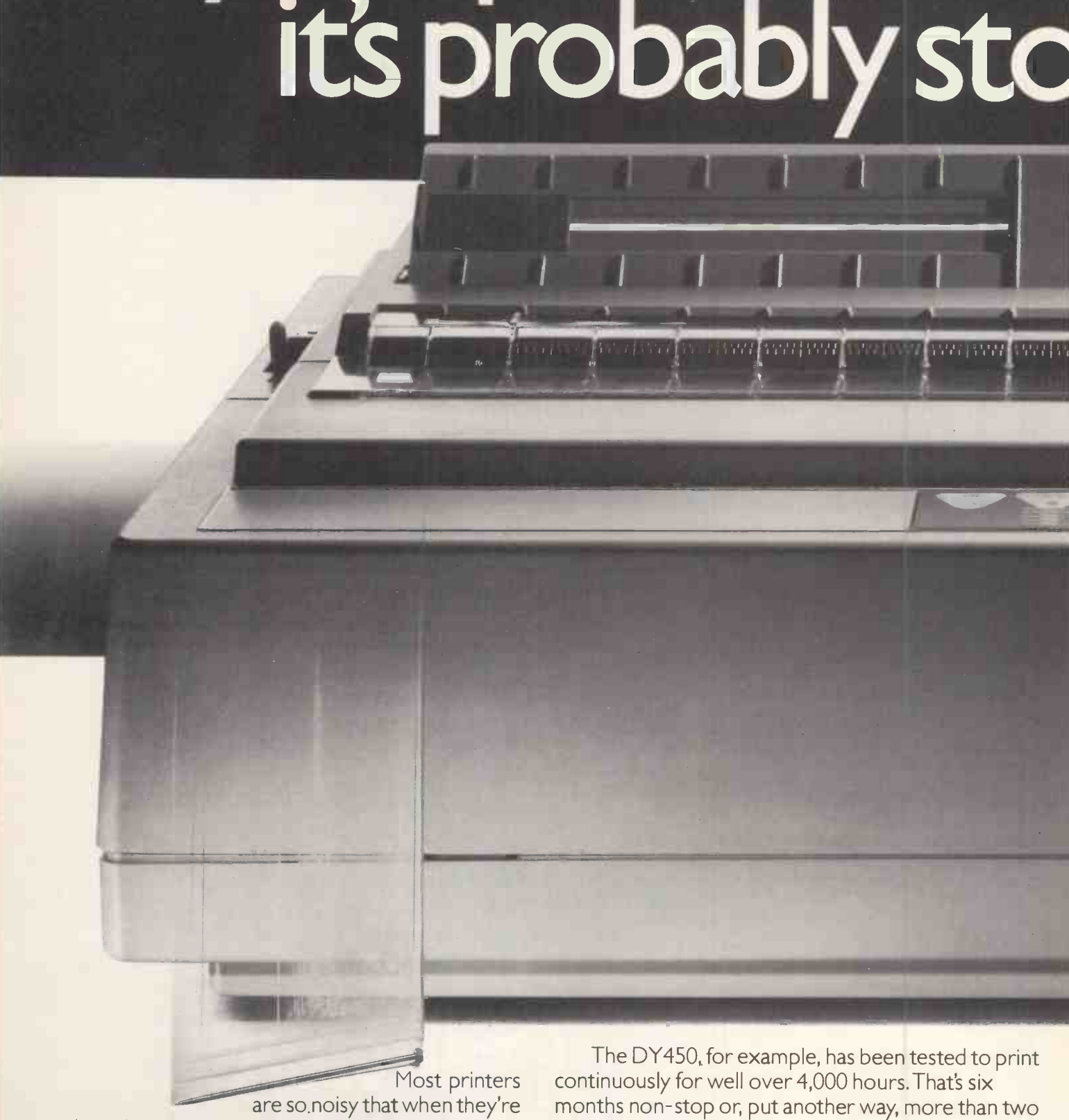
Order your copy of the November issue now.

Practical Computing

On sale at W H Smith and all good newsagents after 17 October

Contents may vary due to circumstances beyond our control and are subject to change without notice

If your printer is as it's probably sto



Most printers are so noisy that when they're working the rest of the office comes to a grinding halt.

Not so with an Olivetti.

Even when an Olivetti daisy wheel or dot matrix printer is working at full speed, you can still hear a pin drop.

Which is just as well, considering every Olivetti is tested to work for a lot longer than ordinary printers.

The DY450, for example, has been tested to print continuously for well over 4,000 hours. That's six months non-stop or, put another way, more than two working years.

And all seven printers in the new Olivetti range are fully compatible with the industry standard, handle all popular software and offer excellent paper handling.

So they won't cause any operating headaches whatsoever.

quiet as an Olivetti, pped working.

Neither will they cause any financial headaches.

As you'd expect from a company with our reputation for innovation and experience in print technology, we've learnt that the best doesn't have to be the most expensive.

Consequently, you'll find the price performance of an Olivetti printer is unbeatable.

For more information on the new Olivetti printers, simply complete the coupon now.

We've kept quiet about them for long enough.

To: Valerie Belfer, British Olivetti, Olivetti House, 86-88 Upper Richmond Road, Putney, London SW15 2UR. Tel: 01-785 6666. Please send me details on the new Olivetti range of printers.

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CBM MPS-801	50 CPS Matrix Printer	200.00
CBM MPS-802	60 CPS Letter Qual Matrix	300.00

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CBM 710	80 Col 128k Ram	845.00
CBM 715	80 Col 256k Ram	995.00

COMMODORE DISK DRIVES

CBM 1001	Single Drive 1 Mb (8250 Disk)	495.00
CBM 8050	Dual Drive 1 Mb	895.00
CBM 8250	Dual Drive 2Mb	895.00

COMMODORE PRINTERS

CBM 4023	Matrix 80 Col 60 cps	345.00
MPP 1361	Matrix 132/256 Col 160 cps	625.00
CBM 6400	Daisy Wheel 132 Col 45 cps	995.00

ROMS & CHIPSWITCHES (CBM Basic 2-4)

RAM/ROMS (4 K/b Ram in Rom !)	59.09
Upgrade ROMs: Basic 2 & 3 to 4	50.00
Basic 1 to 2	75.00

INTERFACES

Parallel Centronics (Non-addressable)	45.00
Parallel Centronics (Addressable)	75.00
Serial (Uni-directional)	120.00
Analogue to digital	from 190.00
Television for Fat 40(!) & 8032	45.00

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MBC 555 128k + Dual Disk Drive c/w Software	999.00
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Hi-Res Colour Monitor	475.00

EPSON

PX-8 Portable 64K Micro (cassette op)	798.00
FX-80 Matrix printer 160 cps	438.00
FX-100 Matrix printer 160 cps 13o col	569.00
MX-100 Matrix printer 100 cps 13o col	475.00
RX-80 FT Matrix printer 160 cps	319.00

apricot

CPU - Single Disk Drive 315k	1395.00
CPU - Dual Disk Drive 630k	1595.00
CPU - Integral Winchester 5Mb + 315k	2495.00
CPU - Integral Winchester 10Mb + 315k	2795.00
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CPU 256k - Dual Drive 2 4Mb + Monitor	2895.00
CPU 256k - 10Mb Hard & 1.2Mb + Monitor	3995.00

OTHER PRINTERS

CP80	Matrix 80 col 50 cps	199.00
GP 700A	Matrix 80 col 35 cps 4 Colour	495.00
Juki 6100	Daisy Wheel 132 Col 20 cps	420.00
Cannon PW 108A	FX Compatible	399.00

PRINTER BUFFERS

Printer Buffers are available for most computers with either RS232, IEEE, Centronics and can be supplied in any combination (i.e) IEEE - Centronics
Three sizes are available - 16k, 32k, 48k. Prices start from 128.00

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Cable IEEE to IEEE (2 Metre Stackable)	35.00
Cable IEEE to IEEE (2 Metre Non Stack)	20.00
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69

A SELECTION FROM OUR PRODUCT RANGE

High Level Languages

		CP/M	CP/M-86	MS-DOS	PCDOS
BASIC INTERPRETER	Microsoft	●		●	●
BASIC COMPILER V5.3	Microsoft	●		●	●
BUSINESS BASIC COMPILER	Microsoft			●	●
C COMPILER	Microsoft			●	●
CBASIC	Digital Research	●	●		
CBASIC COMPILER	Digital Research	●	●		
CIS COBOL	Micro Focus	●	●	●	
COBOL COMPILER	Microsoft	●		●	●
FORTRAN COMPILER	Microsoft	●		●	●
LEVEL-2 COBOL	Micro Focus	●	●	●	●
muLISP	Microsoft	●		●	
muMATH/muSIMP	Microsoft	●			
PASCAL COMPILER	Microsoft			●	●
PASCAL MT+	Digital Research	●	●		
PL/1	Digital Research	●	●		
PROFORTRAN	Prospero	●	●	●	●
PROPASCAL	Prospero	●	●	●	●

Low Level Languages

		CP/M	CP/M-86	MS-DOS	PCDOS
MACRO-80	Microsoft	●			
PROGRAMMERS UTILS (RASM)	Digital Research	●	●		

Program Development Tools

		CP/M	CP/M-86	MS-DOS	PCDOS
ANIMATOR	Micro Focus	●	●		
BUG	Phoenix Software	●			
DISPLAY MANAGER	Digital Research	●	●	●	
FTNUMB	Micrology	●			
LEVEL II ANIMATOR	Micro Focus	●	●	●	●
PASM	Phoenix	●			
POEVELOP	Phoenix	●			
PLINK	Phoenix	●			
PLINK II	Phoenix	●			
PLINK-86	Phoenix		●	●	●
SID	Digital Research	●	●		
SPEED PROGRAMMING PACKAGE	Digital Research	●	●		
XLT-86	Digital Research	●			
ZSID	Digital Research	●			

Utilities/System Tools

		CP/M	CP/M-86	MS-DOS	PCDOS
CLIP	Keele Codes	●	●	●	●
DESPOOL	Digital Research	●			
DISKED-2	Slogger Software	●			
DISKMAN	Slogger Software	●			
DISKORG	Slogger Software	●			
DISKTOOLS-1 (DISKMAN & DISKORG)	Slogger Software	●			
DISKTOOLS 2 (DISKTOOLS-1 & DISKED-2)	Slogger Software	●			
dUTIL (FOR DBASE-II)	Fox & Geller	●		●	●
FILESHARE	Micro Focus	●	●		
DEC RAINBOW SERVICE S/W:	Silicon Valley Corp.				
(1) Format/Verify Service			●		
(2) Autorun Service			●		
(3) Function Key Service			●		
SERVICE S/W VOL. 1 (1, 2 & 3)			●		
THE OPERATING GUIDE	Decision Systems	●			

Sorting

		CP/M	CP/M-86	MS-DOS	PCDOS
MSORT	Microsoft	●		●	●
SUPERSORT	Micropro	●	●	●	●

Code Generators

		CP/M	CP/M-86	MS-DOS	PCDOS
AUTOCODE	Stemmos	●		●	●
FORMS-2	Micro Focus	●	●	●	●
QUICKCODE	Fox & Geller	●		●	●
SOURCEWRITER	Softwright	●	●	●	●
THE LAST ONE	O.J. 'AI' Systems	●	●	●	●
THE LAST ONE—COMPACT	O.J. 'AI' Systems	●	●	●	●

Telecommunications/Conversions

		CP/M	CP/M-86	MS-DOS	PCDOS
BACDEBIT	Comley	●			
BACSCOPY	Comley	●			
BSTAM	Byrom Software	●	●	●	●
BSTMS	Byrom Software	●			
ICL CO3 EMULATION (Bulk)	Synchro Systems	●			
ICL CO3 EMULATION (Interactive)	Synchro Systems	●			
ICL CO3 EMULATION (Interactive & Bulk)	Synchro Systems	●			
REFORMATTER CP/M ↔ DEC	Microtech Exports	●			
REFORMATTER CP/M ↔ IBM	Microtech Exports	●	●		

Word Processing/ Text Editing/Editors

		CP/M	CP/M-86	MS-DOS	PCDOS
EDIT-80 V2.02	Microsoft	●			
FRIDAY	Ashton Tate	●	●	●	●
MAILMERGE	Micropro	●	●	●	●
MEMOPLAN	Chang Labs	●	●		●
WORD	Microsoft				●
WORD WITH MOUSE	Microsoft				●
PARAGRAB	Focus	●			●
PEDIT	Phoenix	●			
PLANSTAR	Micropro				●
PMATE	Phoenix	●		●	●
SPELLSTAR	Micropro	●	●	●	●
STARBURST	Micropro				●
STARINDEX	Micropro	●	●	●	●
WORDMASTER	Micropro	●	●		
WORDSTAR	Micropro	●	●	●	●
WORDSTAR PROFESSIONAL (WS+MM+SS+STAR INDEX)	Micropro	●	●	●	●

Databases/Data Management Systems

		CP/M	CP/M-86	MS-DOS	PCDOS
DATASTAR	Micropro	●	●	●	●
dBASE-II	Ashton Tate	●	●	●	●
FRIDAY	Ashton Tate	●	●	●	●
FRAMEWORK	Ashton Tate				●
INFOSTAR	Micropro	●	●	●	●
REPORTSTAR	Micropro	●	●	●	●
dBASE III	Ashton Tate				●

Financial Accounting

		CP/M	CP/M-86	MS-DOS	PCDOS
INCOMPLETE RECORDS SYSTEM	MPI	●	●	●	●
NOMINAL LEDGER	Padmede	●		●	●
OPEN ITEM PURCHASE LEDGER	Padmede	●		●	●
OPEN ITEM SALES LEDGER	Padmede	●		●	●
PADMEDE BUSINESS CONTROL SYSTEM	Padmede	●		●	●
PAYROLL	MPI	●		●	●
PURCHASE LEDGER	Padmede	●		●	●
SALES INVOICING	Padmede	●		●	●
SALES LEDGER	Padmede	●		●	●
TIME & COST RECORDING	Padmede	●		●	●

Financial Modelling/Problem Solving

		CP/M	CP/M-86	MS-DOS	PCDOS
CALCSTAR	Micropro	●	●	●	●
DECISION ANALYST	Executive Software	●	●	●	●
LINEAR & GOAL PROGRAMMING	E A S	●			
MATHSPACK	MPI	●		●	●
MICROPLAN	Chang Labs	●		●	●
MULTIPLAN	Microsoft	●		●	●
PLANTRAC 1	Computerline	●		●	●
PLANTRAC 1+	Computerline	●		●	●
PROFIT PLAN	Chang Labs	●	●		●
QSTAT	Pivotal Software	●			
STATSPACK	MPI	●		●	●
TKI SOLVER	Software Arts				●
TKI SOLVER PACKS					
FINANCIAL MANAGEMENT					●
MECH ENGINEERING					●

Business Applications

		CP/M	CP/M-86	MS-DOS	PCDOS
JOB COSTING	Heseltine	●	●	●	●
POLICY MASTER	CSA Micro Systems	●	●	●	●
PRINT ESTIMATION	Software Mgmt Systems	●		●	●
STOCK CONTROL	Padmede	●		●	●

Training Aids

		CP/M	CP/M-86	MS-DOS	PCDOS
CP/M TUTOR	Syntax Software	●			
KEYBOARD MASTER	Anthony Ashpitel	●	●		●
TYPING MASTER	Anthony Ashpitel	●	●		●

Graphics

		CP/M	CP/M-86	MS-DOS	PCDOS
dGRAPH	Fox & Geller	●			●

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WordStar is probably the most popular word processing package available for use on microcomputer systems. It offers a complete range of word and text processing facilities that are both powerful and simple to use. Text files can be created easily and editing, formatting and screen manipulation is simple and easily learned.

WordStar features include comprehensive screen editing facilities with menu and four levels of help messages as required: powerful editing commands that allow text to be inserted, deleted, moved, copied or read from files: word-wrap, which eliminates the need for carriage returns: a wide range of print enhancements such as boldface, double strike, underline, superscripts and variable line height: flexibility in formatting, which allows justified or ragged right margins (or both), and in pagination where the user selects page length, margins and headings and footings: a decimal tab facility that allows columns of numbers to be typed easily; paragraph indenting; and program execution, which allows another program - for example a system utility - to be executed with an automatic return to WordStar.

MAILMERGE

MailMerge is a powerful file merging tool that is ideal for mailing applications where lists are selected on a range of criteria. Operating in conjunction with WordStar, it allows the creation of 'personalised' letters by incorporating specified variables such as salutation or name into the basic document file prepared on WordStar.

MailMerge features include the use of the same data file for both form letters and mailing labels; multiple copy printing, which allows the same file to be automatically printed more than one time; and chained printing where a file name can be specified within text for subsequent automatic printing.

SPELLSTAR

SpellStar is a powerful spelling checker that finds spelling and typing errors in word processing text files. It is ables to proof-read the files at many thousands of words per minute, comparing the file to its integral 20,000-word dictionary stored on disc.

Operating only in conjunction with the WordStar word processing package, SpellStar features include showing the error highlighted in context on-screen within the WordStar file; and the provision of three subsequent options: change the spelling, leave the spelling as it is, or leave the spelling and add the word either to the integral dictionary or a specifically created supplementary dictionary.

STARINDEX

StarIndex runs with WordStar data files to create indexes, tables of contents, figures and tables, and to enhance the print control of the file to improve presentation.

Commands are typed into the file at the appropriate place so that comprehensive, truly alphabetical indexes can be constructed, tables of contents etc produced, or the pages, table of figures sequentially numbered. It can also be used to enhance the quality of the printed document with the inclusion of such commands as boldface, double-strike, underline, space and elongate.

STARBURST

StarBurst is a management tool designed for developing complex overall systems from a range of standard packages. A vocabulary of 24 commands allows the user to develop a specific menu that will carry out multiple keystroke operations with a single keystroke. No programming knowledge is needed.

The program will work with all the Micropro range as well as many other standard applications packages.

DATASTAR

DataStar is a powerful yet easy to learn data entry system that allows users to generate the specific forms and parameters for data entry, and then retrieve and update the information as required. The files that can be constructed using DataStar can be used with applications programs that have been written in BASIC, COBOL or FORTRAN.

The package consists of two separate programs, DataStar itself, and FormGen. The latter gives users, the necessary tools to design and generate the forms needed for data entry, on screen. This includes not only defining the location of data fields, but defining their contents as well.

DataStar features include powerful editing facilities normally found only on large key-to-disc systems; several different forms of data verification to reduce errors; a wide range of comprehensive help messages and instructions on-screen; the provision of arithmetic functions with results automatically entered to desired data fields; and powerful search/retrieve and edit/updating facilities that offer several ways of locating desired records and updating updating them.

DataStar can be easily integrated with a wide range of other applications programs. It can, for example, be used as the data entry portion of a stock control or employee record suite without the need to modify the existing packages.

INFOSTAR

InfoStar is a data management system that has been developed by combining the capabilities of Micropro's DataStar data entry and updating system with a high speed and full featured report generator called ReportStar.

Up to 65535 records can be maintained per file, with records being of variable length. There can be up to 255 fields per record, with each field containing a maximum of 120 characters. Data can be entered using DATASTAR, which can easily be customised to suit a users specific requirements. Sorting updating and reporting is performed by ReportStar, which can sort on upto 32 key fields at speeds of up to 560 records per minute. This speed is maintained in reporting, where a report can be produced in under 60 seconds.

To further enhance its capabilities, the package can be interfaced with other Micropro business programs, such as WordStar.

CALCSTAR

CalcStar is similar to the popular Visicalc package, but has been specifically configured for CP/M-based systems. It offers the same spread-sheet modelling facilities that make financial modelling and analysis so much easier.

CalcStar features include screen 'windowing' onto a matrix of up to 600 entries arranged to user requirements; and easy programming of user-defined formulae for modelling and simulation.

The package has the advantage of being able to interface directly with the popular WordStar word processing package, and makes use of WordStar command keys. This interfacing allows full management reports incorporating a variety of models and simulations to be prepared easily.

WORDMASTER

Intended primarily for use by programmers, WordMaster provides a comprehensive on-screen text editing capability. It is equipped with a scratch-pad memory facility that allows text to be stored temporarily for subsequent insertion, any number of times, into the file being edited.

WordMaster features include on-screen insertion, and deletion of text; block definition and movement; a wide range of cursor commands such as tab, page and scroll; and the use of the scratch-pad memory to hold complex strings of commands for later execution.

PLANSTAR

A sophisticated financial planning tool.

With PlanStar, plain English is all you need from data input and manipulation to production of finished reports.

Consolidation of many spreadsheets takes just a single command. Virtual Memory allows over 32,000 cells per spreadsheet and 1,000 sheets per project. Since formulae and data are stored separately, temporary worksheets can be used to ask "What-if" questions over and over again, leaving your original data intact.

It comes complete with an indexed and cross-referenced User Manual, on-screen tutorial program, reference card, Help screens and sample models to help you to get started.

PlanStar's editor uses the familiar WordStar commands. The PlanStar window lets you view and modify data as you would with CalcStar. Move data from a DataStar, InfoStar and CalcStar files straight into a PlanStar to give your final reports a truly professional appearance. Or use StarBurst to create your own menus for a customised financial modelling system.

PlanStar also accepts DIF (Data Interchange Format) files and comma-separated ASCII files PlanStar also allows transfer of control to and from your own BASIC program.

SUPERSORT

SuperSort is a powerful and extremely flexible tool for sorting, selecting and merging data from a number of files. Up to 32 separate files can be merged into one file, in most cases at the rate of 560 records per minute, and up to 32 different selection criteria can be specified.

SuperSort features include the integration of new records into a master file with just one operation; acceptance of data in a wide range of forms, including justified or unjustified text that can incorporate floating decimals, exponential notation, or be in a number of standard formats such as binary, BCD or ASCII; the provision of plain English help and error messages; and a maximum record length of 4096 bytes. SuperSort will not sort files larger than 512K bytes.

All the Micropro products can work together to create a comprehensive working system. StarBurst (with an IBM-PC) can even allow you to switch from one package to another by means of menu.

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Still room on the bandwagon

Richard Page looks at three new micros designed to exploit the huge software base which has developed round the IBM PC.

THE IBM PC has now established a position of dominance in the U.K., as it has in the U.S. That dominance is not as complete, perhaps, because of the strength of the ACT Apricot on its home ground, and because of the continuing sales of British eight-bit micros.

Also, IBM does not dominate the U.K. hardware market to quite the same extent as it does the U.S. Its pre-eminent position in the world of serious personal computing is partly the result of two other factors: the massive amount of independent software which has rapidly become available, and the large number of IBM PC compatible micros from other manufacturers.

The IBMulators currently on the market include the Advance 86B, A M Stearns Desktop, Columbia, Compaq, Corona, Direct IPC, Eagle, Ericcson PC, Hyperion, Mad-1, North Star Dimension, Olivetti M-24, OSM PC, Otrona 2001, Seequa Chameleon, Sperry PC, Tava PC, Televideo Tele-PC and Zenith Z-100.

Robert Piper reviewed six of them in the June issue of *PC*, page 70. Three of the most recent to be added are the ITT Xtra, the Aviette PC-16 and the Future Technology Systems PCi, which are reviewed in this article. There are many more to come, particularly from the Taiwanese — see Taiwan Tools Up *PC* June 1984, page 88.

Of course, some products offer advantages over the IBM PC itself — the Olivetti M-24, for example, runs faster. In general, the hardware and software have become pretty much interchangeable. With the planned extension by IBM of its standard through the IBM PCjr — supported by the IBM-comptible add-ons for the BBC, Apple and Atari micros — this interchangeability is likely to become more rather than less pronounced.

IBM has already announced its AT or "Advanced Technology" model in the U.S. — see page 21 of this issue. The PC/AT features the much improved Intel 80286 chip instead of the familiar 8088. When that arrives, it will throw the whole question of IBM compatibility wide open once again.

But it will not be the end of the IBM PC. Like the Apple II and eight-bit CP/M it has established a standard and achieved a volume of sales that ensure it will be around for a considerable time to come.

Keyboards supplied with (from the top) the PCi, PC-16, IBM PC and Xtra.

FUTURE TECHNOLOGY PCi

THE PCi is no run-of-the-mill compatible. By using Digital Research's Concurrent CP/M it adopts a very individual approach to running IBM PC software.

It is manufactured for the OEM market by Future Technology Systems, and is unlikely to be seen in the showrooms under its maker's own name. Versions of the machine will be sold carrying the badges of such famous firms as Honeywell, and others as yet undisclosed. It will also be available direct to end-users in a wide variety of specifications, through the Computer Market chain of stores and known as the CMBI.

The PCi is by no means cheap, and does not as yet display a particularly high level of compatibility. But it uses Concurrent CP/M, which brings several worthwhile benefits, one of them being the ability to do four things at once.

Although it is a three-box machine like the IBM PC, it bears little resemblance to Big Blue's own product. It has a far more purposeful appearance — an impression no doubt partially derived from the bank of LEDs which flash meaningfully every time the machine is booted up. Their function is to aid diagnostics if for any reason a boot cannot be completed successfully. Alongside them there is a 5Mbyte Rodime 5.25in. hard disc and a 5.25in. floppy drive with an unformatted capacity of 1Mbyte. Larger Winchesters are available if needed.

The rear of the unit houses all the

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standard connectors plus two serial communications ports, in addition to the normal serial printer port. There is also a hardware Reset button, but sadly no parallel printer port.

Inside the machine is a full-blown 16-bit 8086 running at a fast 8MHz and coupled to the massive 512K RAM needed to satisfy Concurrent CP/M's huge appetite for memory. If that should not prove sufficient a further 256K can be added to bring the total to 768K. There are five expansion slots, but they are entirely incompatible with PC hardware as the PCi uses a completely different bus.

The standard green-screen monitor displays extremely high-resolution graphics at 800 by 400 pixels. Resolution can be degraded to the IBM standard of 640 by 200 pixels when running PC software. Brightness and contrast are adjustable from the keyboard by pressing the Control and cursor keys simultaneously. The character set, although legible, could have been made more aesthetically pleasing with such powerful graphics available.

The keyboard looks really impressive, but unfortunately it has a detrimental effect on the machine's ability to use unmodified IBM PC software. One of the prime prerequisities of any PC compatible must be to match the IBM keyboard; only minor enhancements like LED status indicators are permissible. The PCi has 13 function keys positioned horizontally along the top of the QWERTY keypad, unlike the PC, which has two vertical rows of five down the left-hand side. Furthermore, the PCi has dedicated cursor-control keys, whereas the IBM PC uses an alternate mode on the numeric keypad to manipulate the cursor.

This means that IBM software will have to be modified so that the keys perform the functions that the operator expects of them. These mods will be beyond the average end-user's capability, and will therefore have to be performed by the PCi's OEMs or by software houses. A further problem will appear when manuals are being prepared: standard IBM software documentation will not match up to the PCi's non-standard keyboard.

The main attraction of Concurrent CP/M is that it permits up to four applications packages to run concurrently. There is only one physical console and the user selects the one required by pressing the Break key followed by a number in the range 0 to 3. The three remaining consoles that are running in the background are referred to as virtual consoles.

So with a spreadsheet busy calculating on console 1, the user can switch to a word processor on console 2 and type a letter. Once that letter is finished it is printed out while the operator updates a database on console 3. Meanwhile the spreadsheet on console 1 can still be recalculating.

IBM software runs under PC-DOS, and will not run directly under Concurrent CP/M, so Digital Research has included an emulation program called PC Mode which will support this feature. At present, Concurrent CP/M's PC Mode will only run IBM software written for use under DOS 1.1, which is something of a major limitation since most modern IBM PC packages only run under DOS 2.0 or later. A modified emulator that is compatible with DOS 2.0 is promised for some time in the future.

Concurrent CP/M is an immensely powerful operating system which will enable moderately priced micros to run effective multi-user systems. The PCi, for instance, can be configured as a three-user setup simply by plugging a dumb terminal into each of the RS-232 comms ports.

Concurrent CP/M also supports overlapping windows which can be used to view four applications at the same time on one screen. Some rather complex key actions are needed to set up the windows but, once perfected, a particular arrangement can be saved to disc for future use. The current window always comes to the foreground and is highlighted by a double-intensity line.

CP/M is rather difficult to master. Early versions had a tendency to crash inexplicably. Though it is still not clear whether all these problems have yet been ironed out, Concurrent CP/M does seem to have given Digital Research the edge over Microsoft, for the moment at least.

Compatibility with the IBM PC was hard to assess as the machine came pre-loaded with PC software on the hard disc and there was no manual to describe the process of running other disc-based packages under PC Mode. Digital Research says that while Concurrent CP/M running on an IBM PC should support up to 90 percent of mainstream PC software, non-IBM-like machines such as the PCi will only achieve between 30 percent to 70 percent compatibility. Future maintains that its fine tuning of the firmware should ensure that the PCi will perform in the upper end of that range.

Future Technology is relying on its OEMs to provide documentation, so none was supplied with the review machine. Hardware support will be provided by a subsidiary of FTS, but precise details have yet to be published.

Conclusions

- **The PCi is a good-looking machine produced by a British company with an enviable reputation.**
- **The hardware specification is far superior to that of the IBM but it can be suitably degraded to run IBM software.**
- **Concurrent CP/M is still in its infancy, and users of PC Mode cannot expect similar levels of compatibility to other more conventional clones for some time yet. But Concurrent CP/M does offer other advantages, such as multi-tasking and windows, which make it attractive in its own right.**
- **The system we tested is sold by Computer Markets as the CMBI-3 and includes only 256K RAM; it costs £4,513. A dual-floppy version with 256K, the CMBI-2, sells at £3,453. It is therefore very expensive compared to conventional compatibles though it is potentially vastly more powerful.**

ITT XTRA

ITT IS ONE of the world's largest high-tech multi-nationals, but there is no doubt that in building the Xtra it is intending to steal as much of the IBM PC's thunder as it possibly can. At present the Xtra is the subject of one of the most forceful promotional campaigns seen since ACT's launch of the Sirius in 1982.

Although not particularly cheap, and bearing little or no outward resemblance to the real thing, the Xtra is an exceptionally well-finished machine. It displays a high degree of compatibility with mainstream IBM PC software — and ITT hopes to give its machine enough impetus to make the other compatibles look like also-rans. The machine we reviewed was a pre-production model, but it showed few indications of this fact. No internal patching could be seen and there was only a minor problem on the display intensity.

The three-box technique is enhanced in the Xtra by the use of a tasteful colour scheme which also extends to the optional colour monitor. The processor unit has an unusual footprint being half an inch deeper, at 15in., than it is wide. This does not leave a lot of room for the keyboard on a normal-size desk, but you can stand the processor on its side on the floor. On the front of the unit are two half-height Qume

320K/360K drives, which performed faultlessly and quietly during the review.

The rear of the unit houses one serial and one parallel port plus the other standard connections for mains supply and monitor. There is no Reset button: all that can be done to restart a stalled program is the often ineffective soft Reset achieved by depressing the Ctrl, Alt and Del simultaneously. ITT obviously decided that the cassette interface and Basic in ROM could be done away with in a dedicated business machine, and has passed on the reduced production costs to the user.

Inside there is an 8088 running at 5MHz, coupled to 128K of memory in the standard machine, and a non-graphics monochrome adaptor, IBM-style. The motherboard is well laid-out, and fitting additional cards into any of the five spare expansion slots is simplicity itself. An extra 128K RAM can be plugged into the motherboard to provide the 256K memory needed to run some of the more interesting applications packages.

A colour-graphics adaptor is available which drives either composite video or RGB monitors. The monochrome monitor is a compact, attractively styled unit available with either a green or amber screen. Designed to sit on top of the processor or straight on the desk top it has a built-in tilt/swivel base.

A combined brightness and contrast control is located on the monitor pedestal. Power is fed from the processor box power supply, so no separate mains connection is needed. The display on the review machine was rather dim, although good enough for use in subdued office lighting. STC was puzzled by this problem, and suspected an incorrectly adjusted preset.

The character set is rather coarse-grained and crude, and not very attractive. Screen persistence is short, and I found the amber hue much more restful than the more conventional green. The optional colour monitor is the proven Princeton Graphics model. Though it bears a striking resemblance to the IBM equivalent, it is a far superior beast. It requires a separate mains lead, but the connecting leads are long enough to allow a more imaginative arrangement of the three-box setup.

The ITT Xtra's keyboard matches the IBM layout, with the addition of LED status indicators on Caps Lock and Num Lock. The casing is more substantial and attractive than many of its rivals and incorporates a clever tilt facility.

Key action is always a matter of personal preference. Although I found it acceptable the keypads felt rather too springy and vague for my liking. The lead connecting the keyboard to the system box is commendably long. Manufacturers who skimp on this item can make themselves very unpopular with the long-suffering operators who have to struggle with taut cables day in day out.

ITT has customised MS-DOS 2 for the Xtra, renaming it ITT DOS 2.11 and including some useful additional utilities. There is an easy-to-use set up program to configure the ports and the display, and an async. communications utility allows the Xtra to be linked with host mainframe computers. One vital but missing utility was the one to configure the keyboard to produce a £ sign, but this should be added soon. Hopefully the correct key will also be included on the keyboard. For those writing their own programs ITT Advanced Basic, equivalent to IBM Basica, is to be included with every system.

STC recommends the use of a parallel-interface daisywheel printer, presumably to keep the serial port free for comms. However, a short description on how to configure the system for serial printers is also included.

With 256K of RAM and the colour-graphics card and monitor, the Xtra ran all the applications packages we could find. It even passed some of the more tricky tests when text and graphics are mixed on the same screen. With the basic 128K of RAM and no graphics its ability to run modern integrated software is severely restricted,

(continued on next page)

	FTS PCi*	ITT XTRA	TASHKL PC-16	IBM PC
PROCESSOR UNIT				
CPU	8086, 8MHz	8088, 5MHz	8088, 4.77MHz	8088, 4.77MHz
RAM	512K	128K	128K	128K
Maximum integral RAM	768K	640K	640K	640K
Disc drive — type	5.25in. floppy, Winchester	Dual half-height floppies	Dual half-height floppies	Dual 5.25in.
— capacity	1Mbyte, 5Mbyte	360K each	360K each	360K each
Spare expansion slots	5, not IBM PC compatible	5	2 long, 3 short	2
Serial ports	3	1	1	1
Parallel ports	none	1	1	1
Dimensions h x w x d (mm.)	150 x 420 x 420	159 x 356 x 394	140 x 508 x 406	140 x 508 x 406
SOFTWARE				
Operating systems	Concurrent CP/M-86	ITT DOS 2.11	MS-DOS version 2	PC-DOS version 2.0
Programming languages	None	ITT Advanced Basic	None	ROM Basic, Disc Basic, Basica
IBM COMPATIBILITY				
Microsoft Flight Simulator	No	Yes, with graphics	Yes	Yes
Microsoft Windows demo	No	Yes, with graphics	Yes	Yes
WordStar	Yes	Yes	Yes	Yes
dBase II	Yes	Yes	Yes	Yes
Oz	not tested	Yes, with 256K and graphics	Yes, with 256K	Yes
Open Access	not tested	Yes, with 256K and graphics	Yes, with 256K	Yes
Microsoft Word	not tested	Yes	Yes	Yes
IBM diagnostics	No	No	No	Yes
Lotus 1-2-3	Yes	Yes, with graphics	Yes	Yes
DISTRIBUTION				
Distributor	Computer Markets	STC Business Systems	Tashkl Computer Systems	IBM
Price	£4,513	£2,104	£1,650	£2,236

*as sold by Computer Markets as the CMBI-3

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but the same could be said of the IBM PC.

The three manuals supplied with the review system were in preliminary format but looked very promising. The Xtra users' guide, the ITT DOS manual and the Advanced Basic manual were well presented and comprehensive.

The Xtra only carries a six-month parts and labour guarantee, and it requires the user to return the unit to the dealer for attention. On-site maintenance agreements are available through CFM Ltd, a subsidiary of STC, at around 12 percent of hardware cost.

Conclusions

● The Xtra is a beautifully finished machine which looks very attractive.

● It displays levels of compatibility on a par with the Compaq, one of the best machines available in this respect.

● The Xtra comes from a respected multinational. Consequently it is not likely to be here today and gone tomorrow.

● At £2,104 it is not that much cheaper than an IBM PC with equivalent spec, and therefore cannot be considered good value for money.

PC-16

THE PC-16 is distributed in the U.K. by Tashkl Computer Systems. It is an unashamed budget PC compatible from a somewhat inscrutable Taiwanese manufacturer. Many other products originating from the Far East are blatant copies of items produced in the West, but the PC-16 displays less resemblance to the real thing than many compatibles produced elsewhere.

Although not quite down in the same price league as the Advance 86, the PC-16 is good value at £1,650. The price includes a guarantee of a year's on-site maintenance, and the machine proved a reliable and compatible performer during the review period.

Superficially, at least, the PC-16 is an IBM look-alike. Closer examination reveals that the left-hand drive space is blank and that two half-height Teac 320K/360K drives are mounted one above the other in the right-hand space.

The rear of the unit includes connections for serial and parallel printers, monochrome monitor, and RGB and composite video colour outputs. In common with most other PC compatibles it has no hardware Reset button.

The top part of the case is quickly removable but is rather too flimsy to support the weight of the monitor without flexing badly. Underneath the covers the most noticeable deviation from the IBM layout is the surprisingly small motherboard. The standard 128K of RAM is located on a separate multi-function board which plugs into one of the expansion slots. This board also provides sockets for a further 128K of RAM, a clock/calendar with battery backup, and the serial and parallel ports.

The PC-16 also includes as standard a colour-graphics card fitted into the next slot. This still leaves two full-length and three half-length spare expansion slots, which should be sufficient for most users' requirements. Into the space in front of the short expansion slots it is possible to fit a hard disc, which will need an additional interface card, or further floppy discs. In operation, the machine is quieter than the PC as it does not have the same irritating throbbing from the fan. The disc drives also seem more pleasant to live with.

The processor unit is the only unknown quantity in a PC-16 system as both he monitor and keyboard are bought in from proven manufacturers. The monochrome unit supplied as standard is a Taxan 12in. model, available with either a green or amber display. It is a good-looking unit which performs well and, although such things are above all a matter of personal preference, the amber-screen version is generally considered less taxing on the eye for prolonged use.

The optional Amdek medium-resolution monitor is a large, rather ugly unit, but it has a good performance and convenient controls. This monitor uses the RGB output as in most compatibles, which means that Microsoft's Flight Simulator cannot be run in colour; a composite-video motor is required to run this program.

The PC-16's keyboard is manufactured by Keytronics, the supplier of PC copy keyboards for around 70 percent of all compatibles. Useful features not found on the IBM are LED status indicators on the Num Lock and Caps Lock keys. A rear-edge tilt device is provided to angle the somewhat springy keys towards the user. There was no £ key on the review machine.

Around the time we were doing the review an agreement was signed with Microsoft to license MS-DOS version 2 for use on the PC-16. There was no Keybuk file to configure the keyboard to produce a £ sign, nor could the serial port parameters be redefined. However, these utilities are pretty standard now, so they should be available by the time the PC-16 reaches the dealers. Prospective purchasers should check that they are.

Breaking with tradition, Tashkl will probably not include any form of Basic interpreter with the machine, but GWBasic or Basica should be available as an extra. Software Ltd has been appointed by the machine's distributor to sell and support all software for PC-16 users.

The review machine was equipped with 256K of RAM and the standard colour-graphics card, so there could be no excuses for not running IBM software. It passed all the relevant compatibility tests, and even ran Microsoft's Windows demo, complete with mouse hardware and all. Like many other PC compatibles, its performance when combining text and graphics was inconsistent on a couple of packages. However, all the major ones ran with no problems.

The documentation supplied with the review machine sometimes read more like a workshop manual than a computer reference book. Sections on use of the multi-function and colourgraphics card were still on oversize loose-leaf sheets which would not fit in the A5 manual.

Presentation was not conducive to easy reading, and there were an unfortunate number of spelling errors. Tashkl says that the production costs on the manual have been kept down to keep the overall price of the PC-16 competitive, but surely the extra price per unit incurred in providing worthwhile documentation cannot add that much to a machine.

The support situation is much better news. Tashkl has eliminated most of the risks associated with the purchase of a Taiwanese product by including with each machine a one-year on-site maintenance agreement through National Advanced Systems. The agreement will guarantee an eight-hour response time to a call-out and will include the cost of all parts and labour.

Conclusions

● At £1,650 the PC-16 is excellent value for money. Although more expensive than the Advance 86B it has a more conventional appearance and is less bulky.

● It proved to be highly compatible with IBM PC software and hardware.

● The one-year on-site maintenance agreement included in the asking price should do a lot to dispel doubts concerning the machine's uncertain origins.

● Both the monitor and the keyboard are made by manufacturers with proven reputations.

● The PC-16 is let down only by its slightly cheap external finish and the poor documentation.

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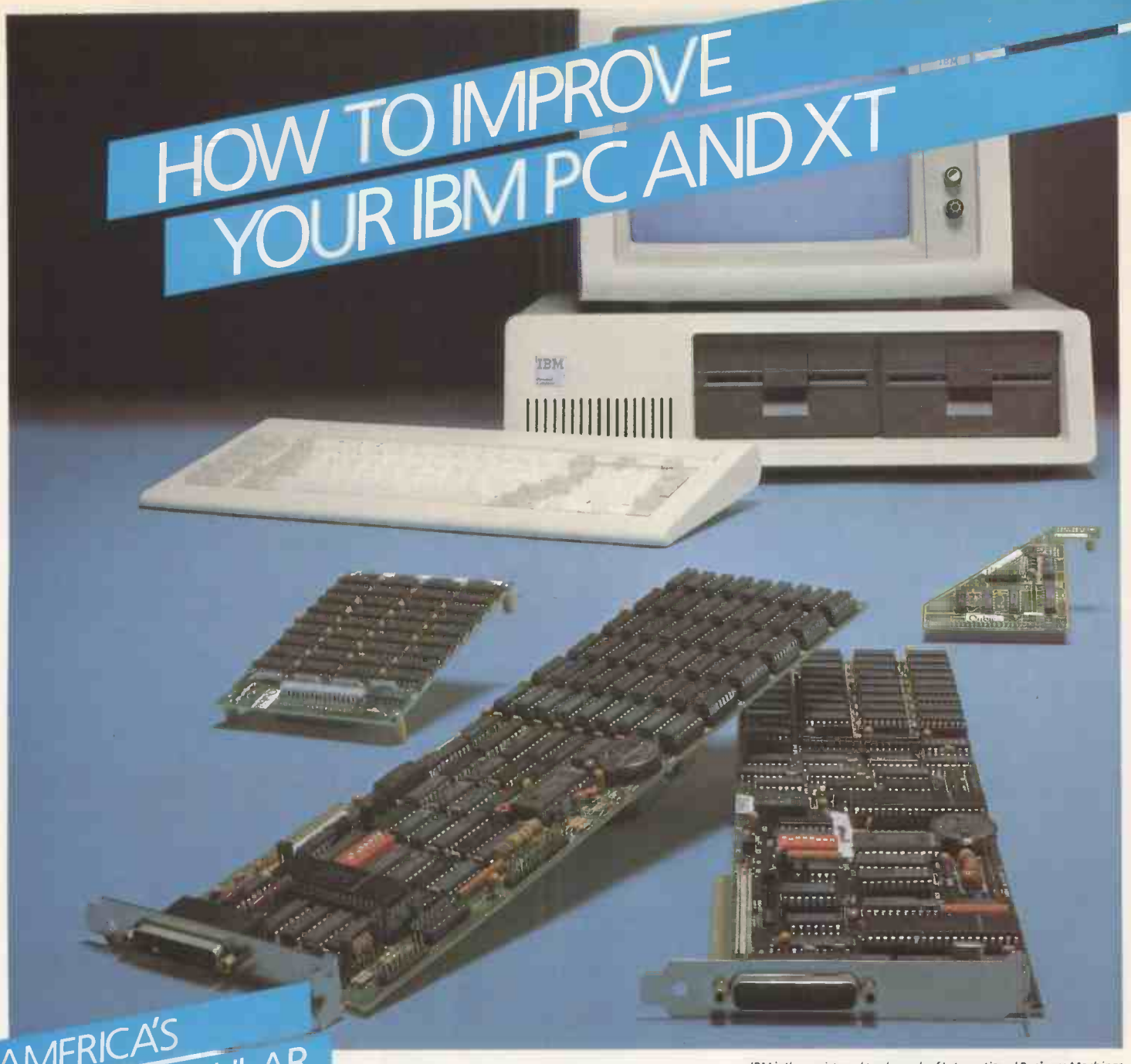

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77

AMSTRAD CPC-464

Can the British hi-fi firm make a successful debut on the home microcomputer scene? Ian Stobie reports.

NOT OFTEN is a machine as pleasant to review as the Amstrad CPC-464. It is easy to set up and use, and the documentation is clear and complete. The screen display is rock steady and the cassette system works. Amstrad, better known for budget hi-fi, has come up with a remarkably impressive home computer at the first attempt.

The Amstrad offering is a mid-range home machine, pitched above the Spectrum and aimed at Commodore 64 and BBC territory. For the money it has a good specification and is very complete. For £349 you get a system with 64K of RAM, a built-in cassette drive and, also included in the price, a 14in. colour monitor. For about £100 less you can get an identical system but with a monochrome monitor. These systems are available now, and Amstrad is reportedly shipping 150,000 CPC-464s to U.K. stores for Christmas.

With a £200 disc drive promised for October, Amstrad is also hoping to appeal to the more ambitious home user. The important thing about the Amstrad disc unit is that it comes with CP/M 2.2, which potentially opens up the huge existing base of commercial CP/M software to the home user. The cost of an Amstrad system suitable for tasks like word processing would work out at around £700, plus the cost of software: £239 for the basic machine with monochrome monitor, £200 for one disc drive and say £250 for a good-quality dot-matrix printer.

Amstrad has obviously taken some care over the styling of its home computer. The CPC-464 is very easy to set up and does not look out of place in normal room. A single cable from the mains goes into the monitor unit; two coiled cables then connect the monitor to the keyboard unit, one carrying the video signal, the other low-voltage power. The Z-80A processor, 64K of RAM, and 32K of software in ROM are housed inside the keyboard unit, along with the cassette drive.

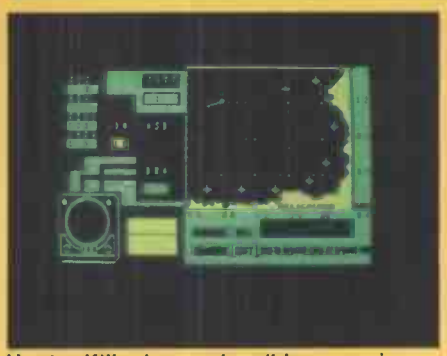
The standard of construction is good; the keyboard in particular is well laid out and easy to type on. Keys are of proper, business-computer type construction and do not embody any bizarre cost-cutting

Benchmarks

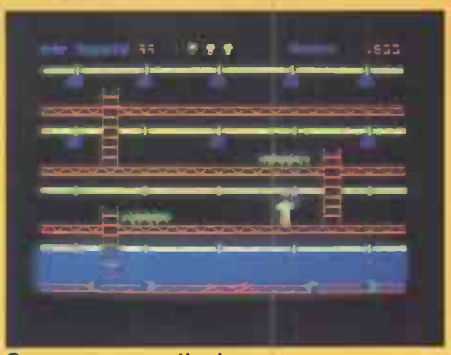
The table shows the time in seconds to run eight standard Basic routines. Our Benchmark routines test out various typical tasks, each repeating an appropriate set of Basic statements 1,000 times. Particularly interesting are the times taken for Benchmarks 7 and 8. Benchmark 7 puts data into an array, while Benchmark 8 uses log and trig functions.

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Av.
Amstrad CPC-464 — Z-80A	1.2	3.4	9.3	9.7	10.3	19.2	30.4	34.3	14.7
BBC Model B — 6502	1.0	3.1	8.3	8.7	9.2	13.9	21.9	52.0	14.8
Sinclair QL — 68008	1.9	5.4	9.3	9.1	11.8	24.0	42.4	20.7	15.6
IBM PC — 8088	1.2	4.8	11.7	12.2	13.4	23.3	37.4	30.0	16.8
Yamaha MSX — Z-80A clone	2.1	6.0	16.6	18.4	19.0	31.7	44.9	216	44.3
Spectrum — Z-80A	4.8	8.7	21.1	20.4	24.0	55.3	80.7	253	58.5

Gems of Strados — nice graphics.

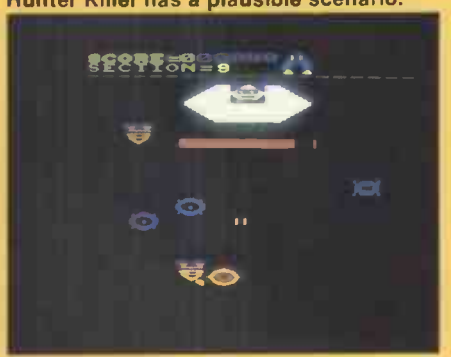


Hunter Killer has a plausible scenario.



Spannerman on the loose.

Sosoft's Electro Freddie.



Shooting 'em up in Laserwarp.

Master Chess saves unfinished games.

technology. The separate numeric keypad doubles as a set of programmable function keys, while the cursor keys are laid out in a sensible pattern for playing games.

Joysticks are not supplied with the system, but one port of the Atari/Commodore type is provided which will take common brands of joystick. Amstrad's own joystick, available as an option, comes equipped with a second port, letting you piggyback two joysticks together. A Centronics-type printer port is also standard.

The colour monitor unit contains an ordinary 14in. TV-type CRT but the display is far steadier than on a domestic TV, and the colours bright. The monochrome monitor also measures 14in. diagonally and has a green screen; colours are displayed as different green intensities. Across 80 columns the monochrome monitor is definitely the easier to read, but as most entertainment software uses colour and only the 40-column text mode, most users will probably go for the colour version.

The CPC-464 is available only with one of these monitors bundled in, even though the system is quite capable of driving a domestic TV through Amstrad's optional £30 TV adaptor. If you already own a suitable display this policy may seem unreasonable, but given Amstrad's high production volumes the extra cost attributable to the monitor is probably low.

Transportable

The TV adaptor itself contains a 5V power supply for the keyboard unit. Keyboard and TV adaptor together weigh less than 4kg., making this combination quite portable if you are going out somewhere where there is a TV.

The Amstrad has three display modes, all of which offer mixed text and graphics and a choice of colours. The highest-resolution mode gives you 25 lines of text across 80 columns with 200- by 640-dot graphics. Medium resolution is 25 lines by 40 columns with 200- by 320-dot graphics, while low resolution offers you 25 lines by 20 columns with 200- by 160-dot graphics. The number of colours you can use at one time depends on the mode — two in high resolution, four in medium resolution and a total of 16 in low resolution.

Serious use

We did not have the CP/M disc system to review, though it is scheduled for October and is of undoubted interest. Amstrad is offering CP/M not so much to pass its machine off as a budget business system, but in recognition of the fact that many people wish to use more serious software at home.

As 16-bit MS-DOS takes over the lead further up the market in the office sector, Digital Research's CP/M 2.2 seems to be getting a new lease of life by migrating to ever-cheaper machines. Old CP/M business packages are being recycled at lower prices to a new mass market. It is too early to say what products will be available on the CPC-464, but Amstrad is confident that many of the old favourites like WordStar will make it across to its machine.

The Amstrad disc drive is built around a Hitachi-type 3in. mechanism. It gives you a formatted capacity of 180K on one side of the neat, plastic-encased media; you can then manually turn over and use 180K on the flip side. The choice of the Hitachi system might seem odd, as the competing Sony 3.5in. discs are very reliable and seem to be winning most of the micro-floppy market. But Hitachi drives are cheaper, and it is easier to convert software on to them from more traditional media.

The Amstrad disc unit can have a second, optional drive plugged into it, which can be either a second 3in. Hitachi drive or a standard single-sided double-density

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5.25in. drive. Amstrad itself will be offering only a second 3in. drive costing £160, but some software houses are already hitching up standard floppy units to copy their products across.

Software announced so far for the disc system is mostly languages and utilities, with the application packagess still to come. Logo — the Digital Research version — will come included in the price with the disc system. C, Forth and Pascal are under development. Amsoft plans to offer an integrated word-processing/spreadsheet/business-graphics/database package, the individual components of which are under development at the moment by software houses Tasman and Saxon.

Some serious packages are available on cassette. Amsword is similar to Tasman Software's word-processing program for the Spectrum and costs £20, as does a spreadsheet called Amscalc. Cassette-based Z-80 assemblers are available from both Kuma and Hisoft. Amstrad says that cassette data files should in many cases transfer across to disc quite easily; the CP/M BIOS has been written to allow this to be done.

First games

We looked at the first crop of games and educational programs, leaving the serious stuff to a follow-up article when we get a disc drive. The games were of average rather than outstanding Spectrum quality, but this is not bad for a small sample of the eight games first off the launch pad. All these programs, except the Kuma ones, are available from Amstrad's software arm, Amsoft, as well as fom the originating software houses. For the Kuma games contact Kuma Computer Ltd, telephone Pangbourne (07357) 4335. The price is £8.95 including VAT unless otherwise stated, which is high by Spectrum standards.

At this stage in the machine's life quantity of software is probably no less important than quality. Most of the important home-computer software houses are interested in the Amstrad, especially Spectrum houses used to writing in Z-80 code. Many software houses have noted the Amstrad's similarity in specification to the Japanese MSX machines and are simultaneously developing software for both environments. Amstrad has adopted a very open policy towards third-party suppliers, offering both technical information and marketing support.

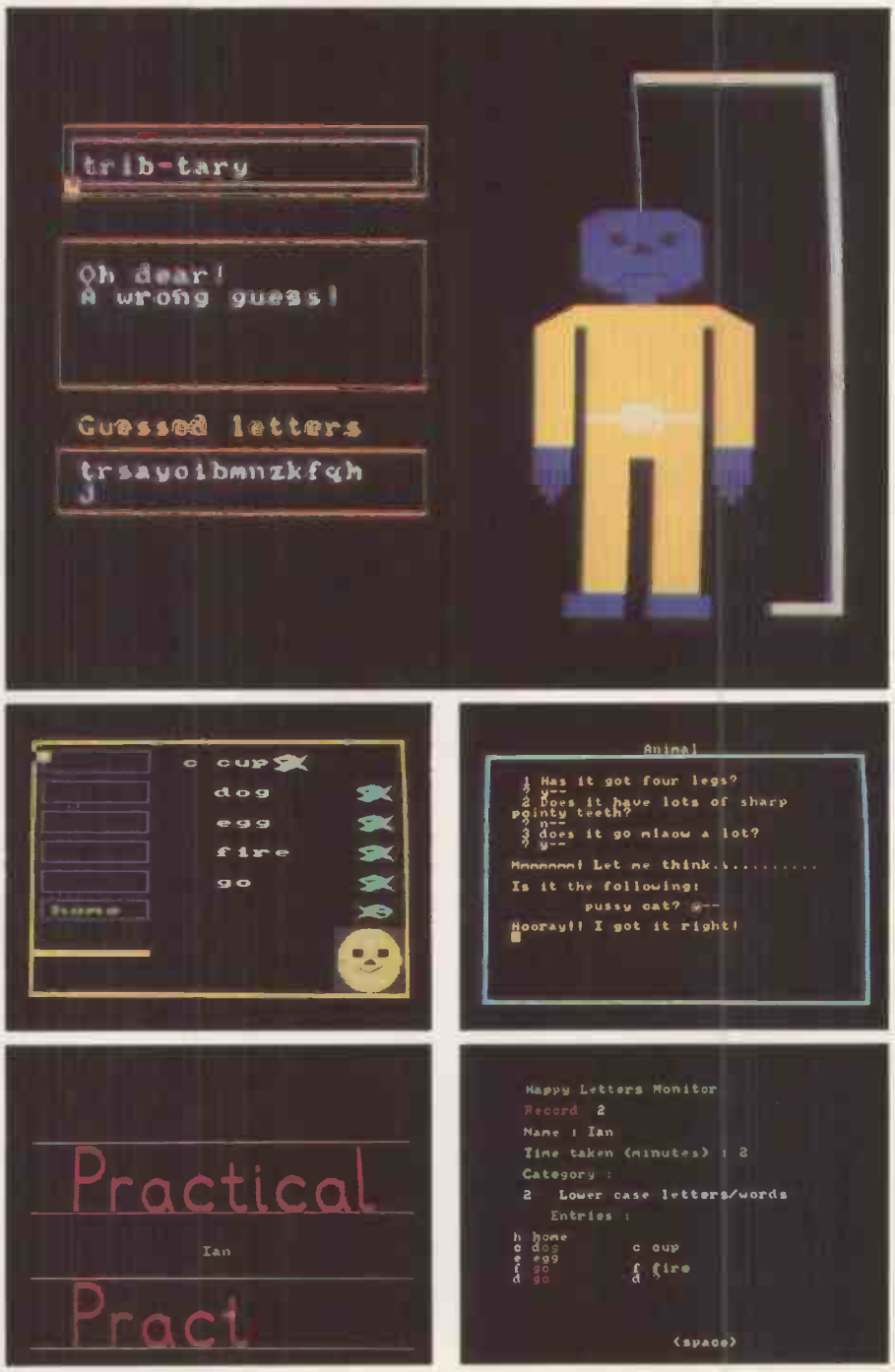
The Amstrad's excellent Basic was written by a U.K.-based company, Locomotive Software. The syntax of most commands is close to Microsoft Basic, but specific Amstrad features like graphics and sound are well supported, and there are some unusual and very powerful new commands.

Of the Amstrad's 64K of RAM, 16K is used for mapping the display and just over 5K is used by the operating system, which leaves a very respectable 42.5K for use by Basic programmers. The Amstrad manages to have a full 64K of RAM memory as well as 32K of built-in ROM, despite the fact that the Z-80's total address space is only 64K. This is achieved by a clever automatic bank-switching arrangement which overlays the ROM into the same address space whenever it is required.

The results of running our Benchmark routine show the Basic to be very fast: faster, in fact, than the QL and the BBC Micro. What is more, the CPC-464 is more accurate than Sinclair's 68008-based wonder machine: the Amstrad displays numeric variables to nine significant digits while the QL manages just eight significant digits.

A good selection of graphics commands helps put this speed to good effect in creating effective displays. Both relative and absolute drawing and plotting commands are provided, and they all have the same syntax regardless of graphics mode. No sprites are provided, but fast animation effects can be achieved using the Symbol, Locate and Ink commands. Symbol lets you create your own user-defined character set; Locate repositions the cursor; Ink replaces a given colour with another from the palette of 27 possible hues.

The Amstrad uses the same sound chip as



Bourne's educational programs are well matched to their intended users. Illustrations show (from the top) Wordhang, Happy Letters, Animal/Vegetable/Mineral, Happy Writing and the assessemnt screen provided in all the Bourne packages.

the Oric and all the MSX machines, but the Basic controls it in a different way. The chip provides three independent channels each with a range of eight octaves. On the Amstrad, sound is output to the built-in speaker, and also to a hi-fi socket which splits the three channels to produce a stereo effect when connected up to an amplifier or headphones.

The simplest sound command takes the form of

SOUND<channel, tone, duration>

More complex commands give you a great deal of control of the shape of the waveform, letting you specify both volume and tone envelopes, in the way that you can with a synthesiser. Unfortunately the Amstrad's manual has a rather compressed discussion of these facilities.

Very unusually for an eight-bit home micro, the Amstrad has interrupt-driven timers available to the Basic programmer. The Basic commands take the form of

EVERY<n ticks>GOSUB

or

AFTER<n ticks>GOSUB

Because each of the four independent timers is interrupt-driven there is no need to check them; they interrupt your code as it is executed and divert program flow to the specified subroutine. These instructions greatly simplify writing programs where, for instance, you need to check periodically the status of a few keys, or if you regularly have to send an object flying across the screen.

The programmer also gets good editing and debugging facilities. I particularly like the way the Amstrad's copy-cursor editing system works, letting you selectively re-enter text already displayed somewhere on the screen, as on the BBC Micro. Traditional line-orientated editing is also available. Listing to the screen can easily be stopped and restarted, and programs can be renumbered. Most usefully, programs in memory can be merged with fragments of code loaded from cassette.

Amstrad's documentation is very good. The users' guide which comes with the

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Amstrad software

Electro Freddie from Sosoft is a typical Spectrum cutie game. A Clive Sinclair look-alike figure rather unconvincingly called Claude comes at you as you try to push home computers on to a conveyor belt to ship them out of the factory. He throws Spectrums at you while Orics rain down from the roof. It is quite playable, with four different screens, but nothing brilliant. Rating: 11/20.

Spannerman from Gem Software is more inventive, with an even cuter scenario. You, the village plumber, are in your local earthquake-struck nuclear power plant trying to fix leaks with your trusty spanner. As the radioactive water level rises and debris rains down you rush to tighten up the ever-deteriorating pipework, kicking aside any of the giant mutant power-station rats that assail you. This game has nice noise effects and five levels of difficulty. It is a little like Donkey Kong. Rating: 16/20

Hunter Killer from Protek is a simulation game, with you crewing a Second World War submarine. The task is to seek out and torpedo enemy subs in the Heligoland Bight area — the problem is both to find the things and to avoid disaster from both enemy fire and your own incompetence. As in most similar games the graphics are rather static, but the simulation seems plausibly accurate and the program notes are good. Rating: 12/20.

Master Chess from Mikro-Gen, still at £8.95, is in a rather different league. The playing standard seems to be high, although this is hard to tell as most chess programs smash me with little effort. The facilities provided are good: you can save half-completed games, set up chess problems, get the program's recommendations for your own moves and flip between different levels of play. Rating: 16/20.

Laserwarp, also from Mikro-Gen, is straightforward shoot-'em-up stuff. There are nine screens, but little changes except the shape of the things coming at you. Your own movements are rather restricted. The graphics are good and the difficulty level quite high, but the underlying Space Invaders concept is a little threadbare. Rating: 8/20.

Gems of Strados from Kuma at £7.95 is a typical adventure game. You wander around a maze of interconnected rooms, picking up objects and seeking a treasure. This one has good instructions and a nice maze display in low-resolution Amstrad graphics. But it also features instant death in ways you cannot avoid, so I found it frustrating. Adventure afficionados might rate it higher, but I give it only 8/20.

Holdfast from Kuma at £5.95 is billed as a non-violent simulation game. We had a preliminary version to review which was text only, but graphics are promised. You are trying to get a clinic and school for your village, but the militaristic government of Dictatoria, where you live, has other priorities. The problem is to force them to make concessions rather than wipe you out. The program presents various options and then tells you what happens. Rating: 12/20.

Happy Writing is one of four educational offerings from Bourne Educational Software. Most commercial educational programs are fairly poor, so it was with low expectations that I loaded the Bourne offerings. But they turned out to be thoughtfully put together and correspond closely to the age ranges suggested. They are priced at £18.95 each. Happy Writing puts the computer to good use teaching three- to six-year-olds how to write. A moving dot on the screen demonstrates the way letters are formed, and the child is then prompted to copy them with paper and pencil. This sounds rather simple, but it is nicely done, with clear graphics and a few sound effects.

Happy Letters is also aimed at the same age group. Here the object is to get children to recognise letters and to grasp that upper- and lower-case letters mean the same. Several words are displayed on the screen. A moving letter then appears and the child has to hit the Enter key when it is next to a word beginning with the same letter. If the match is correct a fish moves across and gobbles the word. A number of options offer easier or harder words, but this is the general idea. Like all Bourne's educational programs, Happy Letters collects data on how the player is performing. Summaries of the last five players can be displayed, so a supervising adult can come back later to see how things are going.

Wordhang is a fairly stralghtforward Hangman program, recommended for age five upwards. According to Bourne, Wordhang should encourage children to learn to spell. The program already knows 250 words of varying difficulty. As with the other Bourne programs, players have the option of entering their own words.

Animal/Vegetable/Mineral, for age seven upwards, is a version of the familiar computer game Animals. Here the educational pay-off is in demystifying the computer as the child is actually teaching the computer new things, not the other way round. The player thinks of an object and the program then asks questions about it, each having a yes or no answer. Eventually the computer makes a guess; if this is wrong the child then types in what he or she was thinking of and then suggests a question which the computer could ask to distinguish between the new object and the wrong guess. Even with adults this game has great power to give a feeling of how computers really work — that is quite stupidly and only with information they have already been given.

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system is comprehensive, with a glossary, index and separate easy beginners' section. However, I found the chapters on sound and graphics rather confusingly presented. A cassette-based tutorial guide is available for a steep £19.95.

Two additional manuals intended for professional software developers are available also at £19.95 each. One is a Basic reference manual; the other details the operating system and Basic routines contained in the 32K ROM. Few home micros can have had so much information available about them so early in their lives.

Conclusions

● I am aware this is a rave review, but we don't do them very often in *Practical Computing* and it is a relief to find something at the home end of the market that deserves it.

● The Amstrad is a very refined home computer. It is stylish in appearance and well built. Its specification combines the best features of its strongest competitors: 64K of RAM, good graphics and sound, 80-column display and a proper keyboard. The all-in-one concept, with cassette and display included in the price, makes the system easy to set up and use; it also makes the system simple to buy.

● A machine based around the eight-bit Z-80 may seem conservative now that the Sinclair QL has supposedly burst on to the scene. But in performance terms the Amstrad machine turns out to be faster; in our Benchmark tests its average figure is better than any home computer we have tested, including the QL and the BBC. And most important, Amstrad has been able to deliver working machines in quantity.

● Against the heavily hyped MSX machines, the Amstrad stands up well. It boasts a standard 64K against varying — usually smaller — quantities of memory in the Japanese machines. Again, the Amstrad is actually available now.

● The expandability of the Amstrad system is good, with provision for attaching printers and other third-party add-ons. Amstrad's promised disc drive offers CP/M, which must be of considerable interest to those interested in doing more than playing games.

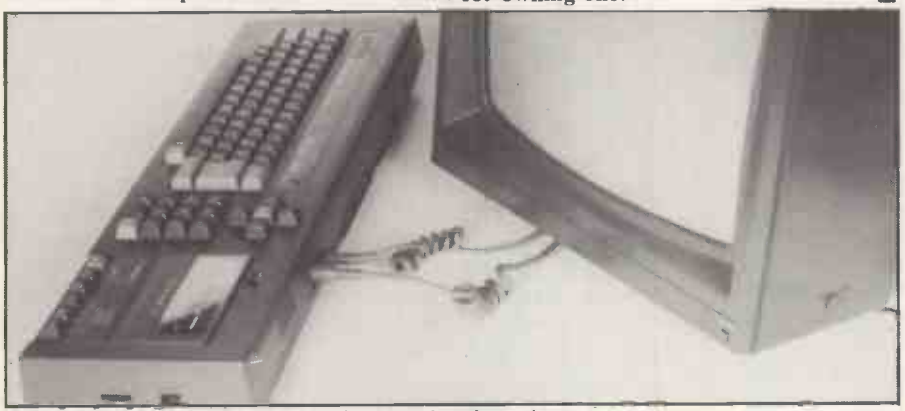
● The initial range of software is encouraging. None of the programs we reviewed were brilliant but, on a small sample, the quality is average to good. The Bourne Educational Software range of programs, also available on the BBC Micro and Electron, deserve the attention of anyone with small children.

● The documentation is of unparalleled completeness for a product at this stage in its life. The user manual which comes with the system is very thorough, although at some points a bit confusing.

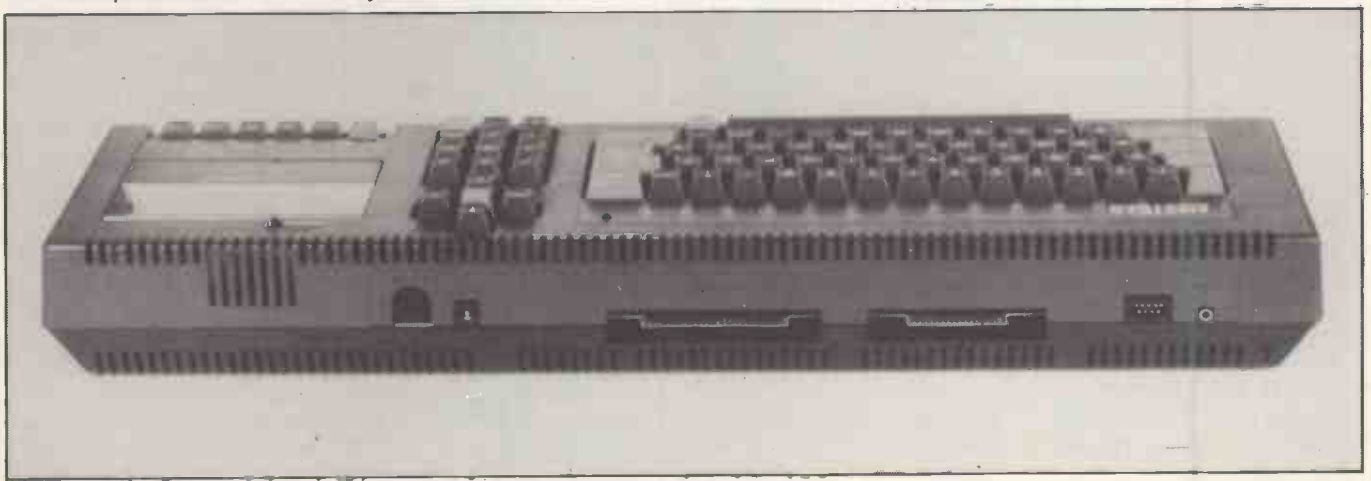
● The CPC-464 is a very competent machine, very competently sold and supported. It will undoubtedly sell in large numbers, which is a further good reason for owning one.

Specification

CPU: eight-bit Z-80A running at 4MHz
Memory: 64K RAM; 32K ROM containing Basic and Amstrad operating system
Display: 14in. colour or a green monochrome monitor included in the price; optional £30 adaptor is available to drive a domestic TV; three screen modes give 25 lines of 20-, 40- or 80-column text and graphics in three resolutions: 200 vertical dots by 160, 320 or 640 horizontally; text and graphics can be mixed and colours chosen from a palette of 27 shades; up to 16 different colours available at a time, depending on mode
Sound: three-channel eight-octave sound with tone and volume envelopes and white-noise generator, programmable from Basic; built-in speaker and stereo headphone output socket; uses AY-8912 sound chip
Cassette: built-in tape cassette deck for program and data storage; transfer speed software selectable, with pre-recorded cassettes automatically loading at either 1,000 or 2,000 bits per second
Discs: optional 3in. Hitachi disc drive, 180K per side, promised for October; drive will come with CP/M version 2.2 and Digital Research's Logo in the £199.95 price; additional second drive unit to cost £159.95
Interfaces: Joystick port, parallel printer port, stereo sound output, RGB monitor output, expansion bus for discs and other optional add-ons
Size: Keyboard dimensions 570mm. (22.4in.) by 165mm. (6.5in.) by 70mm. (28in.); colour monitor 365mm. (16.3in.) by 360mm. (14.2in.) by 340mm.(13.4in.)
Weight: keyboard weighs 2.4kg. (5.3lb.); colour monitor 10.6kg. (23.4lb.); monochrome monitor 6.3kg. (13.9lb.), optional TV adaptor 1.4kg. (3.1lb.).
U.K. price: £349 including VAT for Amstrad with 64K of RAM, built-in cassette and 14in. colour monitor; monochrome version costs £239
Manufacturer: made in Korea for U.K.-based Amstrad Consumer Electronics plc
U.K. distribution: Amstrad, 169 Kings Road, Brentwood, Essex CM14 4EF; telephone (0277) 228888; available immediately



Video and power cables connect keyboard and monitor.



From the left: monitor, power, disc, printer, joystick and stereo/audio interfaces.

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CASU MICRO-PX

Chris Bidmead checks out this 16-bit micro for users who need speed and power without the embellishments of the latest commercial software.

THE CASU MICRO-PX(S)20 is a true 16-bit micro built around the Intel 80186 upgrade of the familiar 8086. Inside the 12.5in. square by 3.5in. high case, a harnessed pair of 3.5in. Winchesters give a backing store capacity of 20Mbyte. A similar sized double-sided floppy drive adds a further 800K — if you can lay your hands on the double-sided discs. The internal 128K of RAM is enhanceable to 256K by the addition of another board. Altogether this remarkably small British micro makes the IBM PC look like an oversized, overpriced piece of hardware.

However, at present the Casu Micro-PX is not in competition with that ubiquitous box. It comes only with Concurrent CP/M 3.1, in a restricted version designed to drive serial terminals. There is no status line, no opportunity for windowing, and the screen scrolls in an undisciplined manner when switching between virtual terminals. Worst of all for the user accustomed to the latest version of Concurrent CP/M on the IBM PC, there is no PC mode. So popular software packages like Lotus 1-2-3 cannot be run, even if you could get them across to the 3.5in. format.

A largely British-made machine built round the 80186 CPU.

Casu does not expect the PX to make a dent in the proliferating IBM and IBM-compatible market. Also, at the time of writing the company has not put MS-DOS on the machine, although there are plans to move in that direction, after adding a memory-mapped screen. It plans to evaluate the PC mode of Concurrent CP/M before seeing whether MS-DOS is necessary. In this sense, Casu admits that the current machine is an intermediate product.

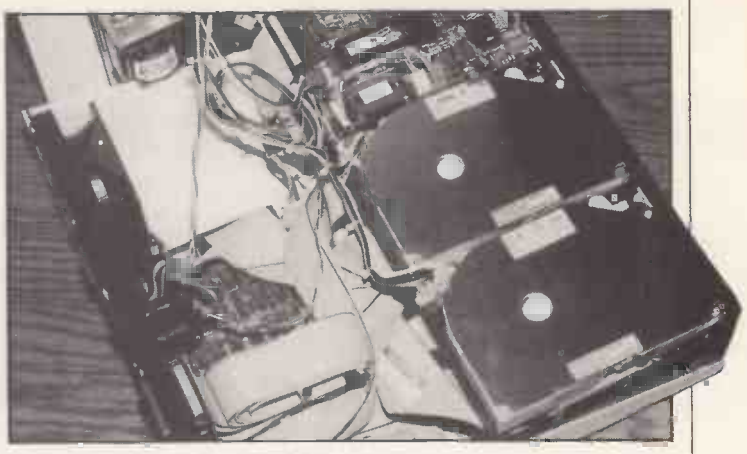
Blocking the path to MS-DOS, should it become desirable, is a large hardware hurdle. The elegant 3.5in. drives, formatted to Casu's own specification, are physically incompatible with the IBM PC's standard MS-DOS 5.25in. format, although electrically and electronically the new small drives perform to the same specifications.

Protected

With the copy of ASCOM that Casu was able to supply it was possible to download software by way of the RS-232 port. However, protected software like Lotus 1-2-3 requires the presence of a soft-dongled distribution disc in the drive. Microsoft is another company that is beginning to lock up its products with system-specific kludges like artificial bad sectors. Unlike the Apricot, the Casu is not backed by the massive market presence that enables ACT to pressurise IBM software vendors to produce special customised versions. So even if the Casu PX achieves IBM compatibility in all other respects, the drives will defeat attempts to run many of the best-selling MS-DOS packages.

The review machine was supplied with a Televideo 924, an ergonomically pleasing terminal with a tilting and swivelling green monochrome screen that stands neatly on top of the processor box and matches the system well. Televideo is the standard terminal for the Casu PX, and has the advantage of running at 19,200 baud.

The front panel of the central processor is plain and simple: a 3.5in. drive slot and an LED to indicate hard disc access. The main power switch is at the back of the central processor case, together with the Reset button and the a.c. outlet for the



Two 3.5in. Winchesters and a double-sided 3.5in. floppy are tucked into a box little more than 12in. square.

VDU, so only one mains cable is needed. Six 25-way D-type connectors are also found on the back panel, but this communications cornucopia proves illusory since only two of them are active on the standard system; they are wired for the serial console and printer. The other four D-sockets are unconnected, awaiting expansion. No Centronics port is available.

Getting inside the case is a simple matter of loosening a pair of bolts and sliding the lid forward until it is free. The internal layout confirms the impression of compact, well thought out design. Casu's own switch-mode power-supply unit lifts away with the lid, leaving the 3in. fan as the prominent feature of the back panel.

Three discs

The three miniature drives — one Epson floppy and two Winchesters from Rodime — form an orderly row behind the front panel. On production models you might find Teac or Sony floppies there, as they are completely compatible. Beneath the drives lies the main logic board, a crucial component that comprises the whole of the electronics except for the Winchester controller. The version on the review machine appeared to be made in the U.S. by Slicer, but we understand that Casu is now licensed to manufacture the board in its Uxbridge factory. When the memory-mapped IBM-compatible board comes, it too will be a Slicer design licensed for Uxbridge manufacture.

It measures a mere 6in. by 12in., its compactness being achieved partly by piggybacking the 64K memory chips one on top of another. Two tightly packed rows of eight chips, double-deckered, manage to squeeze 256K into a space smaller than that taken up by 128K on most systems. The board does in fact provide a Centronics parallel port, but Casu does not connect it to the outside world because none of its customers has asked for it. One modern requirement missing in a world of operating systems that provide for automatic time and date was a battery-backed real-time clock.

There was evidence of an expansion bus, and the posts at the corners of the board suggest that a second board, perhaps to drive the spare ports, may be mounted internally. Given the already tight component packing, heat might become a problem. If you need to enhance memory beyond 256K — the documentation suggests that 1Mbyte is on the cards — or add another drive, provision is made to upgrade to the Super-PX, which is in effect the same micro in a bigger box.

Little can be said about the software that comes with the system since the Casu was delivered with WordStar as the only applications software. The version supplied was not the latest concurrent WordStar, and there were problems when running the same code from two different virtual consoles. Because of the way the serial terminal is implemented, when switching virtual consoles back to WordStar the previous screen image failed to clear properly. Concurrent CP/M was almost all there, together with some utilities supplied by Casu. The Concurrent CP/M command Print was not implemented, and neither was Chset. The command Date was there but Date C command did not work.

Casu's software showed evidence of the sort of sharp edges that appear in in-house software not yet exposed to the rough-and-tumble of customer reaction. Also the poor documentation did not help. Programs to do quite simple system assignments like changing the baud rate and protocol of the RS-232 ports were screen-orientated, which is fine for a memory-mapped system but introduces unnecessary complications if you want to switch from the Televideo terminal to one of your own choice. There was a program to install a new terminal, but on power-up the PX firmware insists on sending a Televideo Clear Screen command, indicating that Casu has not thought through the implications.

The formatting program PXFform offers formatting for 8in. and 5.25in. drives, and a note in the manual points out that the latter option can also be used for 3.5in. drives. It does not point out that you have to select drive A: in order to format drive C:.

Specification

CPU: Intel 80186 running at 6MHz or 8MHz
RAM: 256K, optional maximum 1Mbyte in 256K increments
Discs: single 3.5in. double-sided double-density drive floppy, two 3.5in. 10Mbyte internal Winchester drives
Interfaces: tape, two RS-232 ports for console and printer, printer port
Display: Televideo 12in. monochrome green screen 24 lines of 80 characters plus status line; characters formed on a seven- by eight-dot matrix; eight different character sets
Keyboard: detached; 16 programmable function keys doubling up to 32 held in non-volatile RAM
Dimensions: 317mm. (12.5in.) by 317mm. (12.5in.) by 89mm. (3.5In.)
Weight: 7kg. (15.4lb.)
Operating system: Concurrent CP/M-86 version 3.1
U.K. price: £3,450; Televideo terminal £470; range starts at £1,650 for a single-floppy system to £6,025 for a 40Mbyte hard disc system with 0.25in. magnetic tape cartridge backup
U.K. supplier: Casu Electronics Ltd, Arundel Road, Uxbridge Industrial Estate, Uxbridge, Middlesex. Telephone: 01-561 6820

Conclusions

- **The Casu Micro-PX(S)20 is a powerful and fast Concurrent CP/M micro for users who do not need the flourishes of the latest commercial applications software, but do need big disc capacity, speed and the access to the impressive range of compilers and utilities now in the Digital Research stable.**
- **A British firm that uses largely British-made components is probably good news when it comes to support. But without a dealer network you will have to make your own arrangements with Casu.**
- **A price of £3,450 for a 20Mbyte machine looks like excellent value for money.**

APRICOT F1

ACT makes a strong pitch for the first-time business buyer with a cheap but usable MS-DOS micro that allows plenty of scope for upgrading.

ACT'S LATEST addition to the Apricot family has been designed specifically to fit into a particular niche in the micro market. It is a 16-bit business micro with 256K RAM and a 720K 3.5in. floppy selling for under £1,000 — though this does not include the cost of a monitor. Colour-display circuitry is included as standard, as well as a cordless infrared keyboard, and RS-232 and Centronics ports.

Unusual design

Externally, the F1 is rather unusual in design, being narrow, low and deep. At the back there are the RS-232 and Centronics ports, and RGB and composite monitor outputs. One expansion slot is provided internally, as well as an Intel bus that allows an expansion box with a further five slots to be added.

Another novelty is that the keyboard is linked to the main unit by infrared. The sensor is located on the left of the front face. Although this is neat technology, in practice you have to be rather precise in the positioning of the keyboard. Paradoxically, this liberated keyboard is more constrained in its use than one using the conventional coiled flex.

A small hole over the infrared detector allows you to replace the cordless link with a fibre-optic light pipe supplied with the machine. There is also a second hole that can be used for an optional infrared mouse, which doubles as a trackball when lying on its back. Although the same light frequency is used, different codes ensure that mouse and keyboard commands are distinguishable.

As well as the full complement of QWERTY keys there are 10 function keys, a numeric pad and cursor keys. The overall appearance of the keyboard unit is rather more stylish than that of its chunkier Apricot PC predecessor. The contoured keys used throughout look very neat, but in practice it is only too easy to strike two at once. The feel of the keyboard is far better than on the previous Apricot keyboards, which are very light and can tire your hands quickly.

Auto-repeat rates and time and date are set by pressing small buttons located along the top of the keyboard. They replace some of the labyrinthine command trees called up from the main manager menu, which formed the opening menu on the older system.

Icon-based format

When the system is booted up, the first screen uses a new icon-based format. You select applications by using either the mouse/trackball or the cursor-control keys to move a small cursor across the screen on to the appropriate icon. It is also possible to invoke commands or run programs directly from MS-DOS.

Icons for each application available

The Apricot family

For a company that began manufacturing micros less than 18 months ago, ACT has gone a long way fast. The first Apricot PC was launched in June 1983 and included pioneering features such as the use of 3.5in. discs. Since then ACT has launched the hard disc version, the XI. It crept in almost without being noticed in April this year. Both 5Mbyte and 10Mbyte versions are available.

The addition of a Winchester increases the power of the Apricot enormously. Its transportability means that you can carry around a full 16-bit micro with enough storage to satisfy even the most profligate of memory users. The Winchester head is locked securely when the machine is turned off, protecting it while in transit. The machine on which this review was written has so far withstood without any obvious ill-effects the bangs and bonks of being carted around for several weeks.

Any inadequacies in the Apricot's design have been in far more mundane areas. For example, with an integral modem fitted, the telephone cable trails rather inelegantly while the unit is being transported. The same goes for the keyboard lead; to stand the system box upright on the ground you have to detach the lead, but it cannot be unplugged from the keyboard for easy stowage.

In June ACT launched its most recent Apricot products: the F1 and F1E, a new transportable with a liquid crystal display, and two local area networks. The contrast with the demure release of the XI could hardly have been greater. The entire Royal Albert Hall in London was hired, along with the inevitable tasteless ACT dancing girls, Ned Sherrin and the man billed as the first micro comedian, Ronnie Corbett. One of the intentions of this inflated PR exercise was to emphasise that the Apricot family had suddenly come of age!

In technical terms it is the Apricot Portable that is the most impressive machine of the range. Apart from offering one of the fabled 25-line by 80-character LCDs — this one from Hitachi — it also sports voice recognition as standard. It was only recently that Texas Instruments introduced one of the first variable voice systems for business micros. Now ACT is offering it as part of a micro costing little more than the TI add-on — reviewed in last month's *PC*.

The technology is very similar, except that the Apricot Portable does not offer the dictation feature of the TI Professional, nor any of its telephone facilities. Otherwise the same kind of voice-training techniques and keyword vocabularies found in the TI system are used by the Apricot.

The Apricot Portable is fully compatible with the machines in the range, uses the same 8086 processor and comes with 256K RAM as standard. A single 720K 3.5in. microfloppy is built into the side of the rather original-looking machine, which resembles a large dark-grey Toblerone bar. At the right-hand side of the machine is a small microphone attached by a self-retracting lead.

The Portable shares with the F1 features such as the

The F1 keyboard has to be positioned precisely to maintain its infrared link.

from the disc currently loaded appear on the left of the central part of the screen. Along the bottom are icons for a range of utilities. You only need to point the cursor in the general direction of the desired icon. The software will then complete the movement.

Next to the main icon area there is displayed a directory of files which are executable under MS-DOS — that is, those with extensions of .Come, .Exe or .Bat. After you have placed the cusor over the relevant file, pressing Enter highlights it and Return then runs it. Finally there is a command line above the lower icons which accepts alphanumeric input from the keyboard and attempts to implement it as an MS-DOS command.

Of the lower icons, the rightmost one exits to the operating system. The Help function, represented by a ?, can be used from within any other operation. The disc icon handles all copying and formatting of discs; when a Winchester is attached the icon switches to a drum-shaped figure, representing the hard disc.

From a further menu called up by the utilities icon you can edit icons, character founts and keyboard set, and alter the system configuration. To the left of the utilities is the file-management icon which copies, renames and deletes files. The final left-hand icon, represented by a hand, is the Activity icon; it enables you to return to the first command menu directly without having to pass back up through the whole command tree of icon menus.

Sophisticated

The icon editor uses Macpaint-like techniques, with various colours and stipples available. There are also more sophisticated functions such as cut-and-paste. The keyboard editor allows various parameters to be specified for each key: for example, the effect Shift and Control will have and whether the Auto-repeat applies.

The character-fount generator works on a standard pixel grid. It enables you to add to or modify standard founts, or even build up entire tailor-made character sets. A fount may contain up to 256 characters.

One advanced feature is the ability of

(continued on next page)

cordless infrared keyboard, optional mouse, one expansion slot, RS-232 and Centronics interfaces, a port for colour monitor and the same bundled software. The keyboard and main unit can be stowed in a carrying case for easier carrying. The whole system weighs 13lb. and costs £1,695 plus VAT.

Interestingly enough, many of the 2,500 dealers whom ACT claimed attended the June launch were more impressed by the other products announced that day: two local area networks, allowing respectively seven and 32 users to be hooked up. Point 7 uses an enhanced Apricot XI together with a six-terminal cluster controller to link up to seven micros. The six terminals can be any Apricot, Sirius or IBM PC machine.

There are two alternative modes of operating Point 7. The system can operate under Multi-user Concurrent-DOS from Digital Research, effectively functioning as a seven-terminal system with access to the central Winchester. Alternatively, some of the micros can operate as stand-alones, thereby enhancing the overall system performance.

ACT offers a multi-user variant of the ACT-Diary package, which enables a group diary to be maintained in the multi-user environment. Other software from the ACT Pulsar range will also be available. The cost of the modified Apricot XI and controller is £3,795 plus VAT.

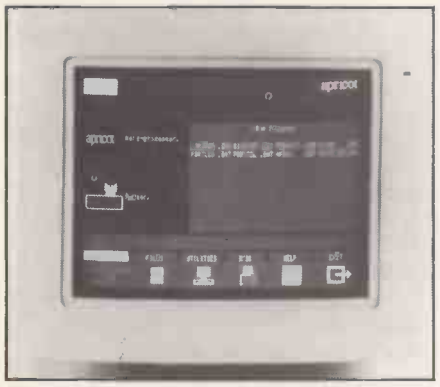
The Point 32 system uses an enhanced 10Mbyte or 20Mbyte Apricot as a file server to a Microsoft-Net network operating at 1Mbit per second. Up to 32 Apricot, Sirius and IBM micros can be linked over a distance of 2,000 feet. Tape backup of 100Mbyte or 200Mbyte is also available. The 10Mbyte version costs £2,995 and the 20Mbyte system £4,395.

New features being offered for the Apricot range include Prestel software which makes use of the integral modems which can be fitted. The cost for the Prestel software is £145; Prestel charges and the cost of telephone calls are extra. ACT is also planning to provide various database facilities for Apricots, accessed via standard telephone lines.

The Apricot range now represents one of the most integrated families of business micros available. The importance of the networks — in the dealers' eyes, at least — is that they offer the possibility of catering for the very top end of the business-micro market, one currently being fought for by multi-user systems as well as other LANs. In this respect, the inclusion of the IBM PC in the network is a shrewd move. ACT is clearly hoping to draw into its fold some of the swelling numbers of users of its main rival in the U.K., and convince them that it need not be an either/or choice.

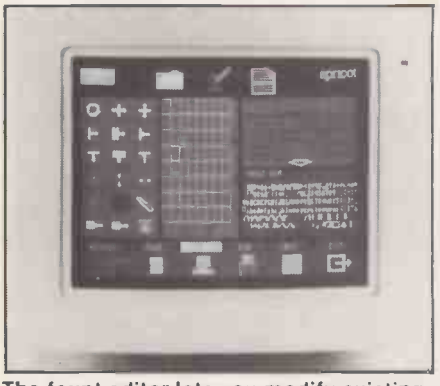
So with the hint of a real up-market micro coming next year to sit atop this whole edifice, the Apricot family looks set to dominate an even larger slice of business computing in the U.K. with products that prove you do not have to be boring to be successful. ACT has become a pretty big fish in the U.K. pond, but it remains to be seen how it will fare in the rougher, ruder waters of the world market it is now beginning to enter in earnest.

APRICOT F1



The opening menu with its command window. Icons are displayed along the foot of the screen.

The icon editor uses Macpaint-like techniques, with various colours and stipples available.



The fount editor lets you modify existing character sets or generate new ones on the standard grid.

Benchmarks

The table shows the time taken in seconds to run the set of eight standard Basic routines. The Apricot F1 emerges as relatively slow, with times slightly slower than the IBM PC, though some improvement can be expected when the final production models come through. For an entry-level business machine the speed is probably adequate.

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Av.
Apricot F1 — 8086	1.3	4.5	12.0	12.5	13.7	25.3	39.5	38.5	18.4
Orion — 8086	0.6	2.1	4.8	4.9	5.8	10.5	16.7	13.0	7.3
Apricot — 8086	1.5	4.8	10.4	10.8	12.2	22.8	35.5	34.0	16.5
IBM PC — 8088	1.2	4.8	11.7	12.2	13.4	23.3	37.4	30.0	16.9

(continued from previous page)

the software to rescale characters for the different display modes on the various Apricot machines. For example, the 10 by 16 pixels used on the high-resolution monochrome monitors is automatically converted to eight by eight pixels for the LCD screen on the new Apricot Portable.

The system configuration icon calls up a further menu which allows keyboard tables to be loaded, printer and RS-232 parameters to be set, and bell and key-click levels to be altered. Sensibly enough, the F1 lets you hear the effect of any changes as you make them.

The overall effect of these icon-based commands is visually pleasing, an effect which is helped by the smoothness of the screen scroll. Some 42K of RAM is used for the video display. Taken together with the 45K required by MS-DOS, this leaves 169K of RAM for user applications.

The buyer ACT had in mind when designing the Apricot is quite clearly the first-time business user who is unwilling to commit too much to the first acquisition yet wishes to allow for future growth. ACT has ensured that its product is completely upgradable through the whole Apricot series, which includes the new Portable as well as the hard-disc XI machine currently at the top of the range. There are hints that a new machine could be around next year to slot in above the XI.

A further aspect of this market-driven approach is the simultaneous launch of a cut-down version of the F1, called the F1E, aimed at the higher-education sector. According to ACT this area is as yet rather poorly served by micros. In particular, the F1E is designed to provide 16-bit and MS-DOS experience for those intending to enter business and industry. It also has the added advantage for ACT of introducing them to the Apricot range.

The F1E provides 128K RAM instead of the F1's 256K, and has a 315K floppy. The educational bias is reflected in the software bundled with the machine, which includes DR Logo. Otherwise, the machine is functionally identical to the F1, uses the same icon-driven utilities and is compatible with all other machines in the Apricot range. You can upgrade the F1E to F1 standard with a Business Upgrade Kit, which includes 128K RAM, MS-DOS and the expansion slot box.

There is no doubt that ACT has a point. After all, the BBC Model B so widely used in education is hardly representative of the up-and-coming technology in business micros. But hard-pressed colleges may jib at paying £795 for a system which does not even include a monitor. A crucial factor could be ACT's success or otherwise in persuading the BBC that it should back more than one horse in the micro stakes, and that Acorn's stablemate should be ACT.

Specification

CPU: 8086 running at 4.77MHz
RAM; 256K standard, expandable to 768K; includes 42K video RAM; F1E has 128K as standard
ROM: 32K ROM bootstrap and BIOS routines
Weight: systems unit 4.1kg. (9.59lb), keyboard 1.3kg. (2.87lb.)
Dimensions: systems unit 420mm. (16.5in.) deep by 221mm (8.7 in.) wide by 160mm. (6.3in.) high.
Keyboard: full-size QWERTY with 92 keys, including 10 function keys
Mass storage: Sony 3.5in. microfloppy, 720K on F1, 315K on F1E
Interfaces: RS-232, Centronics, external bus, one internal expansion slot, RGB and composite video outputs
Software in price: MS-DOS 2.11, Superwriter, Supercalc, Superplanner, ACT Diary, ACT Sketch and ACT Game with F1; CP/M-86, Personal Basic and DR Logo with F1E.
Peripherals: cordless mouse, £95; 10in. colour monitor £395
Price: F1 £995, F1E £795; all prices exclude VAT
Manufacturer: ACT plc, 111 Hagley Road, Birmingham B16 8LB. Telephone: 021-454 8585

Conclusions

● For the first-time business user the F1 represents a very safe bet. It offers a cheap entry system with full functionality and an extended upgrade path.

● The keyboard's infrared communications may not be to everyone's liking, though you can always use the light pipes.

● As long as you are happy with the philosophy of icons, ACT's implementation of them cannot really be faulted. Diehards may hanker after no-nonsense word-driven menus.

● The compatibility of the F1 with the whole Apricot range is a real boon, and one well judged for the business market.

● The system is not as portable as the main Apricot machine, and lacks extras like the useful microscreen: it is a question of paying your money and taking your choice.

● The F1E is a powerful machine in its own right which could well prove suitable for home and educational use, but it would probably still be worth paying the extra £200 for the full F1 if you can.

Your chance to win ACT's exciting new business micro — plus software — in our free competition.

Win an

Rules

1. The competition is open to all readers of *Practical Computing* normally resident in the U.K., except for employees of Business Press International Ltd or Applied Computing Techniques (Holdings) plc, or their families.
2. Each entry must be written in ink on the official entry form printed here. Only one entry per person is permitted.
3. Completed entry forms should be posted to the address shown on the entry form to arrive not later than November 30, 1984. Envelopes must be clearly marked "SPOT THE MICRO COMPETITION" in the top left-hand corner.
4. The Editor of *Practical Computing* is the sole judge of the competition. No correspondence can be entered into regarding the result of the competition and it is a condition of entry that the judge's decision is final.
5. The winner will be notified by post and the result of the competition announced in the first available issue of *Practical Computing*. The winning entry will be reproduced, and other entries may be reproduced without payment.
6. The prize is an ACT Apricot F1 system with colour monitor, printer, mouse, integral modem and software. No cash substitute will be offered.
7. The prize will be awarded to the individual named on the winning entry form.

THE NEW Apricot F1 business computer is reviewed in this issue on page 86. It offers a full 256K RAM, 720K floppy disc, cordless infrared keyboard, colour monitor, printer, integral modem and cordless mouse. The prize has been generously donated by ACT plc, and includes ACT Diary, ACT Sketch and the three business application packages Supercalc, Superwriter and Superplanner.

The Apricot F1 is also designed to be a top-of-the-range educational system, and would of course be suitable for home professional computing.

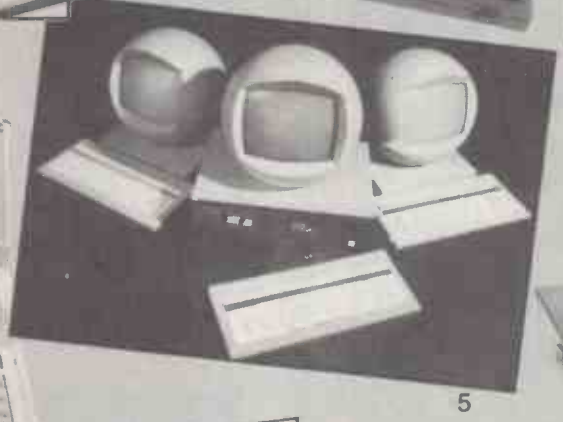
The winning entry to our Spot the Micro competition will be the one which, in the judge's opinion, answers all the questions correctly and provides the most original and witty suggestions to the tie-breaker problems, which relate to artificial intelligence, this month's special topic. Each question has only one correct answer. Write down the name of each machine shown in the photos against the appropriate number.


1


2


3


4


5


6


8


9

ACT Apricot F1

The £2,200 prize

- ACT Apricot F1 with inclusive software including Superwriter, Supercalc and Superplanner, worth £1,144.
- 10in. colour monitor, worth £454.
- On-board modem and Micromail voucher, worth £339.
- Printer and cable, worth £201.
- Cordless mouse, worth £109.

TOTAL VALUE £2,247

The prices quoted include VAT. The software bundle also includes ACT Diary and ACT Sketch.

7

10

Entry form for *Practical Computing* Spot the Micro Competition

Name .....

Address .....

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Answers

The micros shown in the photographs are

1..... 2.....

3..... 4.....

5..... 6.....

7..... 8.....

9..... 10.....

Tie-breakers

1. In not more than 15 words, provide a witty or original definition of the term "artificial intelligence".

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2. Many people believe that recursion will play a key role in AI, so your task for the second tie-breaker is . . . to devise a second tie-breaker. Limit yourself to 30 words or less. A sample solution might be: "A second tie-breaker for the competition would be to design a second tie-breaker."

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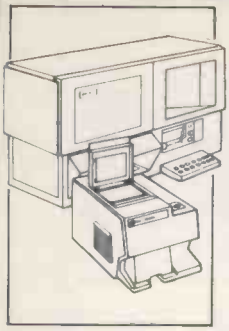
Return this entry form to Practical Computing, Room L307, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. Write "SPOT THE MICRO COMPETITION" clearly on the top left-hand corner of the envelope.

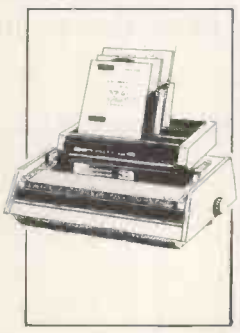


Updatable information system

The Microx System from Bell & Howell is a microfiche information-processing machine. You can add, annotate, erase or replace information more easily than with a paper-filing system. In fact, the Microx records, files, processes, retrieves — and prints, all in a matter of minutes and can be locked after use. The Microx records images on photo-plastic film masters — hard wearing and easily handled in normal light. Each master holds up to 98 documents and a grid reference allows easy identification. I have full details.

378 on enquiry card

The Trend 930 printer means business



The latest addition to Trend's successful 900 series of high-speed printers is the 930. This versatile machine now has even more flexibility with the addition of single or dual bin sheet feeders. When your letters need to create the best impression select the Executive Quality 80 characters per second, with the daisywheel look-alike finish. For office memos, etc, choose the Draft Mode with its quick 200 cps speed. The 930 will handle cut sheets and multi-part fanfold forms with ease. Contact me now for more details of this superior WP printer.

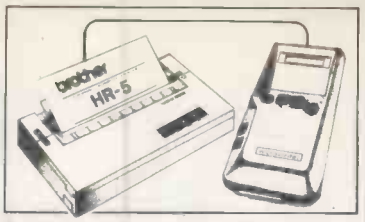
379 on enquiry card

PAGE PLUS Computers

COMPILED BY–

Ursula Hewitt

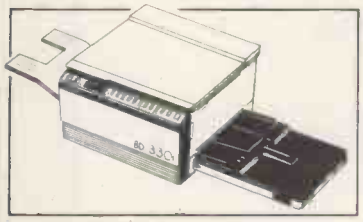
Maple House, Heath Drive,
Walton-on-the-Hill, Surrey. KT20 7QJ
Tadworth (073781) 4139



Microwriter plus Brother printer £399

Microwriter have just announced another money-saving package for readers: a Microwriter complete with Brother HR-5 battery or mains operated printer for only £399. Ideal for busy professionals, the Microwriter is a powerful, hand-held word processor with its own memory and text editing and communications facilities, yet it takes less than an hour to learn to use — even if you can't already type. Use your Microwriter wherever you need to work, then simply plug into the portable HR-5 for speedy printout. Contact me now for full details.

384 on enquiry card



Full copier features for under £1,000

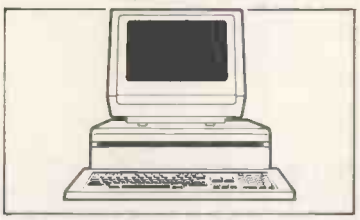
The Toshiba Copyboy will provide all the features normally expected of more expensive machines, but in a size suitable for users wanting copies from 100 to 3000 per month. Copyboy has big copier features, a straight through paper path which virtually eliminates paper jams, full edge to edge copying and a speed of 12 per minute. Lion Office Equipment, the sole UK distributor, see the Copyboy being used by small businesses and individual departments where speed, convenience and confidentiality are required. Contact me for full details.

380 on enquiry card

The Xerox 16/8 PC the two-in-one micro

The Rank Xerox 16/8, by offering to you both 8 Bit AND through 16 Bit processing, is the two-in-one micro to meet your business needs now — and in the future. It can utilise all your existing 8 Bit data and programs and all the much faster processing 16 Bit software now becoming more widely available. It comes with three operating systems — CP/M®, MS-DOS™ and CP/M86. It is the micro designed to combat obsolescence so find out more by contacting me now.

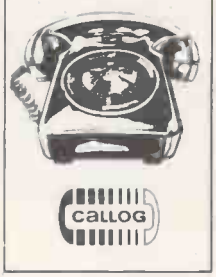
381 on enquiry card



Cut company telephone costs

Does your company use the telephone efficiently? Can you allocate the cost of this expensive overhead to departments or projects? You'll need more information from your quarterly bill to answer that and Callog can help you. Callog provides a complete management information service with a detailed analysis of every outgoing call. You'll see immediate benefits in better telephone habits, more accountability and significant savings on your bills. These savings far outweigh the modest service fee. I have details of this simple and cost effective method of saving your company money. Circle this number now.

385 on enquiry card



The last word in dictation

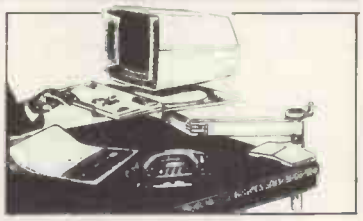
The BM 550 portable dictator from Sony's MicroWorld range has all the features that enable easy and efficient dictation. This slim and sleek portable, weighing less than seven ounces has a slide switch for one hand operation, electronic indexing for better communication with the secretary and the micro cassette flexibility of up to two hours recording. Circle this number now and I'll be happy to send you all the details.

386 on enquiry card

A typewriter to remember

The latest addition from Silver Reed is the Intelligent EX66 Electronic Memory Typewriter. Featuring a 20 character, liquid crystal display, a 32 character key buffer and 2-line 512 character correcting memory, it makes the typist's job so much easier. Simultaneous text typing and storage are possible, thanks to a built-in 8K text/phase/format memory that can be expanded by another 8K to a maximum of 16K. Upgradability is further enhanced by the optional interface. In the automatic printing mode bi-directional printing is standard and to make your secretary even happier, it comes with a host of sophisticated hardcopy and editing features. A super machine, let me send you full details.

382 on enquiry card



Westra Spacemaker adjustable swivel vdu arm

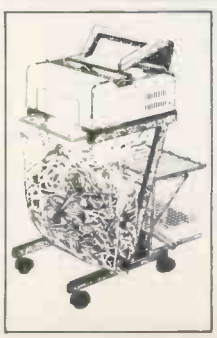
As the VDU screen becomes an essential part of the office, the Westra Spacemaker enables the VDU to be positioned off the desk when not in use saving valuable working surface yet allowing it to swivel over the desktop when required. The screen surface has a tilt adjustment and the height of the arm can be easily altered. Useful also for other office equipment items such as microfilm readers, models are available with two screen surface sizes. On show at the London Business Show, Earls Court, Stand No 265, 23-26 October. Or circle this number for full details.

383 on enquiry card

A new range of acoustic printer covers

Noise reduces efficiency in offices. Twinlock now introduce a new range of five Acoustic Printer Covers and make it possible for printers to be the work-and-time savers they were designed to be. The flame retardant acoustic foam lining reduces printer noise by up to 90%. A clear acrylic lid for observation, double-hinged with gas struts for easy access, also acts as a dust protector. A quiet, long-life fan keeps the printer cool, and a unique two-way plug (British Standard) caters for the fan and printer together. Twinlock can assist you in finding the correct model for your machine. Simply contact me.

387 on enquiry card



Shredders for computer print-out

The increasing use of word processors, printers and computer installations means that Business Aids' electronic Scimitar Data Shredders are in greater demand than ever. The Compact Data 1001 is ideal for the smaller computer user; models 2001 and 2002 accept 25 sheets or eight streams of continuous stationery, while the high-security 2002XC converts paper into illegible 2 × 15mm chips. Data 4001 is a wide-throated console model; the heavy duty Data 5000 and 6000 have a 30-sheet capacity and process up to 20 streams of print-out simultaneously. Contact me now.

388 on enquiry card

XCHANGE

Originally bundled in with the QL, Psion's integrated software suite is now available for other established 16-bit micros. Glyn Moody reports.

THE PSION integrated software saga seems to have been going almost as long as that of the QL with which it is now bundled. The most recent incarnation of the four standard packages of word processor, spreadsheet, graphics and database is as Xchange, available for serious machines including the IBM PC, Apricot and Sirius. Later releases will be for the Macintosh and Rainbow among others. The minimum hardware requirements are 256K RAM and 320K disc capacity.

The integrated system costs £495 and separate programs cost £175, except for the database, Archive, which is £250. Any combination of packages may be used together, and the total integrated suite may be built up module by module without any further adaptation.

Different

The integrated approach adopted by Psion is different from that of either Lotus with Symphony or Ashton-Tate's Framework. Both Symphony and Framework start from one particular application — spreadsheet in the one case, database in the other — and extend its facilities to include the other applications. This provides a strong kind of integration: the exchange of information is readily achieved, and all command functions are necessarily unified. A disadvantage of such an approach is that applications are forced into the same mould as that of the original application. For example, Symphony is noticeably an extended spreadsheet in its basic philosophy.

Psion has opted for quite a different route. The four programs each function happily as stand-alone packages, but share a basic integration of commands and data. Transfer of data between applications is less fluent than in the unitary programs like Framework, since it is necessary to return to the main menu in order to exchange data.

The same menu controls the way in which up to eight tasks can be held as background programs, and selects the main foreground task. Data is held for all the tasks while the machine is powered up. Exchange of data between applications is effected simply by using the Xchange command to highlight the origin and destination of information from the list of current tasks. A print-spooling facility will be available in the final releases, which will allow a limited kind of concurrency.

Improvement

The programs themselves are almost identical in appearance to those reviewed on the QL in last month's *Practical Computing*, except that the use of colour is more imaginative, though this varies from machine to machine. The most notable difference, apart from the main menu which handles the various application tasks, is the overall speed improvement. A virtual-memory system is used throughout. Unfortunately Quill, the word processor, is still too slow for serious use. The same problems found on the QL, such as the slow backspace deletion, also dog Xchange. Quill does, however, now offer a mail-merge facility. The graphics package still looks the most impressive and boasts a new display format: a three-dimensional bar graph. This additional facility will be available for the QL through QLUB.

One important new feature is the Task Sequencing Language, TSL, which lets you mimic keystrokes by key codes. For example Carriage Return is represented by cr and function keys by f1, f2, etc. Single letters preceded by an ampersand are equivalent to special commands. So &d followed by text displays the text on the input line. Unfortunately this facility is poorly documented, so it is hard to judge how useful it will be in practice. Psion claims that it will allow Xchange to be set up with a user-friendly front end for less experienced computer users.

The manuals themselves are novel. Psion commissioned a team of industrial designers to rethink the manual concept, and they came up with a flip-over ring binder packaged in a plastic casing which also doubles as a disc container. Its small footprint lends itself to desk-top use.

As with the QL, users have the option of paying an additional sum for a hot-line support service and all upgrades of the programs. Psion is charging 15 percent of the retail price for this service.

In many ways the earlier launch of the QL bundled software gave a slightly misleading impression of the Psion packages. The full-blown Xchange programs, freed from the constraints of the QL's limited RAM and slow Microdrives, emerge as a far more successfully integrated and balanced applications suite.

Conclusions

- **Xchange represents a very good integrated business system for the lower end of the market. For £495 you are getting four usable programs that offer all the main facilities, as well as the possibility of a gradual upgrade path.**
- **Quill lets the suite down, and in its present form should not be regarded as comparable with other standard word-processing packages.**
- **The integration is sensibly implemented, and should suffice for most purposes. In particular, executives and professionals will find it meets their needs and is relatively easy to use.**
- **While Xchange lacks the superficial sophistication of the modish Symphony and Framework, its more down-to-earth approach has the advantage of simplicity and flexibility.**
- **Psion can be reached on 01-723 9408.**

Xchange's manuals are smartly packaged in free-standing plastic cases.

Polyglot programming

The BBC Micro is well endowed with alternative programming languages to replace its Basic mother tongue. Clive Grace has been trying them out.

FROM ITS earliest days the BBC Micro has been blessed with a large selection of available languages. Disc or cassette implementations are often available, but the neatest way of getting a new language on to the machine is by slotting in a new sideways ROM chip. It then becomes a simple matter to switch out Basic in favour of the language of your choice.

At present there are two main producers of quality languages for the BBC machine. Acornsoft has built up a reputation for commissioning good programmers, and Acornsoft languages have maintained a consistently high standard for resilient implementations. HCCS Associates is smaller, but has made dramatic advances in software. It was the first firm to market Forth and Pascal on ROM, and its packaging and documentation is generally excellent, if spartan.

Forth is well suited to microcomputer implementations, and nearly every machine now available has a version of this powerful and maturing language. There are currently three versions for the BBC: HCCS, Acornsoft and a new release of Split-Forth which has yet to prove its weight in a competitive market.

Fast execution

Forth is a stack-orientated language which is semi-compiled into a threaded interpretative code. A typical Forth program — see listing 1 — takes on the form of a screen, typically of 1K. Any number of screens can be incorporated. Forth executes extremely fast and the code is very compact, making it excellent for control purposes. Its stacks and reverse-Polish notation make it ideal for fast mathematical and robotics applications.

HCCS Forth was the first ROM-based version on the market. It eschews innovations, adhering closely to the Forth '79 standard. It has been around long enough for any bugs to have been eliminated, and it is augmented by an excellent manual with a number of example screens, including vital utilities such as a 6502 assembler.

There are plans for an enhanced 16K ROM with the assembler built in and with the possibility of generating overlay files, allowing a huge increase in the amount of Forth code which can be accommodated. The excellent, error-free manual is written in a straightforward style, and offers the new user a wealth of relevant information. HCCS Forth has attracted a large user base at under £35.

Acornsoft Forth is quite different. Instead of embracing either Fig-Forth or the '79 standard, it is a hybrid of the two. Because of Forth's ability to define new words in its vocabulary, the programmer can define the differing commands and effectively merge the two standards. All in all the result is a very good version, incorporating the best of both standards.

The original idea was to release Forth on tape and disc, and follow it up fairly shortly with a ROM version. But a shortage of chips has led to the ROM version being delayed. Acornsoft says that the ROM version will be available when the chips are ready and the compiler is completely bug-free.

The manual is sold separately and costs £7.50. It covers all releases and serves as a source reference for many versions of Forth. In-depth explanations are supplied for every Forth word.

Computaphile's Split-Forth is the latest version of the language. It is a ROM-based compiler which follows the Fig-Forth standard. A disc drive is needed to hold various overlay files and an extended library of words for more advanced purposes.

Split-Forth's major virtue is its ability to generate stand-alone code which can be executed without the compiler being present. Split-Forth is a great deal more fragile than other versions; to weigh against its obvious advantages it has a propensity to crash for reasons which can often be obscure to all but the most experienced programmers.

```
(                                    )
(                LISP                )
(                                    )
(    Copyright (c) Acornsoft 1982    )
( Copyright (c) Owl Computers 1979   )
(                                    )

Evaluate : (SETQ NICE-ANIMALS
←'(IS! IT! NICE! AND! CUDDLY?
←←(DOES! IT! GO! BAAAH? SHEEP . LAMB)
←←DOES! IT! EAT! ACORNS?
←←(DOES! IT CACHE! GOODIES . SQUIRREL)
←←. HAMSTER . KEWNEY)

Error number 9
Arg : HAMSTER
Arg : NICE-ANIMALS
Arg : NICE-ANIMALS
Arg : NIL

Evaluate : RE-ANIMALS_
```

Acornsoft's Lisp is derived from the MAC LIsp standard.

Pascal is a language which has found firm support among educational, scientific and mathematical users. It is a direct descendant of older Algol-based languages. The main feature of Pascal is its structure: good programming habits are enforced from the beginning, and from the start users must have a fairly good idea of how their program is going to look in its finished form.

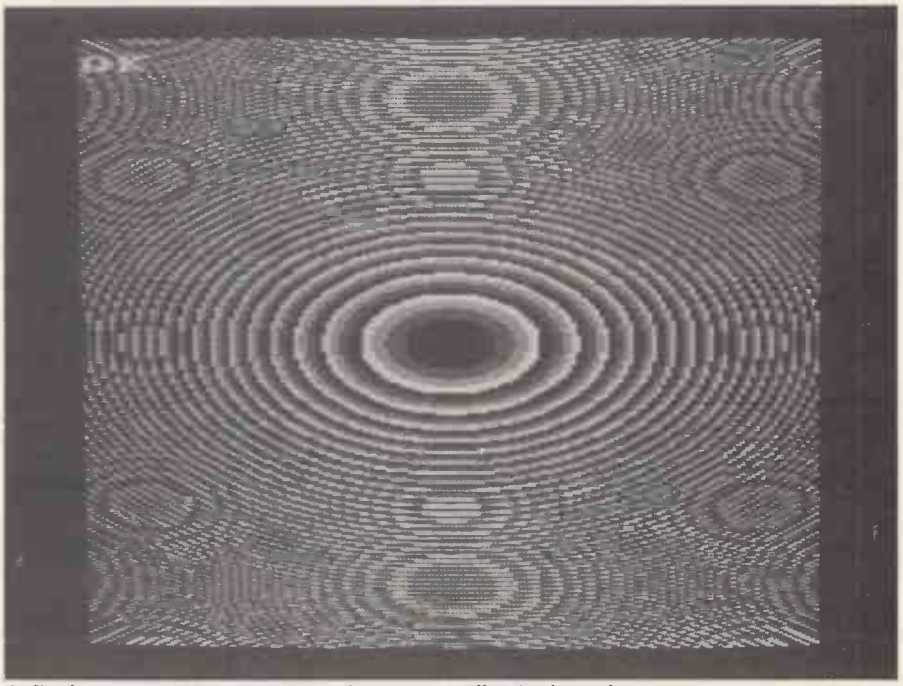
Acornsoft has a teaching version called S-Pascal which incorporates an editor, compiler and debugger in one program. It is only available on tape and disc, and can generate stand-alone code. It is not possible to relocate S-Pascal programs, as the language incorporates a run-time system which allows the object code to be run on any BBC machine.

There are a lot of advantages to having a teaching version of a language. The limitation is the diminutive 3.5K allowed for programs, but in the learning stages there is little likelihood of huge programs being generated. In keeping with Pascal's original intentions it stresses the importance of the structured approach in many applications.

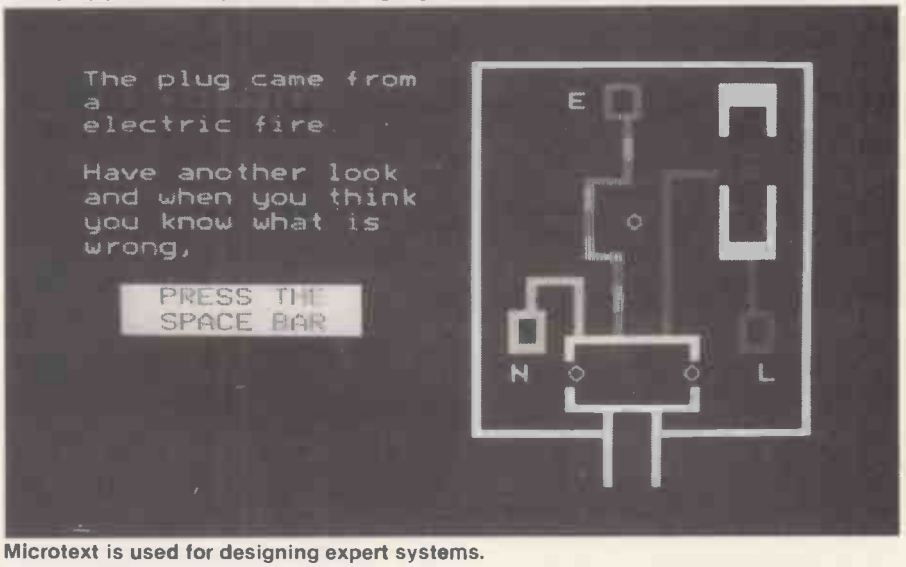
Pascal-T from NCCS is another subset which is cut down from larger compilers. Unlike S-Pascal it resides in ROM, so much larger programs are possible. Even though it is a subset it is capable of handling very complex routines and has many good features such as visible compilation and comprehensive error checking.

Comprehensive

A Forth compiler is incorporated into the nucleus of Pascal-T, but unlike S-Pascal it requires the presence of the compiler in order to execute any code. It is far more comprehensive than Acornsoft's implementation and allows more involved programs to be written — but then it is a good deal more expensive at £59, compared with less than £20 for the Acornsoft software.



A display produced by Forth — a language well suited to micros.



Microtext is used for designing expert systems.

	Disc	Cassette	ROM	DFS required?	Supplier
Multi-Forth 83	—	—	£40	No	Skywave
Forth	£19.90*	£16.85*	N/A	No	Acornsoft
Forth 2.5	—	—	£34.72	No	HCCS
Split-Forth	—	—	£23.50	Yes	Computaphile
Pascal-T	—	—	£59	Yes	HCCS
S-Pascal	£19.90	£16.85	—	No	Acornsoft
Lisp	£19.90*	£16.85*	N/A	No	Acornsoft
BCPL	—	—	£99.65	Yes	Acornsoft
Microtext	£19.90	£16.85	—	No	Acornsoft
Peeko-Computer	—	£9.95	—	No	Acornsoft
Turtle Graphics	£19.90	£16.85	—	No	Acornsoft
XCal	—	—	£65	Yes	HCCS
Logo-Forth	—	—	£55	No	HCCS

*Manual for these products costs £7.50 extra.

Suppliers
Acornsoft, Betjeman House, 104 Hills Road, Cambridge CB2 1LQ
HCCS, 575-583 Durham Road, Engine Lane, Low Fell, Gateshead, Tyne & Wear
Computaphile, 103 Woodchester, Yate, Bristol BS17 4TX
Skywave Software, 73 Curzon Road, Boscombe, Bournemouth BH1 4PW

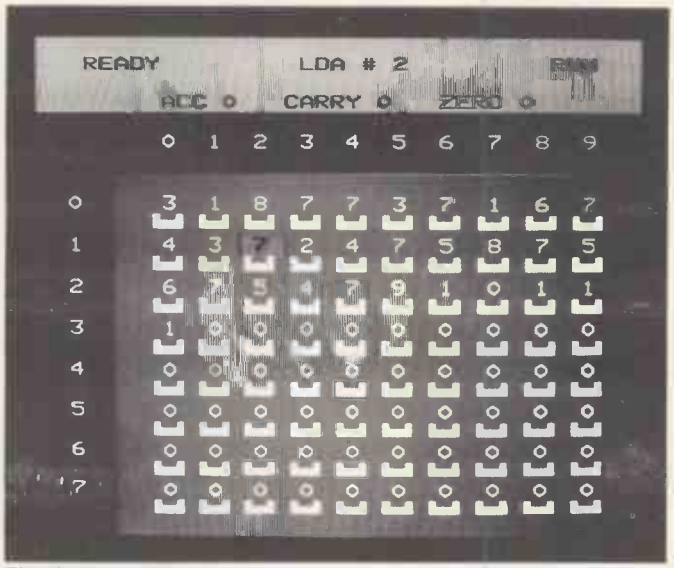
Acornsoft **Lisp** is an interpreted version of MAC Lisp, one of several Lisp standards. Lisp is used heavily in artificial intelligence research — see Chris Bidmead's article on page 128 of this issue — and for writing text editors because of its ability to manipulate words and strings of data.

Lisp's major feature is that it can treat a symbol or word table in a manner which allows attributes to be assigned to it. Other languages normally give control only over a string of characters as it stands in relation to the rest of the program as either alphanumeric or numeric data. By contrast, Lisp is capable of linking several attributes to any section of any stream of data and treat it with many different approaches.

A single data definition becomes redundant, and it becomes possible to perform

(continued on next page)

Microtext requires no prior programming knowledge.



The Peeko-Computer introduces the programmer to assembler.

(continued from previous page)
fast processing functions like comparisons, something that Lisp handles very efficiently. A simple question-and-answer session can be set up with relative ease, with the advantage that in Lisp the program has the ability to analyse data and make decisions which in some circles are considered intelligent.

Although Acornsoft Lisp will not let your computer think for itself, it will give an excellent introduction to the heady world of AI and encourages the user to think laterally as well as logically. After using Acornsoft Lisp it became all too clear that AI machines need a great deal of on-line storage.

The BBC Micro can hardly be said to be generous with its memory, so for those wishing to develop large interactive Lisp programs the soon-to-be-released ROM version will probably represent a major improvement over the disc and cassette versions now on offer. Even then, only 30K of code can be written in mode 7, but it will work with the 6502 second processors which will give the BBC Micro as much memory as an eight-bit processor can page at one time, 64K in all. That is at least approaching the size of a reasonable Lisp program.

C Forerunner

The most expensive of all the languages available on the BBC is **BCPL.** This language is intended exclusively for writing compilers and operating systems in scientific and technical fields, and is a forerunner of the much talked-about C language.

BCPL has many advantages over other languages — even C — in that the code is very portable, it is not operating system specific, and once BCPL has been installed, code written on one machine will be similar to another. Unlike C, BCPL does not need an operating system like Unix to realise its power. Although it is a harder language to learn than many, it confers advantages otherwise available only in the realms of assembler.

The Acornsoft BCPL package comes with a disc consisting of no less than two editors, a debugging tool, many utilities, a stack examiner and a host of other goodies which are standard on all BCPL systems. A ROM is included which contains a command-level dictionary and a housekeeping tool.

The documentation is very good, in typical Acornsoft style, although the order of the manual is somewhat jumbled. A disc drive — or better still two — is essential, as BCPL is based around files and requires the use of an editor and a whole host of utilities which would make cassette development tediously slow if not impossible.

BCPL can only be considered a language for the very serious-minded. It takes a lot of understanding before you can use it to the full, and it is by no means the friendliest of languages. There are inherent similarities between BCPL and C, but BCPL is a technical language with all the requirements of a modern and powerful development tool.

The many educational users of the BBC Micro are still waiting for an Acornsoft version of **Logo.** Meanwhile, HCCS has produced a limited subset of Logo on ROM, which it calls Logo-Forth. Though the influence of Seymore Papert is acknowledged, its resemblance to full Logo is only fleeting.

The HCCS approach is unusual in that it uses the stack orientation of Forth and its compiler to perform the logic involved to move a turtle around the screen. A Pascal editor included in the package is

```
 10  program fibonacci (output);
 20  var n,m : integer;
 30  function fib(x:integer):integer;
 40    begin
 50    if x <= 1
 60    then fib := 1
 70    else fib := fib(x-2)+fib(x-1)
 80    end;
 90
100  begin
110  for m:=0 to 20 do
120    begin
130    n:=fib(m)
140    write ( 'Fib( ',m, ') is ' );
150    writeln(n)
160    end
170  end.
```

Listing 1. An S-Pascal listing.

```
Forth V2.5
EDITOR  OK
L
SCR # 2
 0 ( Demonstration Forth Screen )
 1 FORTH DEFINITIONS DECIMAL
 2 : CIRCLE                ( CIRCLE I have defined as a command )
 3 5 MODE                  ( Go into MODE 5 )
 4 5 EMIT                  ( EMIT is the same as VDU in BASIC )
 5 80 -80 DO 128 -128      ( set up plotting routine )
 6 DO 0 J J * I I *
 7 + 100 / 3 AND GCOL 69 ( Logical AND the Colours )
 8 J 80 + 8 * I 128 +
 9 * PLOT                  ( Plot Circles )
10 LOOP                    ( Repeat )
11 LOOP ;                  ( Ends definition )
12 -->                     ( Call up next screen )
13
14
15                          ( Simply Typing in 'CIRCLE' will execute )

  OK
```

Listing 2. A typical Forth screen, which can be incorporated into larger programs.

Acornsoft's Turtle Graphics package can produce a few of the simpler drawing routines in Logo.

adequate and takes little time to learn.

As in Forth, typing in VList will list all the words defined in the language, including those defined by the user. This is where Forth's ability to define new words and commands comes in very useful in the world of Logo. For instance

```
TEACH BOX: teaches the computer to
    draw a box
4 TIMES: set up loop
300 FORWARD: move 300 pixels forward
90 RIGHT: turn 90 degrees
DONE?: tests for loop No — Retry
END: Yes — then End.
```

will teach the computer how to draw a square box of 300 pixels each side. Any subsequent reference to Box then draws a square at any specified graphics origin. Recursive programming then allows the Box command to be used to draw complex geometrical shapes, a theme central to the idiom of Logo.

Acornsoft is also planning a **Turtle Graphics** package, pending the appearance of a full Logo. It is capable of only a few of the simpler drawing routines in Logo, and will just about fit into the Acorn Electron as well. The manual is thin but well written, and includes adequate examples and screen illustrations.

The package proved cumbersome to use for a long time. But simple examples like changing colours at will and moving Home to any part of the screen were easy to set up. This immediacy is primarily due to the series of menus used for editing and writing programs.

Adequate information is given on how to use addition, subtraction and other basic mathematical concepts to highlight the geometry involved. The programs may be listed and sent to a printer. Screen dumps are also possible, though separate software is required to make them.

Different screen modes affect the amount of code you can accommodate, but most programs load and run in any screen mode. When memory has been used up, the abrupt "Not got enough memory" message is given, but you have to write some fairly complex routines before this happens.

Microtext's intended purpose is the design of expert systems. Users with little or no programming knowledge can use it to set up either information-retrieval systems or question-and-answer sessions. It has been used effectively in staff-selection applications, and some companies include Microtext sessions as part of their induction process.

Acornsoft's Microtext bears a striking similarity to Pilot, which has appeared on the Apple, Atari and Commodore machines. It works in the Forth-like style of generating screens for the user. But whereas Forth relies on programming lines or blocks arranged into a screen, Microtext uses the screen as a sketch-pad on which to display information. The displays made possible in mode 7 are stunning, and make good use of the colourful teletext characters.

There are a host of graphics commands, and using Microtext proved delightfully simple. It is ideal for teachers without any previous programming knowledge who wish to set up question-and-answer sessions. Microtext will run on Econet, so it should be popular with schools and colleges.

```
23BC                    .L(V)
  until rdch(':')<>' '
WARNING :null stmt near until
23BC A9 3A      LDA#1
23BE A2 00      LDX#h
23C0 20 45 1C   JSRV(V,0)
23C3 A0 12      LDY#A
23C5 20 4B 1D   JSRsave
23C8 A9 20      LDA#1
23CA A2 00      LDX#h
23CC 85 76      STAr
23CE 86 77      STXr+1
23D0 A0 13      LDY#A+1
23D2 20 44 1D   JSRload
23D5 38         SEC
23D6 E5 76      SBCr
23D8 F0 02      BEQP%+4
23DA A9 FF      LDA#255
end.
23DC C9 FF      CMP#255
23DE F0 03      BEQP%+5
23E0 4C 20 23   JMPL(V)
23E3                    .L(V)
23E3 60         RTS
>_
```

6502 assembler.

In a similar vein is the ROM version of **XCal** from HCCS. The intention is not to set up an expert system but to create question-and-answer sessions via copious use of screens. Although the methodology of XCal is different from that of Microtext, the end result is the same: it is aimed squarely at teachers who want to create a learning environment with the computer.

You specify whether the screen is to be a graph, a histogram, a text screen or a question-and-answer screen. XCal is heavily file orientated and pulls most of the overlay files from the system disc.

Two disc drives are essential: one is needed to support run-time programs while the other holds the user programs. A version with all the necessary programs on one disc is promised.

The documentation assumes only that you are able to switch the machine on and starts from there. Though the manual is very thin, all the necessary information is given — or if not, a suitable reference to the user guide is made. Everything is menu driven, which makes XCal easy to use.

The **Peeko-Computer** is something between a language and a teaching aid. It introduces the programmer to assembler in a way which shows plainly how registers are altered, and how data can be stored on stacks and an accumulator. Knowledge gained on Peeko can equally be used quite effectively on full-blown assembler programs.

Peeko-Computer operates using simplified 6502 op codes selected from a command table. The complete 6502 instruction set is supported, but only 10 instructions can be used at once and programs are limited to 80 bytes.

Users learn what each instruction represents by selecting what they require. Each byte can be single-stepped for debugging. At a price of only £9.95, Peeko-Computer represents good value for money.

BBC keyword search utility

Mark Callaway's machine-code utility for the BBC Micro will search any Basic program for a specified variable, string or command, and report the line numbers at which it occurs.

TO SAVE MEMORY and improve performance, Basic programs are sorted in memory in a compressed or tokenised form. Basic keywords such as Print are stored as single-byte tokens. Line numbers are stored using a complicated three-byte code. If you want to find any lines in your program which say, for example, Goto 1020 you have to scan through the computer's memory looking for the Goto token followed by the coded form of 1020.

When you ask the Find program to find all occurrences of Goto 1020 it has to work out the tokenised form of Goto 1020. It then finds where the tokens occur in memory and prints out the line numbers.

However, converting a line of Basic into its tokenised form is very difficult. Acorn says that there is no simple routine in the Basic ROM that could be used by a Find program. To get round this problem the Find utility puts the required variable into a dummy line and lets the Basic ROM tokenise it in the normal way.

For example, if you wanted to find the tokens for Goto 1020 you would enter a dummy line

```
1 GOTO 1020
```

or use some other line number not used by your program. BBC Basic then tokenises the Goto 1020 and puts it into memory. You can then see how it is tokenised by looking at the computer's memory where the dummy line 1 is stored.

The Find program is called using the

```
   10REM FIND Command for the BBC M
icro with OS 1.0 or better.
   20REM Copyright (C) 1984 Mark Ca
llaway
   30REM Thanks to Alan (Sheep) Sto
kes
   40REM
   50start=&4000:REM Start of Machi
ne Code
   60OSWRCH=&FFEE
   70OSBYTE=&FFF4
   80OSWORD=&FFF1
  100pointer2=&70:REM points to a l
ine of Basic
  110pointer3=&72:REM = pointer2+di
splacement
  130pointer=&74:REM points to a li
ne of Basic, in part 2, the line of
 text we are searching for.
  140pointerP4=&76:REM points to th
e inserted text (=pointer+4)
  180bufferpointer=&78
  190
  200FORPASS=0TO3STEP3
  210P%=start
  220[OPT PASS
  230\ The routine is called by *LI
NE followed by the text to be searc
hed for.
  240\ With the addition of a line
number, this text is then made into
  250\ inserted into the program.
  260CMP#1 \ entered by *LINE ?
  270BEQ ok
  280RTS
  290
  300.ok
  310STX bufferpointer
  320STY bufferpointer+1
  330
  340\ check that the input is no l
onger than 15 characters
  350LDA#13
  360LDY#0
  370.check CMP (bufferpointer),Y
  380BEQ foundend
  390INY
  400JMP check
  410
  411.foundend CPY#15
  412BCC nottoolong
  413
  414LDY#15
  415LDA#13
  416STA (bufferpointer),Y
  417
  419.nottoolong
  420LDA&1C \ &1C, &1D store a copy
 of PAGE
  430STA pointer
  440LDA&1D
  450STA pointer+1 \ points to the
first line of BASIC
  460
  470\ search for a line number whi
ch is not used by the program
  480LDA#0
  490STA lineno
  500STA lineno+1
  510
  520.search
  530LDY#2 \ is the line number sto
red in `lineno' used by the program
  540LDA (pointer),Y
  550CMP lineno
  560BNE foundone
  570DEY
  580LDA (pointer),Y
  590CMP lineno+1
  600BNE foundone
  610
  620INC lineno \ try another line
number
  630BNE T1
  640INC lineno+1
  650.T1 LDY#3
  660LDA (pointer),Y
  670CLC
  680ADC pointer
  690STA pointer
  700BCC search
  710INC pointer+1
  720JMP search
  730
  740.foundone
  750LDA#15
  760LDX#1
  770LDY#0
  780JSR OSBYTE \ clear keyboard bu
ffer
  790
  800LDA#21
  810JSR OSWRCH \ switch screen dri
ver off
  820
  830LDA lineno
  840STA bin
  850LDA lineno+1
  860STA bin+1
  870JSR BINtoDEC \ get unused line
 no in decimal
  880
  890JSR insertlineno \ put line no
 into input buffer
  900
  910LDY#0
  920.LOOP5 LDA (bufferpointer),Y
  930STY tempy
  940PHA
  950TAY
  960LDA#138
  970LDX#0
  980JSR OSBYTE \ put line of text
into keyboard buffer
 1000PLA
 1010LDY tempy
 1020INY
 1030CMP#13
 1040BNE LOOP5
 1050
 1080LDX#0
 1090.LOOP6 LDY message2,X
 1100TXA
 1110PHA
 1120TYA
 1130PHA
 1140LDA#138
 1150LDX#0
 1160JSR OSBYTE \ put a CALLpart2 i
nto  keyboard buffer
 1180PLA
 1190TAY
 1200PLA
 1210TAX
 1220INX
 1230CPX#10
 1240BNE LOOP6
 1250RTS
 1260\*************************
***********
```

* Line command. For example, to find all occurrences of Rem you would type

```
* LINE REM
```

The utility only notices the first 15 characters of any string you ask it to search for.

Accessing Find

When you type * Line followed by a string, the operating system jumps to the location stored in &200 and &201. The accumulator then contains 1, and the X or low-byte register and Y or high-byte register point to the memory location where the string is stored. This is how the Find utility is accessed, and it will be clear what lines 260 to 320 do.

The BBC Micro has a type-ahead buffer which can store the result of up to 31 keys being pressed. Consequently, Find only works with strings less than 16 characters long; the other 16 characters are used by the line number and the Call command. Lines 340 to 400 see if the string is longer than 15 characters. If it is, a Carriage Return is added after the 15th character and the others are ignored.

Basic programs are stored in memory starting at Page. A copy of Page is stored in locations &1C and &1D. Each line is stored in the following way:

Byte 1 is set to 13.
Byte 2 contains the line number Div256.
Byte 3 contains the line number Mod256.
Byte 4 contains the line length, including these first four bytes
Byte 5 is the first of the Basic tokens.

Bytes 2 and 3 are used by the routine that searches for the dummy line number. Byte 4 is often used by Find to discover the number of the next line of Basic.

Lines 420 to 720 find the dummy line number and store it in variable lineno, with its position in memory stored in variable Pointer. Lines 830 to 890 then enter the line number into the keyboard buffer.

Next, the routine copies the string of characters being searched for into the keyboard buffer. Lines 1080 to 1240 then insert a Call command into the buffer. This Call is needed to start the second part of the program.

If you type

```
*LINE GOTO 1020
```

the first part of the Find program puts the characters

```
1 GOTO 1020
```

into the keyboard buffer, followed by

```
CALL 12345
```

You never see these characters on the screen because lines 800 and 810 disable the VDU.

By the time the computer reaches the second part of the program, line 1 has been converted into tokens and stored in memory at the location stored in Pointer. The program then searches through memory for occurrences of these same tokens. First, the VDU driver is enabled using VDU6, and lines 1300 to 1370 calculate the length of the string of tokens you are searching for. A new pointer, PointerP4, is created which points to these tokens.

Each line of the program in turn is then pointed to by Pointer2. The tokens you are searching for will always occur at least once, in the dummy line, but lines 1520 to 1570 suppress any report of this.

Checks

The line pointed to by Pointer2 cannot contain the tokens you are searching for if it is shorter than the string of tokens. Lines 1590 to 1640 check this. Now the line pointed to by Pointer2 is searched for the tokens. It will be searched many times. Firstly, the first and second tokens are checked, then the second and third, and so on, as shown in figure 1. If tokens are being searched for, the search continues until the final tokens of the line have been checked or the required tokens are found.

If the tokens are found, the line number where they occur is printed out by lines 1860 to 1920. Pointer2 then moves to the

(continued on next page)

```
 1270.part2 LDA#6
 1280JSR OSWRCH \ switch the VDU dr
iver back on.
 1290
 1300LDY#4 \ find number of charact
ers in search string
 1310.T4 LDA (pointer),Y
 1320INY
 1330CMP#13
 1340BNE T4
 1350TYA
 1360SBC#5
 1370STA nochars
 1380
 1390LDA pointer \ pointerP4 points
 to the text insert by part1, the t
ext we are searching for.
 1400CLC
 1410ADC#4
 1420STA pointerP4
 1430LDA pointer+1
 1440ADC#0
 1450STA pointerP4+1
 1460
 1470LDA&1C
 1480STA pointer2
 1490LDA&1D
 1500STA pointer2+1 \ POINTER2 will
 scan through the lines of the prog
ram
 1510
 1520.searchline LDA pointer2 \ is
this line the line we inserted ?
 1530CMP pointer
 1540BNE notit
 1550LDA pointer2+1
 1560CMP pointer+1
 1570BEQ nextline
 1580
 1590.notit LDY#3 \ is the text we
are searching for longer than this
line
 1600LDA (pointer2),Y
 1610SEC
 1620SBC#4
 1630CMP nochars
 1640BCC nextline
 1650
 1660
 1670CLC \ pointer3 points to the t
ext of the line we are searching.
 1680LDA pointer2 it is incremented
 as we look for matches at differen
t places along the line.
 1690ADC#4
 1700STA pointer3
 1710LDA pointer2+1
 1720ADC#0
 1730STA pointer3+1
 1740
 1750LDA#4
 1760STA disp
 1770
 1780.T7 LDY#0 \ compare the two li
nes character by character
 1790.compare LDA (pointerP4),Y
 1800CMP (pointer3),Y
 1810BNE nextdisp
 1820INY
 1830CPY nochars
 1840BNE compare
 1850
 1860LDY#1 \ found it!
 1870LDA (pointer2),Y
 1880STA bin+1
 1890INY
 1900LDA (pointer2),Y
 1910STA bin
 1920JSR printno
 1930JMP nextline
 1940
 1950
 1960.nextdisp \ increment pointer3
 and disp so a different part of th
e line
 1970INC disp \ can be checked
 1980INC pointer3
 1990BNE T9
 2000INC pointer3+1
 2010.T9 LDY#3
 2020LDA (pointer2),Y
 2030SEC
 2040SBC nochars
 2050CMP disp
 2060BCS T7
 2070BEQ T7
 2080
 2090.nextline LDY#3
 2100LDA (pointer2),Y
 2110CLC
 2120ADC pointer2 \ pointer2 moves
to the next line
 2130STA pointer2
 2140BCC T6
 2150INC pointer2+1
 2160
 2170.T6 \ reached the end of the p
rogram ?
 2180LDY#1
 2190LDA (pointer2),Y
 2200CMP#255
 2210BNE searchline
 2220
 2230LDA lineno \ delete line that
was inserted by pass1
 2240STA bin
 2250LDA lineno+1
 2260STA bin+1
 2270JSR BINtoDEC
 2280
 2290LDA#21
 2300JSR OSWRCH \ switch screen dri
ver off
 2310
 2320JSR insertlineno \ type line n
o into buffer
 2330LDA#138
 2340LDX#0
 2350LDY#13
 2360JSR OSBYTE \ put carriage retu
rn into buffer
 2370
 2380LDA#138 put a CHR$6 and CHR$13
 into the input buffer
 2390LDX#0
 2400LDY#6
 2410JSR OSBYTE
 2420LDA#138
 2430LDX#0
 2440LDY#13
 2450JSR OSBYTE
 2460
 2470RTS \ END OF MAIN PROG
 2480\**************************
**********
 2490.BINtoDEC \ convert a 16 bit b
inary number stored in bin
 2500\ into 5 digit decimal stored
in dec
 2510LDA#0
```

(listing continued on next page)

The pointer used to search a line.

```
pointer   pointerP4
   1 GOTO 1050                {the dummy line}
1230 PRINT"GO":GOTO 1050      {the line being searched}
pointer2  pointer3  disp=0
```

The first comparison.

```
   1 GOTO 1050
                              {does not match}
1230 PRINT"GO":GOTO 1050
pointer2  pointer3  disp=0
```

The second comparison.

```
   1 GOTO 1050
                              {does not match}
1230 PRINT"GO":GOTO 1050
pointer2  pointer3  disp=1
```

The seventh comparison.

```
   1 GOTO 1050
                              {does not match}
1230 PRINT"GO":GOTO 1050
pointer2  pointer3  disp=6
```

This example should not be taken literally. The letters P,R,I,N,T, etc. do not appear in memory, just a string of tokens. But the tokens are compared in the same way as the letters in the example.

Figure 1. The search procedure used by Find.

(continued from previous page)

next line and the search continues. The Find program knows when it has reached the end if it comes to a line beginning 13, 255. This is detected by lines 2170 to 2210. Finally, the dummy line inserted by part 1 is deleted by entering its line number followed by a Carriage Return into the input buffer.

To use the Find utility first make a tape or disc copy of the listed program. You can store the 548 bytes of machine code either below Page or above Himen. To get some free memory below Page use the following procedure.

1. Press Break.
2. Type
   PRINT PAGE
   The computer replies with XXXXX.
3. Type
   PAGE = PAGE + &300
4. Type
   PRINT PAGE
   The computer replies with YYYYY.
5. Load Find from tape or disc.
6. Change line 50 to
   50 Start = XXXXX + 2
7. Change line 3526 to read
   3526 *key10?&200 = Z% MOD256
   ||M?&201 = Z%DIV256
   ||MPAGE = YYYYY||MOLD||M
8. Run the program, and the Find utility is ready for you to use.

If you would like a copy of the program on tape, please send a cheque for £3.50 to the author: Mark Callaway (Find), 10 Lealands, Lesbury, Alnwick, Northumberland NE66 3QN.

(listing continued from previous page)

```
2520LDX#5
2530.LOOP2 STA dec-1,X
2540DEX
2550BNE LOOP2
2560
2570LDX#0
2580LDY#0
2590
2600.LOOP3
2610LDA#0 \ bin=0 ?
2620CMP bin
2630BNE T3
2640CMP bin+1
2650BNE T3
2660RTS
2670
2680.T3 LDA bin+1 \ bin >= PT ?
2690CMP PT+1,Y
2700BCC notmore
2710BNE more
2720LDA bin
2730CMP PT,Y
2740BCS more
2750
2760.notmore INY
2770INX
2780INY
2790JMP T3
2800
2810.more SEC \  bin=bin-PT
2820LDA bin
2830SBC PT,Y
2840STA bin
2850LDA bin+1
2860SBC PT+1,Y
2870STA bin+1
2880
2890INC dec,X \ update dec
2900JMP LOOP3
2910
2920RTS
2930\*****************************
***********
2940\ print number stored in bin
2950.printno JSR BINtoDEC
2960LDX#0
2970.nextdigit LDA dec,X
2980CLC
2990ADC#ASC"0"
3000JSR OSWRCH
3010INX
3020CPX#5
3030BNE nextdigit
3040
3050LDX#3
3060LDA#32
3070.T5 JSR OSWRCH
3080DEX
3090BNE T5
3100RTS
3110
3120.insertlineno LDX#0 \ put a li
ne no stored in dec into the input
buffer
3130.LOOP4 LDA dec,X
3140CLC
3150ADC#ASC("0") \ ASC of "zero"
3160TAY
3170TXA
3180PHA
3190LDA#138
3200LDX#0
3210JSR OSBYTE \ type line number
into keyboard buffer
3220
3230PLA
3240TAX
3250INX
3260CPX#5
3270BNE LOOP4
3280RTS
3290]
3300
3301REM Set up storage
3302disp=P%:P%=P%+1:REM used when
searching a line for tokens
3303nochars=P%:P%=P%+1:REM number
of tokens we are searching for.
3304lineno=P%:P%=P%+2:REM line num
ber of the line created by part 1
3305bin=P%:P%=P%+2:REM input to bi
nary to decimal convertor.
3306dec=P%:P%=P%+5:REM output of b
inary to decimal convertor.
3307
3310REM set up messages
3320message2=P%:P%=P%+10
3330$message2="CALL"+STR$(part2)+"
"
3340?(message2+9)=13
3350
3360REM set up data table for BIN
to DECIMAL convertor
3370PT=P%
3380!PT=10000
3390PT!2=1000
3400PT!4=100
3410PT!6=10
3420PT!8=1
3430P%=P%+10
3440tempy=P%:P%=P%+1
3450NEXT PASS
3460PRINT'"Machine code starts at
&";~start;","
3470PRINT"ends at &";~P%
3480PRINT"and is ";P%-start;" byte
s long."
3490PRINT'"It uses zero page locat
ions &70 to &79  and uses Z% to rec
over after a BREAK."
3500PRINT "Invoke the FIND utility
with *LINE"
3505PRINT"eg. *LINE PRINT"
3510?&200=start MOD256
3520?&201=start DIV256
3525Z%=start
3526*key10?&200=Z% MOD256:M?&201=Z
% DIV256:MOLD!M
3530END
```

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Commentator

Mike Hart's utility allows you to produce clearer Commodore Basic programs by adding comments and indenting lines within subroutines.

ADVOCATES of structured programming were disappointed when the Commodore 64 appeared with a version of Basic which now looks distinctly old-fashioned. In particular there is no Repeat-Until or Do-While facility, variable names are limited to the first two significant characters, and listings do not allow for indentation which will help to keep the structure of a program clear when it comes to debugging and program maintenance. Many of these problems are solved with Comal but this has its own disadvantages, principal amongst which is the fact that the tape version takes some five or six minutes to load and consumes 26K of memory.

Commentator is a 172-byte machine-code routine which sits in the cassette buffer — the second cassette buffer in the case of Pets. It is designed as a simple aid to the writing of better structured programs with Commodore machines without the need to feed in a whole new Basic interpreter, as is possible with the Commodore 64.

Three extras

Essentially, Commentator extends the CHRGet routine in three ways. First, it makes it possible to put any comment in a line within square brackets without generating a Syntax Error. This facility allows lines to be labelled with such words as Repeat, Until, Do, While, Else, etc. but the actual construction of the loop is left to the programmer.

Secondly, it allows a comment to be put at the end of a line, preceded by an apostrophe, thus making Commodore Basic similar to many other Basics such as those offered in Tandy machines. Essentially this replaces the Rem construction. Finally, a fairly simple Auto facility is provided in response to a single key plus Return, but with the automatic addition of a colon after the number. This allows the programmer to indent loops, leave blank lines, etc. and thus improve the appearance and readability of a program.

Commentator does not by itself add new words or structures to the interpreter. Rather, by adding the facility to add labels and comments to a line it allows the programmer to simulate these structures.

The most important facility provided by Commentator is to ensure that Gotos and Gosubs no longer call anonymous line numbers but can reference labelled lines. Some programmers may already have discovered the fact that a construction such as

```
10 GOSUB 1000 (CONVERT S/R)
```

is not illegal in Commodore Basic as the interpreter will only look for valid numbers and will ignore the rest. Whether this is by accident or design when the original interpreter was written can only be a matter of conjecture.

The demonstration program, listing 1, provides some examples of the way in which structured programming can be simulated using Commentator. Lines 100 to 190 form a Repeat-Until loop. Note that the condition is tested at the end of the loop. Lines 200 to 350 form a While-Endwhile structure. Here the condition is tested at the commencement of the loop, and further processing is carried out only while a certain condition holds true.

In lines 400 to 490 the alternative to the If statement is labelled Else, and Endif is used to mark the end of the testing process. The labels Loop and Endloop are completely arbitrary to help give the module a clear and self-contained structure. In lines 600 to 720 both the Gosub call and the subroutine itself are clearly labelled, avoiding the use of anonymous line numbers.

Commentator gives greater clarity to a program in the following ways. There are no calls to a line number without it being labelled with its corresponding function. Blank lines and indentation are used extensively to improve the readability of a program. This will take up more memory space but not considerably more. Variables or complete lines can be tagged with a comment to make clear the function of that construction, as in line 130 and line 440, for example. A programmer is also free to create whatever constructions appear to give greatest clarity: the labels Loop, Endloop are used in lines 420 and 490, for example, to designate a particular section of code.

The Commentator listing is in the form of a combined Basic loader/disassembly. The Data statements are given in hex together with the disassembly code mnemonic. The entire code is designed to sit in the cassette buffer from locations 828 to 999 decimal. Commentator is a

Listing 1. Commentator demo.

```
1 FOR I=828TO999:READ H$
2 D=0:FORJ=1TO2:D%=ASC(MID$(H$,J)):D=16*D+D%-48+(D%>64)*7:NEXT
3 POKE 1,D:NEXT
4 SYS900
10 DATA A2,90,86,61,A4,FB,84,63,A5,FC
11 DATA 85,62,30,03,20,91,B3,20,DD,BD
12 DATA A8,C8,B9,00,01,D0,FA,84,C6,A9
13 DATA 3A,99,00,01,B9,01,01,99,77,02
14 DATA 88,10,F7,18,A5,FB,65,FD,85,FB
15 DATA A5,FC,65,FE,85,FC,60,20,DE,03
16 DATA 84,FB,85,FC,20,DE,03,84,FD,85
17 DATA FE,60,A9,4C,85,73,A9,A6,85,74
18 DATA A9,03,85,75,85,FC,A9,E8,85,FB
19 DATA A9,0A,85,FD,A9,00,85,FE,60,E6
20 DATA 7A,D0,02,E6,7B,60,20,9F,03,A0
21 DATA 00,B1,7A,C9,5B,F0,04,C9,27,D0
22 DATA 14,20,9F,03,B1,7A,F0,0D,C9,5D
23 DATA F0,06,C9,3A,D0,F1,F0,03,20,9F
24 DATA 03,C9,5F,F0,03,4C,79,00,A9,91
25 DATA 20,D2,FF,20,91,B3,20,3C,03,4C
26 DATA 8A,00,20,FD,AE,20,8A,AD,20,F7
27 DATA B7,60
100 :     'REPEAT-UNTIL
110 :
120 :DIM X(100)
130 :[REPEAT] N=N+1 'COUNTER
140 :          PRINT"ENTRY NO";N;
150 :          INPUT X
160 :[UNTIL]   IF X<>999 THEN X(N)=X:GOTO 130 [REPEAT]
170 : PRINT:PRINT"--END--":END
180 :
190 :
200 :    'WHILE-WEND
210 :
220 :INPUT"GUESS SQUARE ROOT OF 10";APPROX
230 :DELTA=SQR(10)-APPROX:X=10
240 :
```

series of machine-code subroutines designed so that it would suit the entire range of Commodore machines. The code extends from 828 to suit the Vic-20 and Commodore 64 machines, but is designed to finish by location 1000, above which it is likely to be corrupted in Basic 4 machines. The subroutines within the code are shown in table 1.

Users of Basic 4 will know that the second cassette buffer is used from location 826 to 896 for Basic 4 disc commands. However, the locations from 897 to 1000 are still usable for machine-code subroutines. The routine was initially developed on a Basic 4 machine and was written so that the main routine would start at location 900 and finish at location 999, where it would be free from corruption.

Modification

Basic 4 users can avoid Basic 4 disc commands altogether, in which case the entire routine will work after modification of the ROM calls detailed in table 2. Alternatively you can sacrifice the line-number generation routine altogether and only feed in lines 1370 to 1850, altering line 100 to read from 900 to 999. In addition, Basic 4 users should amend line 1740 so that it reads F0, 00; it does not now avoid the absolute jump to the end of the CHRGet routine in RAM.

Basic 2 and Basic 4 users may prefer the use of the # or the @ symbol to generate line numbers in which case substitute $23 for #, or $40 for @, in line 1730.

Line no.	Basic 4	Basic 2	Vic-20
1010	86 5E	86 5E	—
1030	84 60	84 60	—
1050	85 5F	85 5F	—
1070	20 BC C4	20 6D C2	20 91 D3
1080	20 93 CF	20 E9 DC	20 DD DD
1130	84 9E	84 9E	—
1170	99 6F 02	99 6F 02	—
1380	85 70	85 70	—
1400	85 71	85 71	—
1420	85 72	85 72	—
1520	E6 77	E6 77	—
1540	E6 78	E6 78	—
1590	B1 77	B1 77	—
1650	B1 77	B1 77	—
1750	4C 76 00	4C 76 00	—
1780	20 BC C4	20 6D D2	20 91 D3
1800	4C 87 00	4C 87 00	—
1820	20 F5 BE	20 F8 CD	20 FD CE
1830	20 84 BD	20 8B CC	20 8A CD
1840	20 2D C9	20 D2 D6	20 F7 D7

Table 2. Alterations required for machines other than Commodore 64.

Although originally designed on a 4032 Pet, the version of Commentator presented here is that for the Commodore 64 machines. Other Commodore programmers can use table 2 to alter the version of the program as they type it in. A dash in the table signifies that no change is necessary.

The call Sys 900 initalises the routine, essentially by diverting the CHRGet routine into a routine at $03A6. Lack of available space in the cassette buffer means that there is no more available room to fit in a routine which will restore CHRGet. However, other utilities that alter CHRGet, such as DOS Universal Wedge, will be affected so CHRGet will need resetting before these other utilities can be utilised.

The easiest way to do this is to use the warm start Sys calls that moves CHRGet from ROM to RAM as part of general initialisation procedures. The appropriate calls are Sys 58263 for the Commodore 64, Sys 58235 for the Vic-20, Sys 54198 for Basic 4, and Sys 57622 for Basic 2. Any Basic programs residing in memory will be lost by this procedure, but machine code can be reinitialised by calling the appropriate start address.

The utility defaults to generating line

(continued on next page)

Lines 1370-1500 — Diversion of CHRGet routine and initialisation of pointers for the line start and increment
Lines 1520-1550 — A small routine to increment the Basic pointer as CHRGet is diverted before this routine can take place
Lines 1570-1750 — Main CHRGet routine which looks for and processes the characters [,] and '. In addition, the Back Arrow token is sought and, if found, triggers off the line-number generation routine
Lines 1000-1270 — This complicated routine assembles the line number and colon in the floating-point accumulator, converts it into a string at the top end of the stack and then places it in the keyboard buffer from where it is output to the screen
Lines 1290-1350 — Adds the line number start and increment parameters to the Sys 885 subroutine call. The default is 1000, + 10, and this can be regenerated with a Sys 900.

Table 1. Commentator subroutines.

```
250 :[WHILE] IF ABS(DELTA)<=0.01 THEN 280 [ENDWHILE]
260 :         DELTA=(X/APPROX-APPROX)/2
270 :         APPROX=APPROX+DELTA:GOTO 250 [WHILE]
280 :[ENDWHILE]
290 :
300 :PRINT"SQUARE ROOT OF 10 (3 D.P)=";INT(APPROX*1000+0.5)/1000
320 :PRINT
330 :PRINT"--END--":END
340 :
350 :
400 :     'IF-THEN-ELSE-ENDIF
410 :
420 : [LOOP] N=N+1:PRINTN, 'COUNTER
430 :
440 :         J=INT(RND(1)*10)+1 ' RANDOM NO. 1-10
450 :
460 :         [IF] IF J<=5 THEN PRINTJ;"<=5":PRINT:GOTO 480 [ENDIF]
470 :         [ELSE] PRINTJ;">5":PRINT
480 :         [ENDIF] IF N<10 THEN 420 [LOOP]
490 : [END LOOP]
500 :
510 :PRINT:PRINT"--END--":END
520 :
530 :
540 :
600 :    ' NAMED GOSUB
610 :
620 :INPUT "2 DIGIT HEX NO=";H$:GOSUB 700 [HEX CONVERT]
630 :PRINT H$;" =";D
640 :PRINT
650 :PRINT"--END--":END
660 :
690 :
700 :'HEX CONVERT
710 :
720 :D=0:FORJ=1TO2:D%=ASC(MID$(H$,J)):D=16*D+D%-48+(D%>64)*7:NEXT:RETURN
READY.
```

(continued from previous page)

numbers starting at 1000 in increments of 10. To change either parameter it is necessary to use the call Sys 885. In this call, both parameters will need to be supplied even if one of them is not to be altered. The next line number will be remembered if you edit existing lines in the program. Press Return after entering the line-generating symbol.

Obviously it is necessary to save Commentator complete with any program that has been written with its use, as otherwise Syntax Error would be generated if one tried to run a program without the diversion of CHRGet. The method of saving Commentator will differ slightly from machine to machine.

On Pets, with tape or disc, the solution is simple. Change the Start of Basic pointers to 40,41 to point to the start of the machine code at 828. Location 40 should contain the value of 60, while location 41 should contain a 3. For Commodore 64 machines with disc essentially the same solution is adopted. As the screen locations lie in the memory between the first cassette buffer and the Basic program you will save this as well — a fact you might find interesting or disconcerting as you see an old screen overloading the present one.

Tape loader

For Commodore 64s with tape or Vic-20s with tape you might like to have a simple loader which reads in the routine and then initialises it. You will obviously need to keep this loader on a clear piece of tape and then make a copy of it which you will extend as you build your Basic program on top of it. Initialisation takes around 10 seconds. Although there are Data statements in the routine this should create no problems if you intend to Run from the beginning every time, as the Data pointer will then be pointing to your first piece of data. If you intend to Run from your own starting point, such as line 100, then you may need to put in a line which reads the existing Data statements to pass over them; for example

```
FOR J = 1 to 172: READ X$:NEXT J
```

The Data pointer will now be ready to read the first piece of genuine data.

An interesting short cut can be used for Commodore 64 owners with tape. A normal save will, of course, overwrite the contents of the cassette buffer, thus destroying what you want to save. The solution lies in the fact that you can fool the Save routine into saving the machine code alongside the name and then relocating it once the routine has been successfully loaded. To use this technique, which is quite capable of adaptation for all of your other favourite machine-code routines, enter the following in direct mode

```
A$ = "":FORJ = 0TO171:A$ = A$ + CHR$
  PEEK(828 + J)):NEXT.
N$ = LEFT$("PROGRAM-NAME[15
  blank spaces]",15)
C$ = N$ + A$:PRINT LEN(C$)
SAVE C$
```

The first command saves the code in A$, the second makes the name 15 characters long, and the third makes C$ equal to name plus code, which should be equal to 187.

Listing 2. Commentator Basic loader/disassembly.

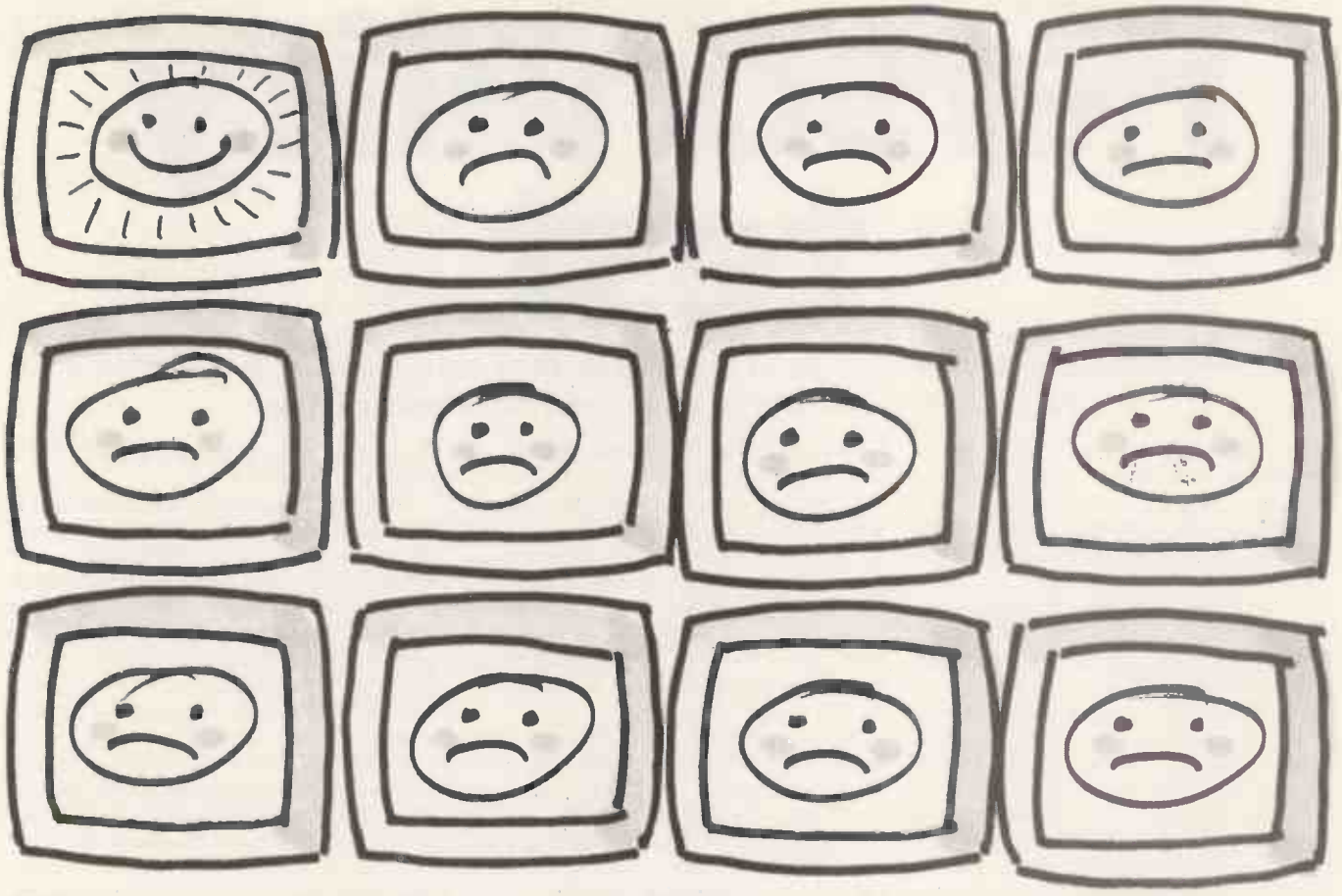
```
10 PRINT CHR$(147):PRINT:PRINT
20 PRINT "       COMMENTATOR      M. C. HART"
30 PRINT "       ============     ==========="
40 PRINT:PRINT"--LOADING...":PRINT
100 FOR I=828 TO 999:READ H$
110 D=0:FORJ=1TO2:D%=ASC(MID$(H$,J)):D=16*D+D%-48+(D%>64)*7:NEXT
120 POKEI,D:NEXTI
130 PRINT:PRINT"--LOADED--"
140 SYS 900
150 PRINT:PRINT"NB SYS 900 INITIALISES 'COMMENTATOR'"
160 PRINT"[ THE PROGRAM INITIALISES ITSELF]"
170 PRINT
180 PRINT"SYS 885,<START>,<INCREMENT> CHANGES"
190 PRINT"THE LINE NUMBER & INCREMENT":PRINT
200 PRINT"BOTH PARAMETERS ARE NECESSARY"
210 PRINT:PRINT"--END--":NEW:END
1000 DATA A2,90     :REM LDX #$90
1010 DATA 86,61     :REM STX $61
1020 DATA A4,FB     :REM LDY $FB
1030 DATA 84,63     :REM STY $63
1040 DATA A5,FC     :REM LDA $FC
1050 DATA 85,62     :REM STA $62
1060 DATA 30,03     :REM BMI $034D
1070 DATA 20,91,B3  :REM JSR $B391
1080 DATA 20,DD,BD  :REM JSR $BDDD
1090 DATA A8        :REM TAY
1100 DATA C8        :REM INY
1110 DATA B9,00,01  :REM LDA $0100,Y
1120 DATA D0,FA     :REM BNE $0351
1130 DATA 84,C6     :REM STY $C6
1140 DATA A9,3A     :REM LDA #$3A
1150 DATA 99,00,01  :REM STA $0100,Y
1160 DATA B9,01,01  :REM LDA $0101,Y
1170 DATA 99,77,02  :REM STA $0277,Y
1180 DATA 88        :REM DEY
1190 DATA 10,F7     :REM BPL $035E
1200 DATA 18        :REM CLC
1210 DATA A5,FB     :REM LDA $FB
1220 DATA 65,FD     :REM ADC $FD
1230 DATA 85,FB     :REM STA $FB
1240 DATA A5,FC     :REM LDA $FC
1250 DATA 65,FE     :REM ADC $FE
1260 DATA 85,FC     :REM STA $FC
1270 DATA 60        :REM RTS
1280 :
1290 DATA 20,DE,03  :REM JSR $03DE
1300 DATA 84,FB     :REM STY $FB
1310 DATA 85,FC     :REM STA $FC
1320 DATA 20,DE,03  :REM JSR $03DE
1330 DATA 84,FD     :REM STY $FD
1340 DATA 85,FE     :REM STA $FE
1350 DATA 60        :REM RTS
1360 :
1370 DATA A9,4C     :REM LDA #$4C
1380 DATA 85,73     :REM STA $73
1390 DATA A9,A6     :REM LDA #$A6
1400 DATA 85,74     :REM STA $74
1410 DATA A9,03     :REM LDA #$03
1420 DATA 85,75     :REM STA $75
1430 DATA 85,FC     :REM STA $FC
1440 DATA A9,E8     :REM LDA #$E8
1450 DATA 85,FB     :REM STA $FB
1460 DATA A9,0A     :REM LDA #$0A
1470 DATA 85,FD     :REM STA $FD
1480 DATA A9,00     :REM LDA #$00
1490 DATA 85,FE     :REM STA $FE
1500 DATA 60        :REM RTS
1510 :
1520 DATA E6,7A     :REM INC $7A
1530 DATA D0,02     :REM BNE $03A5
1540 DATA E6,7B     :REM INC $7B
1550 DATA 60        :REM RTS
1560 :
1570 DATA 20,9F,03  :REM JSR $039F
1580 DATA A0,00     :REM LDY #$00
1590 DATA B1,7A     :REM LDA ($7A),Y
1600 DATA C9,5B     :REM CMP #$5B
1610 DATA F0,04     :REM BEQ $03B5
1620 DATA C9,27     :REM CMP #$27
1630 DATA D0,14     :REM BNE $03C9
1640 DATA 20,9F,03  :REM JSR $039F
1650 DATA B1,7A     :REM LDA ($7A),Y
1660 DATA F0,0D     :REM BEQ $03C9
1670 DATA C9,5D     :REM CMP #$5D
1680 DATA F0,06     :REM BEQ $03C6
1690 DATA C9,3A     :REM CMP #$3A
1700 DATA D0,F1     :REM BNE $03B5
1710 DATA F0,03     :REM BEQ $03C9
1720 DATA 20,9F,03  :REM JSR $039F
1730 DATA C9,5F     :REM CMP #$5F
1740 DATA F0,03     :REM BEQ $03D0
1750 DATA 4C,79,00  :REM JMP $0079
1760 DATA A9,91     :REM LDA #$91
1770 DATA 20,D2,FF  :REM JSR $FFD2
1780 DATA 20,91,B3  :REM JSR $B391
1790 DATA 20,3C,03  :REM JSR $033C
1800 DATA 4C,8A,00  :REM JMP $008A
1810 :
1820 DATA 20,FD,AE  :REM JSR $AEFD
1830 DATA 20,8A,AD  :REM JSR $AD8A
1840 DATA 20,F7,B7  :REM JSR $B7F7
1850 DATA 60        :REM RTS
```

Header

The program should now save successfully on to tape complete with the machine code in its name, and this will feed in with the header on a subsequent Load. The header consists of an identification byte, two bytes of start address, two bytes of end address and 15 bytes of normal name, so the machine code is now located 20 locations further on in memory, starting at location 848. The first line of the program that you are saving should be the following

```
FOR J = 0 TO 171: POKE828 + J,
  PEEK(848 + J):NEXT SYS900
```

and the code will now successfully be relocated into its correct position. This technique initialises Commentator very quickly without the need for a built-in loader, but it does have one drawback. After the initial Save has been performed the Commodore 64 keyboard is somehow disabled, which means that you will have to power off and on again to restore the machine.



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Personality test

Andrew Brimble explains how you can take to your couch and use your micro to discover the secrets of your innermost personality.

MOST PEOPLE seem fascinated by the concept of personality testing, perhaps because we are all interested in our own personality. The idea of a questionnaire-type test which gives an indication about the subject's personality is not new, dating back to the 1940s. What I have done is to take a commonly used test, namely the Eysenck personality inventory, and adapt it to be presented by a computer.

The advantage of using a computer is that the questions can be automatically marked, and the subject's score worked out and explained immediately after the test. Also included is a subroutine which plots a bar chart of the major scores in colour, and a subroutine which plots a graph of the subject's scores in relation to known scores by other groups of people. It is most important that people who take the test do not take the results too seriously, and screens are included which explain what each score means and how the results should be taken.

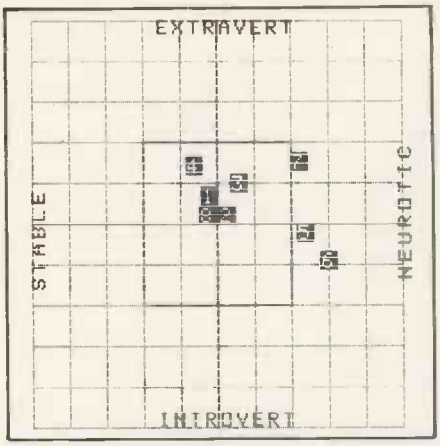
Subjects should be as relaxed as possible, and should be fairly confident about using the keyboard, although they only have to use the 1, 2, Space and Return keys. The answers required are simply Yes or No.

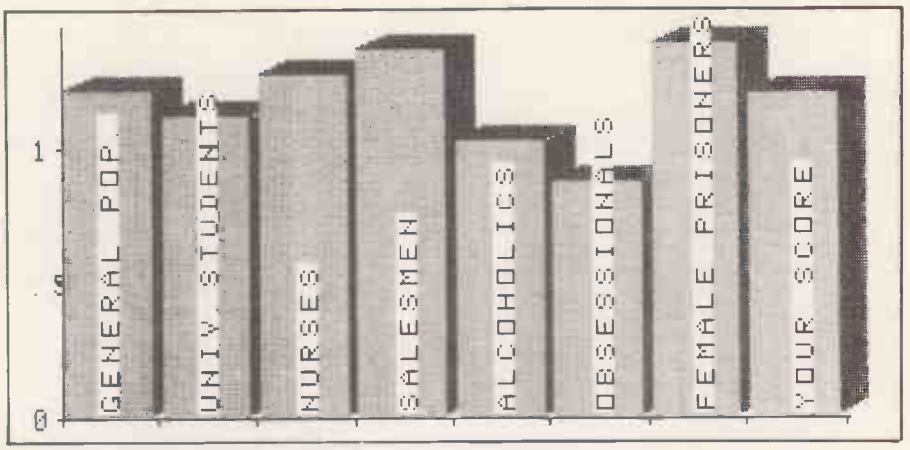
There are three scores. The E score is an index of extraversion/introversion, mean value being about 10. The N score is an index of neuroticism/stability, with a mean of about 10. The L score is an index of untruthfulness, and if this is over 6 the subject has been telling a few lies. At the end of the test the scores are presented and explained, and charts are presented for further information.

The program was written on a Research Machines 380Z, but could be adapted fairly easily to run on almost any similar micro. This version requires an RML 380Z or 480Z, with at least 36K of RAM since the Basic interpreter takes up 20K and the program a further 16K. A high-resolution graphics board and a Basic which supports high-resolution graphics to level 2 are also needed.

You could adapt this version to run without any graphics by removing lines 50, 60, 810, 820, 960, 1070, 1080, 1120, 1130, 1240, 1250, 1290, 1310, 1320, and 1920 to 3520 inclusive. You should add the following lines if you are doing the conversion

```
10 REM --------------------------------
20 REM - PERSONALITY TESTING PROGRAM  -
30 REM - ANDY BRIMBLE : 10/11/83      -
40 REM --------------------------------
50 CALL"RESOLUTION",0,2
60 CALL"COLOUR",0,0,0,3
70 CLEAR 3000
80 DIM AE(15)
90 DIM MN(24)
100 NQ=57 : REM no. of questions
110 REM -----------------------------
120 REM - INTRODUCE PERSONALITY TEST-
130 REM -----------------------------
140 PUT 18:PUT 31:?:?
150 PUT 24:PUT 24:?"Hello, I'm going to ask you some"
160 PUT 24:PUT 24:?"questions about yourself.        "
170 ?:PUT 24:PUT 24:?"The answers will be used to work"
180 PUT 24:PUT 24:?"out an index of your personality."
190 ?:PUT 24:PUT 24:?"The questions are about how you"
200 PUT 24: PUT 24:?"think, feel and act - you should try"
210 PUT 24:PUT 24:?"to decide whether 'yes' or 'no' would"
220 PUT 24: PUT 24:?"be the way you usually think or feel"
230 ?:PUT 24:PUT 24:?"Please relax, and try to answer"
240 PUT 24:PUT 24:?"with your first reaction to each "
250 PUT 24:PUT 24:?"question. Try to answer quickly,"
260 PUT 24:PUT 24:?"just by typing 1 for yes, and"
270 PUT 24:PUT 24:?"                 2 for no."
280 ?:?
290 INPUT"  PRESS <RETURN> WHEN YOU ARE READY >",X$
300 REM -----------------------------
310 REM - ASK QUESTIONS IN TURN      -
320 REM -----------------------------
330 FOR I=1 TO NQ
340 PUT 31:?:PUT 24:PUT 24:?"Question";I
350 PUT 18:READ Q$:?
360 PUT 24:PUT 24:?Q$
370 PUT 20 :?:PUT 24:PUT 24:?"_____"
380 ?:?
390 ?:?:?:PUT 24:PUT 24:?"Please type your answer :"
400 ?:?:PUT 24:PUT 24:?"Type 1 for yes, 2 for no :":PUT 9:PUT 9:PUT21
410 PR$="     ----->"
420 LET A$=GET$(1200)
430 IF A$="1" THEN FORI=1TO5:PUT 13:NEXTX:?PR$;" 1 - YES"
440 IF A$="2" THEN FORI=1TO5:PUT 13:NEXTX:?PR$;" 2 - NO"
450 IF A$="" THEN ?:?:?"Sorry, time's up, lets go on to the next question ":D=D+1:Z=GET(500):GOTO 770
460 IF A$()"1" AND A$()"2" THEN ?:PUT 24:PUT 24:?"1 FOR YES, 2 FOR NO, REMEMBER?":GOTO 420
470 REM -----------------------------
480 REM - ARRAYS FOR MARKING CODES    -
490 REM -----------------------------
500 LET AE(1)=1:AE(2)=3:AE(3)=8:AE(4)=10:AE(5)=13:AE(6)=17:AE(7)=22:AE(8)=25:AE(9)=27:AE(10)=39
510 LET AE(11)=44:AE(12)=46:AE(13)=49:AE(14)=53:AE(15)=56
520 LET BE(1)=5:BE(2)=15:BE(3)=20:BE(4)=29:BE(5)=32:BE(6)=34:BE(7)=37:BE(8)=41:BE(9)=51
530 LET MN(1)=2:MN(2)=4:MN(3)=7:MN(4)=9:MN(5)=11:MN(6)=14:MN(7)=16:MN(8)=19:MN(9)=21:MN(10)=23
540 LET MN(11)=26:MN(12)=28:MN(13)=31:MN(14)=33:MN(15)=35:MN(16)=38:MN(17)=40:MN(18)=43
550 LET MN(19)=45:MN(20)=47:MN(21)=50:MN(22)=52
560 LET MN(23)=55:LET MN(24)=57
570 LET HL(1)=6:HL(2)=24:HL(3)=36
580 LET HN(1)=12:HN(2)=18:HN(3)=30:HN(4)=42:HN(5)=48:HN(6)=54
590 REM -----------------------------
600 REM - MARK QUESTIONS  / SET SCORE -
610 REM -----------------------------
620 FOR S=1 TO 15
630 IF A$="1" AND I=AE(S) THEN E=E+1 : REM E SCORE
640 NEXT S
650 FOR T=1 TO 9
660 IF A$="2" AND I=BE(T) THEN E=E+1 : REM E SCORE
670 NEXT T
680 FOR U=1 TO 24
```





Results are displayed graphically, comparing your personality traits with those of other groups.

820 PUT 31
960 PUT 31:PUT 18: PRINT
1070 ?"ready to see details of N score "
1240 ?"ready to continue :"

The program is laid out in blocks labelled with Rem statements explaining the function of each block. Lines 50 to 100 initialise the screen, call a coloured background, in this case blue, and clear string space and array space for the question strings and their marking codes. Lines 110 to 290 display an introductory screen which remains in view until the subject presses the Return key. Lines 300 to 470 are the heart of the program, as they call up the questions in turn from the Data lines below, and display them. They give the prompt "Type 1 for yes or 2 for no", and wait for the response. There are 57 questions, and they are always asked in the same sequence.

The next two blocks are very important, as they do the donkey-work involved in marking the questions and keeping scores. There are three arrays of marking codes. AE is an array containing the number of questions to which an answer of 1 increments the E score. As each response is given, the number of the question is compared with the data in AE, and if the question numbers match, the E score is incremented. The BE array contains numbers for which 2 increments the E score, MN contains numbers for which 1 increments the N score, and HL and HN are arrays which mark the L score. As each response is given, the number of the question is searched for in each array and if a match is found the appropriate score is incremented.

The remainder of the program displays and explains the scores, and calls up subroutines which plot bar charts and a graph so that subjects can compare their scores with other groups of people. The groups compared are the general population, university students, nurses, salesmen, alcoholics, obsessionals and female prisoners. The diagrams can be seen in figures 1 and 2, which are screen dumps from the program.

```
690 IF A$="1" AND I=MN(U) THEN N=N+1 : REM N SCORE
700 NEXT U
710 FOR V=1 TO 3
720 IF A$="1" AND I=HL(V) THEN L=L+1 : REM L SCORE
730 NEXT V
740 FOR W = 1 TO 6
750 IF A$="2" AND I=HN(W) THEN L=L+1 : REM L SCORE
760 NEXT W
770 NEXT I
780 REM ------------------------------
790 REM - PRESENT SCORES AND COMMENTS -
800 REM ------------------------------
810 CALL"CLEAR"
820 PUT 31:CALL"COLOUR",0,0,0,3
830 PUT 18:?:?
840 PUT 24:PUT 24:?"This is how your answers scored :"
850 ?:?
860 ?:PUT 24:PUT 24:? "E SCORE WAS :";E
870 ?:PUT 24:PUT 24:? "N SCORE WAS :";N
880 ?:PUT 24:PUT 24:? "L SCORE WAS :";L
890 IF L>5 THEN PUT 24:PUT 24:?"I don't think you have been too honest"
900 IF L>5 THEN PUT 24:PUT 24:?"have you?- The test relies on honesty!"
910 ?:PUT 24:? D;" QUESTIONS NOT ANSWERED"
920 ?
930 PUT 24:PUT24:?"PRESS THE SPACE BAR TO FIND OUT MORE  "
940 PUT 24:PUT 24:?"ABOUT YOUR SCORES -------->"
950 Z=GET (3000)
960 PUT 31:PUT18:CALL"COLOUR",0,0,0,3:?
970 ?:PUT 24:?"(Your  E  score was ";E;")":?
980 PUT 24:?"The      E  score is a measure of your"
990 PUT 24:?"extraversion / introversion (if your  "
1000 PUT 24:?"score is above 10 you are probably an "
1010 PUT 24:?"extravert (easy-going, lively, and    "
1020 PUT 24:?"gregarious, and a bit restless !)     "
1030 PUT 24:?"Below 10 and you are more of an intro-"
1040 PUT 24:?"vert(quiet, relaxed, a bit of a loner)"
1050 ?:?:?
1060 PUT 24:?"Press the  RETURN  key when you are   "
1070 PUT 24:?"ready to see a chart comparing your E "
1080 PUT 24:?"score with those of other people.     "
1090 ?:?:?
1100 PUT 20:PUT 21:INPUT"  ",X$
1110 PUT 23
1120 GOSUB 1920
1130 PUT 31:?:?:CALL"COLOUR",0,0,0,3:PUT 18
1140 PUT 24:?"(Your N score was ";N;")":?
1150 PUT 24:?"The   N score is a measure of your    "
1160 PUT 24:?"stability / neuroticism ! : if your   "
1170 PUT 24:?"N score is below 10, you are fairly   "
1180 PUT 24:?"stable. Above 10 and you are rather   "
1190 PUT 24:?"neurotic !  This DOES NOT mean any-   "
1200 PUT 24:?"thing sinister,  however, as the test "
1210 PUT 24:?"is by no means failsafe!"
1220 ?:?
1230 PUT 24:?"Press the  RETURN  key when you are   "
1240 PUT 24:?"ready to see a chart comparing your   "
1250 PUT 24:?"N score with those of other people    "
1260 ?:?:?:?
1270 PUT 20:PUT 21:INPUT" ",X$
1280 PUT 23
1290 GOSUB 2120
1300 PUT31 :?:?:?
1310 GOSUB 3000
1320 PUT 31:CALL"COLOUR",0,0,0,3
1330 ?:?:PUT 24:PUT 18:?"GOODBYE,THEN "
1340 END
```

(continued on next page)

(continued from previous page)

```
1350 DATA"Do you like a lot of excitement and      bustle about you ?"
1360 DATA"Do you often have a restless feeling     that you want to do something,          but don't know what?"
1370 DATA"Do you nearly always have a ready        answer when people talk to you?"
1380 DATA"Do you sometimes feel happy, some-       times sad, for no particular            reason ?"
1390 DATA"Do you usually stay in the back-         ground at parties and get-              togethers ?"
1400 DATA"As a child, did you always do as you     were told immediately, without          grumbling ?"
1410 DATA"Do you sometimes sulk ?"
1420 DATA"When you are drawn into a quarrel, do    you prefer to have it out to            being silent ?"
1430 DATA"Are you moody ?"
1440 DATA"Do you like mixing with people?"
1450 DATA"Have you often lost sleep over your      worries?"
1460 DATA"Do you sometimes get cross?"
1470 DATA"Would you call yourself happy-go-lucky?"
1480 DATA"Do you often make up your mind too late?"
1490 DATA"Do you like working alone ?"
1500 DATA"Have you often felt listless and tired   for no good reason ?"
1510 DATA"Are you rather lively ?"
1520 DATA"Do you sometimes laugh at a dirty joke?"
1530 DATA"Do you often feel fed up ?"
1540 DATA"Do you feel uncomfortable in anything    but everyday clothes ?"
1550 DATA"Does your mind often wander when you     are  trying  to  attend  closely  to something ?"
1560 DATA"Can you put your thoughts into words     quickly ?"
1570 DATA"Are you often lost in thought ?"
1580 DATA"Are you completely free from prejudices of any kind ?"
1590 DATA"Do you like practical jokes ?"
1600 DATA"Do you often think of your past ?"
1610 DATA"Do you very much like good food ?"
1620 DATA"When you get annoyed, do you need       someone friendly to talk to about it ?"
1630 DATA"Do you mind selling things or asking     for money for some good cause ?"
1640 DATA"Do you sometimes boast a little ?"
1650 DATA"Are you touchy about some things ?"
1660 DATA"Would you rather be at home on your      own than at a boring party ?"
1670 DATA"Do you sometimes get so restless that    you can't sit long in a chair ?"
1680 DATA"Do you like planning things carefully,   well ahead of time ?"
1690 DATA"Do you have dizzy turns ?"
1700 DATA"Do you always answer a personal letter   as  soon  as  you  can  after you have  read it ?"
1710 DATA"Can you usually do things better by      figuring them out alone than by talking to others ?"
1720 DATA"Do you ever get short of breath          without  having done heavy work ?"
1730 DATA"Are you an easy going sort of person,    not bothered about having everything    just so ?"
1740 DATA"Do you suffer from nerves?"
1750 DATA"Would you rather plan things than do     things ?"
1760 DATA"Do you sometimes put off until tomorrow  what you ought to do today ?"
1770 DATA"Do you get nervous in places like        lifts, trains, or tunnels ?"
1780 DATA"When you make new friends, is it         usually you who makes the first move,   or does the inviting ?"
1790 DATA"Do you get very bad headaches ?"
1800 DATA"Do you generally feel that things will   sort theaselves out and come right in   the end somehow ?"
1810 DATA"Do you find it hard to fall asleep at    bedtime ?"
1820 DATA"Have you sometimes told lies in your     life ?"
1830 DATA"Do you sometimes say the first thing     that comes into your head ?"
1840 DATA"Do you worry too long after an           embarrassing experience ?"
1850 DATA"Do you usually keep yourself to          yourself, except with very close        friends ?"
1860 DATA"Do you often get into a jam because      you do things without thinking ?"
1870 DATA"Do you like cracking jokes and telling   funny stories to your friends ?"
1880 DATA"Would you rather win than lose a game ?"
1890 DATA"Do you often feel self-conscious when    with superiors ?"
1900 DATA"When the odds are against you, do you    usually think it worth taking a chance ?"
1910 DATA"Do you often get butterflies in your     tummy before an important occasion ?"
1920 REM ------------------------------------------
1930 REM - INITIALISE BAR CHART OF RESULTS-E SCORE-
1940 REM ------------------------------------------
1950 Y6=20
1960 W8 = 0.9
1970 Y8$="E SCORE"
1980 N9=8
1990 L9$(1)="GENERAL POP.":L9$(2)="UNIV.STUDENTS":L9$(3)="NURSES":L9$(4)="SALESMEN"
2000 L9$(5)="ALCOHOLICS":L9$(6)="OBSESSIONALS":L9$(7)="FEMALE PRISONERS":L9$(8)="YOUR SCORE"
2010 Y9(1)=12.1:Y9(2)=11.1:Y9(3)=12.7:Y9(4)=13.6:Y9(5)=10.2:Y9(6)=8.7:Y9(7)=13.8:Y9(8)=E
2020 GOSUB 2250
2030 FOR I=1 TO N9
2040 Y9=Y9(I)
2050 GOSUB 2680
2060 NEXT I
2070 GOSUB2840
2080 PUT18:?:?
2090 ?"This is how your E (extraversion)score^  coapares with these groups of people"
2100 PUT20:X=GET(3000)
2110 TEXT:CALL"CLEAR":RETURN
2120 REM ------------------------------------------
```

```
2130 REM - INITIALISE BAR CHART OF RESULTS-N SCORE-
2140 REM ----------------------------------------
2150 Y8$="N SCORE"
2160 Y9(1)=9.1:Y9(2)=10.0:Y9(3)=10.6:Y9(4)=8.3:Y9(5)=14.0:Y9(6)=15.2:Y9(7)=13.7 :Y9(8)=N
2170 GOSUB 2250
2180 FOR I=1 TO N9
2190 Y9=Y9(I)
2200 GOSUB 2680
2210 NEXT I
2220 GOSUB 2840
2230 PUT18:?:?:?"This is how your N (neuroticisa) score^  compares with these groups of people"
2240 PUT20:X=GET(3000): TEXT:CALL"CLEAR":RETURN


2250 REM -------------------------
2260 REM -DRAW AXES FOR BAR CHART-
2270 REM -------------------------
2280 C1=0
2290 IF Y6>10 THEN Y6=Y6/10:C1=C1+1:GOTO2290
2300 IF Y6<1 THEN Y6=Y6*10:C1=C1-1:GOTO2300
2310 Y6=INT(Y6+.99):Y7=0
2320 X1=G1(1,W1):Y1=G1(2,W1)
2330 X2=G1(3,W1):Y2=G1(4,W1)
2340 IF W1=0 THEN X1=0:X2=318:Y1=0:Y2=191
2350 GRAPH:CALL"RESOLUTION",0,2
2360 CALL"PLOT",X1+10,Y1+12,3
2370 CALL"LINE",X2-6,Y1+12
2380 CALL"PLOT",X1+12,Y1+10
2390 CALL"LINE",X1+12,Y2-6
2400 D1=(X2-X1-19)/N9
2410 FOR X8=(X1+12) TO (X2-6) STEP D1
2420 CALL"PLOT",X8,Y1+10,3
2430 CALL"LINE",X8,Y11+12:NEXT X8
2440 A2=(Y2-Y1-18)/Y6
2450 IF Y6>5 AND Y6=<10 THEN A1=A2
2460 IF Y6>=3 AND Y6=<5 THEN A1=A2:
2470 IF Y6=<2 THEN A1=A2/2
2480 FOR Y8=Y1+12 TO Y2-6 STEP A1
2490 CALL"PLOT",X1+10,Y8,3:CALL"LINE",X1+12,Y8
2500 N4=(Y8-Y1-12)/A2:
2510 B$=MID$(STR$(N4),2)
2520 IF LEN(B$)>1 AND INT(N4)<>N4 THEN B$="."+RIGHT$(B$,1)
2530 CALL"STPLOT",X1,Y8-4,VARADR(B$),3:NEXT Y8
2540 CALL"DEFCHAR",127,255,255,255,255,255,255,255,255
2550 B$=CHR$(127)
2560 L1=LEN(Y8$):IF L1>(Y2-Y1-24)/8 THEN GOTO 2610
2570 Y8=Y2-24:FOR I2=1 TO L1
2580 CALL"STPLOT",X1,Y8,VARADR(B$),0
2590 W$=MID$(Y8$,I2,1):CALL"STPLOT",X1,Y8,VARADR(W$),3
2600 Y8=Y8-8:NEXT I2
2610 IF C1=0 THEN GOTO 2670
2620 F1$="x(":CALL"STPLOT",X1+13,Y2-12,VARADR(F1$),3
2630 C2=10^C1:F1$=MID$(STR$(C2),2)
2640 CALL"STPLOT",X1+29,Y2-12,VARADR(F1$),3
2650 X8=X1+29+8*LEN(F1$)
2660 F1$=")":CALL"STPLOT",X8,Y2-12,VARADR(F1$),3
2670 RETURN
2680 REM ---------------
2690 REM -FILL IN BARS -
2700 REM ---------------
2710 D2=W8*D1:CALL"COLOUR",2,0,7,0:CALL"COLOUR",1,7,0,0
2720 IF W1=0 THEN G1(1,W1)=0:G1(2,W1)=0:G1(3,W1)=318:G1(4,W1)=192
2730 IF V1=0 THEN X=G1(1,W1)+12:V1=1:I5=1
2740 X3=X+((D1-D2)/2):Y3=G1(2,W1)+13:X4=X+(D1+D2)/2:Y4=((Y9/10^C1)*A2)+12+Y1
2750 CALL"FILL",X3,Y3,X4,Y4,I5
2760 IF Y4>Y3 THEN FOR I2=X4 TO (X4+D2/3):IY=5*3/D2*(I2-X4):CALL"PLOT",I2,Y3+IY+1,2
2770 IF Y4>Y3 THEN  CALL"LINE",I2,Y4+IY:NEXTI2
2780 FOR I2=X4 TO X4+D2
2790 CALL"PLOT",I2-D2,Y4+1,2
2800 CALL"LINE",I2-D2+D2/3,Y4+5:NEXTI2
2810 X=X+D1
2820 TEXT
2830 RETURN
2840 REM --------------------
2850 REM -PUT LABELS ON BARS-
2860 REM --------------------
2870 X1=G1(1,W1):X2=G1(3,W1):IF W1= 0 THEN X1=0 : X2=318
2880 D1=(X2-X1-16)/N9:D2=(D1-8)/2
2890 X=X1+12+D2:
2900 FOR I2=1 TO N9
2910 B$=L9$(I2):C=LEN(B$):
2920 A$=CHR$(127):L2=8*(C+1)
2930 FOR Y=Y1+14 TO L2 STEP 8
2940 CALL"STPLOT",X,Y,VARADR(A$),0
2950 NEXT Y
2960 CALL"STPLOT",X+8,Y1+14,VARADR(B$),3,1
2970 X=X+D1
2980 NEXT I2
2990 RETURN
3000 REM -------------------------------
3010 REM -PLOT SCATTER GRAPH OF RESULTS-
3020 REM -------------------------------
3030 S$="NEUROTIC":S1$="STABLE"
3040 S2$="EXTRAVERT":S3$="INTROVERT":J=4
3050 GRAPH 1:GRAPH 0
3060 CALL"RESOLUTION",0,2
3070 CALL"COLOUR",1,0,4,0
3080 FOR X=0 TO 191 STEP 19
3090 CALL"PLOT",X,0,1
3100 CALL"LINE",X,190
3110 NEXT X
3120 FOR Y=0 TO 191 STEP 19
3130 CALL"PLOT",0,Y,1
3140 CALL"LINE",190,Y
3150 NEXT Y
3160 CALL"PLOT",95,0,3
3170 CALL"LINE",95,190
3180 CALL"PLOT",0,95,3
3190 CALL"LINE",190,95
3200 CALL"STPLOT",7,64,VARADR(S1$),3,1
3210 CALL"STPLOT",195,69,VARADR(S$),3,1
3220 CALL"STPLOT",64,183,VARADR(S2$),3
3230 CALL"STPLOT",64,0,VARADR(S3$),3
3240 REM ---------------------------
3250 REM -  PLOT  POINTS /INFO     -
3260 REM ---------------------------
3270 LET A9(1)=12.1:A9(2)=11.1:A9(3)=12.7:A9(4)=13.6:A9(5)=10.2:A9(6)=8.7:A9(7)=13.8:A9(8)=E
3280 LET A8(1)=9.1:A8(2)=10.0:A8(3)=10.6:A8(4)=8.3:A8(5)=14.0:A8(6)=15.2:A8(7)=13.7:A8(8)=N
3290 FOR I = 1 TO 8
3300 YO = A9(I)*9
3310 XO=A8(I)*10
3320 LET A$=STR$(I)
3330 CALL"PLOT",XO,YO,3
3340 CALL"FILL",XO-J,YO-J,XO+J,YO+J
3350 CALL"STPLOT",XO-12,YO-4,VARADR(A$),0
3360 NEXT I
3370 FOR I= 1 TO 8
3380 PUT 9:PUT 9:PUT 9:PUT24
3390 READ N$
3400 ?N$
3410 NEXT I
3420 DATA"1.GENERAL POP"
3430 DATA"2.UNIV STUDENT"
3440 DATA"3.NURSES"
3450 DATA"4.SALESMEN"
3460 DATA"5.ALCOHOLICS"
3470 DATA"6.OBSESSIONALS"
3480 DATA"7.FEMALE PRISON"
3490 DATA"8.YOUR SCORE"
3500 ?:?:?
3510 X=GET(3000)
3520 PUT31:TEXT:CALL"CLEAR":RETURN
```

PRINTERS

DOT MATRIX

All printers have centronic parallel interface unless otherwise stated. All printers have hi res dot addressable graphic mode. Please send SAE for full details.

EPSON

FX80 160CPS 10" wide friction & pin feed	£324 + VAT	£373
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RX80 F/T 100 CPS 10" wide friction & tractor feed	£239 + VAT	£275
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8143 RS 23 Interface for FX and RX printers	£39 + VAT	£45
8148 RS 232 Interface with 2K buffer x on x off	£60 + VAT	£69
RIbbon Cartridge for RX80 FX80 & MX80	£5 + VAT	£6
Ribbon Cartridge for FX100 & MX100	£7 + VAT	£8

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Canon PJ1080A 7 colour 40CPS ink jot printer	£391 + VAT	£449

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20 CPS Bi-Directional Logic seeking 10 12 15 CP1 + PS spacing 2K buffer best selling Daisywheel	£299 + VAT	£344
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Tractor Unit	£95 + VAT	£109
RS 232 Interface	£52 + VAT	£59
Spare Daisywheel	£14 + VAT	£16

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13 CPS Bi-directional 10, 12, 15 CP1 + PS	£344 + VAT	£395
Keyboard Unit	£139 + VAT	£159
Single Sheet Feeder Unit	£217 + VAT	£249
Tractor Unit	£95 + VAT	£109

QUENDATA

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DISC

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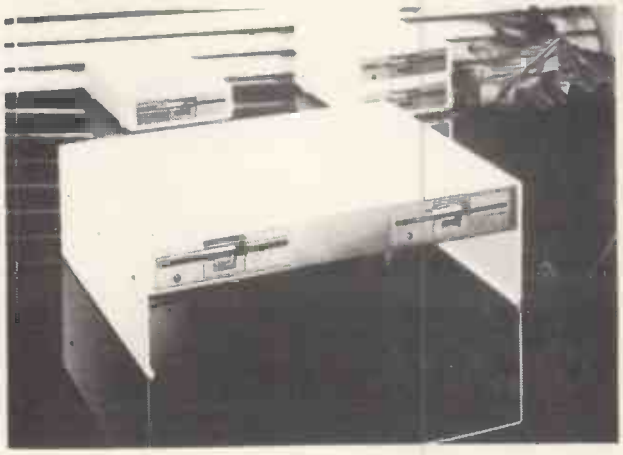

These drives are supplied ready cased with all the necessary cables formatting program and User Guide
There are some very useful utilities included on formating disc e.g.

- DISASSEMBLER: This is 6502 machine code disassembler
- DUP: To copy and rename a file on disc
- FORMAT: Formating progam for 40 & 80 tracks

PRODUCTS

BBC Microcomputer Model B	£348	+ VAT	£399
BBC Mod B - disk Interface	£409	+ VAT	£469
BBC Mod B - Econet interface	£389	+ VAT	£447
BBC Mod B - disk and Econet interfaces	£450	+ VAT	£517
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BBC cassette recorder and lead	£35	+ VAT	£40
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Fitting charge for A to B upgrade kit	£20	+ VAT	£23
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User Guide	£10		
Advanced User Guide	£12.95		
Econet Guide	£7.50		
Econet interface (free fitting)	£60	+ VAT	£69
Speech interface (free fitting)	£47	+ VAT	£54
BBC disk manual - formating disk	£30	+ VAT	£34
Parallel printer cable	£10	+ VAT	£11
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N.B. All prices are subject to change without notice and are rounded up to the nearest pound

OPENING HOURS: MON-FRI 9am-6.30pm, SAT 10am-5pm. We welcome callers, no parking problems.

DRIVES

* FREE: This utility provides a disk usage analysis
* MDUMP: Enables you to display and modify any part of BBC memory
* MERGE: Merge a number of text files into one file
* RELOCATE: Downloads a basic program to &E00
* SDUMP: Screen dump for EPSON In all graphic modes
* VERIFY: Verifies every sector on a disk
* MENU: A flexible menu program

Single drive 100K 40 trks single sided	£86	+ VAT	£99
Dual drive 200K 40 trks single sided	£164	+ VAT	£189
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Single drive 400K 80 trks double sided	£152	+ VAT	£175
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Dual drive 800K 80 trks double sided	£303	+ VAT	£349
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Dual Drive 800K 40 80 trks + PSU + built in monitor stand	£373	+ VAT	£429

All above drives are low power slimline (0 3 A typ at + 12v and 0 4 at + 5v per drive) Normally extra power supply is not required. The BBC Computer power supply is designed to drive to low power drive (IT IS NOT DESIGNED TO DRIVE INTERNAL ROM BOARD)

40 Track SS DD disketts (10 Box)	£18	+ VAT	£20
40 Track DS DD disketts (10 Box)	£23	+ VAT	£26
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SANYO 550-360

As 550 but with 2 x 360K Drives
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SANYO 550-730

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SANYO 555

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BBC 2: BBC Micro Model B + Disk Interface. View (or Wordwise) Wordprocessor. 100K Disk Drive, High Res Green Monitor. Quendata 20 CPS Daisywheel Printer. 1 Box of Disks and all the necessary cables
£799 + VAT = £803.35

BBC 3: Same as System BBC2 but with 400K Drive £875 + VAT = £1006.25

BBC 4: Same as System BBC 2 but with 400K Drive and JUKI 6100 Daisywheel Printer
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BBC 5: BBC Model B + Disk Interface, View (or Wordwise) Wordprocessor, 800K Dual Disk Drive (Mitsubishi), High Res Green Monitor. JUKI 6100 Daisywheel Printer, 1 Box (10) of 80 Track DS discs and all necessary cables £1145 + VAT = £1316.75.

SAN 1: Sanyo MBC 550 Series 16 Bit Microcomputer, 128K Ram. Dual 160K drives (2 x 160K), High Res Graphics (600 x 200 pixels in 8 colours), JUKI 6100 Daisywheel Printer. High Res Green Monitor. 1 Box of 10 discs, Wordstar Wordprocessor. Calcstar spreadsheet and all the necessary cables
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SAN 2: Same as SAN 1 but with Dual 360K Drives (2 x 360K) £1345 + VAT = £1546.75

SAN 3: Same as SAN 1 but with Dual 720K Drives £1395 + VAT = £1604.25

SAN 4: Sanyo MBC 555 Series 16 Bit Microcomputer, 128K Ram. Dual 160K Drives (2 x 160K), High Res Graphics (600 x 200 pixels in 8 colours) JUKI 6100 Daisywheel Printer. High Res Green Monitor. 1 Box of 10 discs. Wordstar, Wordprocessor, Calcstar spreadsheet, Mailmerge, Spellstar (dictionary), Datastar (database), Reportstar plus all the necessary cables £1295 + VAT = £1489.25.

SAN 5: Same as SAN 4 but with Dual 360K Drives £1475 + VAT = £1696.25

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● Circle No. 150

The silicon racket

by Ray Girvan

It was a hot night — hot enough to pop corn on the sidewalk. I sat in my apartment, tense as a cat on heat, and waited for the phone to ring.

There was a rattle of keys outside the door, and I reached for my heater with one hand and the button to kill my files with the other, but it was only Joe.

I sighed. "You nearly gave me cardiac arrest, Joe. Did your mother never teach you to knock on doors?"

"Sorry, Benny," he said dully, "I clean forgot."

"Don't worry. Now you're here, fix me a drink, and have one yourself." Joe is my sidekick. A turtle would stand a better chance of passing the Turing test than him — but he knows his job and keeps his mouth shut.

I sipped at the Scotch on the rocks that he brought. My necktie felt as tight as an anaconda round my throat, so I loosened it, then went one better and threw it in a corner. My top shirt button went with it. Hell, Joe could sew it on later; he was a man of rare talents.

The phone rang, and I was there faster than a panhandler after a handout.

"Yes?" I said, the Bakelite slippery as a cake of soap in my sweaty fingers. Isaacs' voice broke through the frying-fat hiss of static.

"Are you ready, Benny?" he wheezed.

"Give me a moment."

I handed the phone to Joe and went over to my machine. I booted the disc — and not figuratively. Joe dropped the unit once so it rattles like an ancient streetcar and sometimes sticks completely. After a nail-biting wait for the vacuum tubes to warm up, familiar white letters formed on the screen.

Joe held the phone to my ear. "I'm ready," I said, flexing and cracking my knuckles. My mother told me that it gives you arthritis, but what the hell.

"Right, Benny," said Isaacs, "José first. Gluke two points up, ketone five

"Right, Benny," said Isaacs, "José first. Gluke two points up, ketone five points down, cee one six up. . ." And so on, I won't bore you with it all. I typed it in as I heard it, and when he had finished, pressed the big, worn red key on the right of the board. The screen blanked for a long, long minute, then the result came up. I whistled.

"Listen Isaacs, and listen good — you've only got eight minutes. I want you to put two grand on José to win. That's all."

I smacked down the earpiece like I was swatting a fly. Joe was looking at me pityingly.

"Okay, Joe, what is it? Spit it out!" I snapped.

"Benny, the Hammer will flatten José. He's won his last five fights!"

I shook my head. I always get this.

"Joe, just wait and see," I said calmly, and went out to walk the hot streets.

I could have found a bar with a radio and listened to the fight, but I'm the excitable type and I'd be shouting and biting my nails before long. Instead, I wandered the baking sidewalks, gazing at the pulsing neon signs and watching the cop cars cruising like barracudas in a shoal of fat tuna. After an hour I gave in and found a news vendor I knew.

"Hi Jimmy, how's the big fight going?" I asked as coolly as I could.

"Finished 'bout three-quarters of an hour ago. José kayoed the Hammer in the fourth round."

My heart gave a sudden thump, like a fist clenching in my chest. Man, I was rich! I stood to collect 14 grand from various bets Isaacs had laid for me; according to the pundits, José had been an outside chance. But I knew better.

I gave Jimmy a dollar, then made my way back towards the apartment. I was nearly there when a big black Caddy pulled up beside me. I froze as the plate-glass side window rolled down.

"Get in, Benny," a lazy voice drawled, "The man wants to see you."

I got in. Arguing with the man isn't conducive to lasting to a ripe old age. Two heavies, a head taller than me and built like Carnera, searched me and took the clip from my heater. We drove to an apartment block somewhere on the East Side, where we climbed four flights and entered a smart room.

There was a crowd, mostly cheap hoods. You know the sort, lantern jaws and $5 tuxedos with vertical stripes and padded shoulders. They cleared out, leaving me and my escort along with a lean, haggard grey-haired guy with glasses; and behind a great desk like a battle cruiser, the man himself. I was pushed into a chair.

"Well, Benny," Capone said, rubbing pudgy manicured hands together. "They tell me you had a win tonight. Getting to be quite a habit, ain't it?"

I shrugged like a preppie caught with her lover. "I got lucky, I guess."

"Lucky?" Capone yelled, a scar rippling on his cheek. He waved a hand, and one of my keepers slugged me on the jaw, but not too hard. "Fourteen grand tonight, five last week, six the week before! What's your line? I want in on it!"

I'd no choice but to tell the truth or end up feeding the fish in East River. "I predict the fight results by computer."

Al lit a long fat cigar and looked at the grey, lean guy at his right. "Spider, is that possible? You tell me."

Spider shook his head. "No, boss," he said. He was in bad shape; I thought of a skinny mongrel I'd turned over to the dog-catcher once. "Too many variables, too random, it can't be done." He spoke with a plummy Boston accent.

One of my guardians raised a lead-weighted blackjack.

"Wait!" I cried. "It don't work if you just go on past form but I bought the doc who does the blood tests for dope before every fight, so I get the lowdown on sugar and fatigue poisons, how fit the guys are. And I use what I call biorhythms. I can predict the outcome — that's 85 percent certain!"

Capone waved the pug-ugly away. "I don't like this science none, or this mystical crap; but, well, it seems to work. Benny, you're on my payroll now. I need a good computer man."

"Boss?" Spider said plaintively. "You got me."

"I said need a good computer man! You got to liking your work too much!"

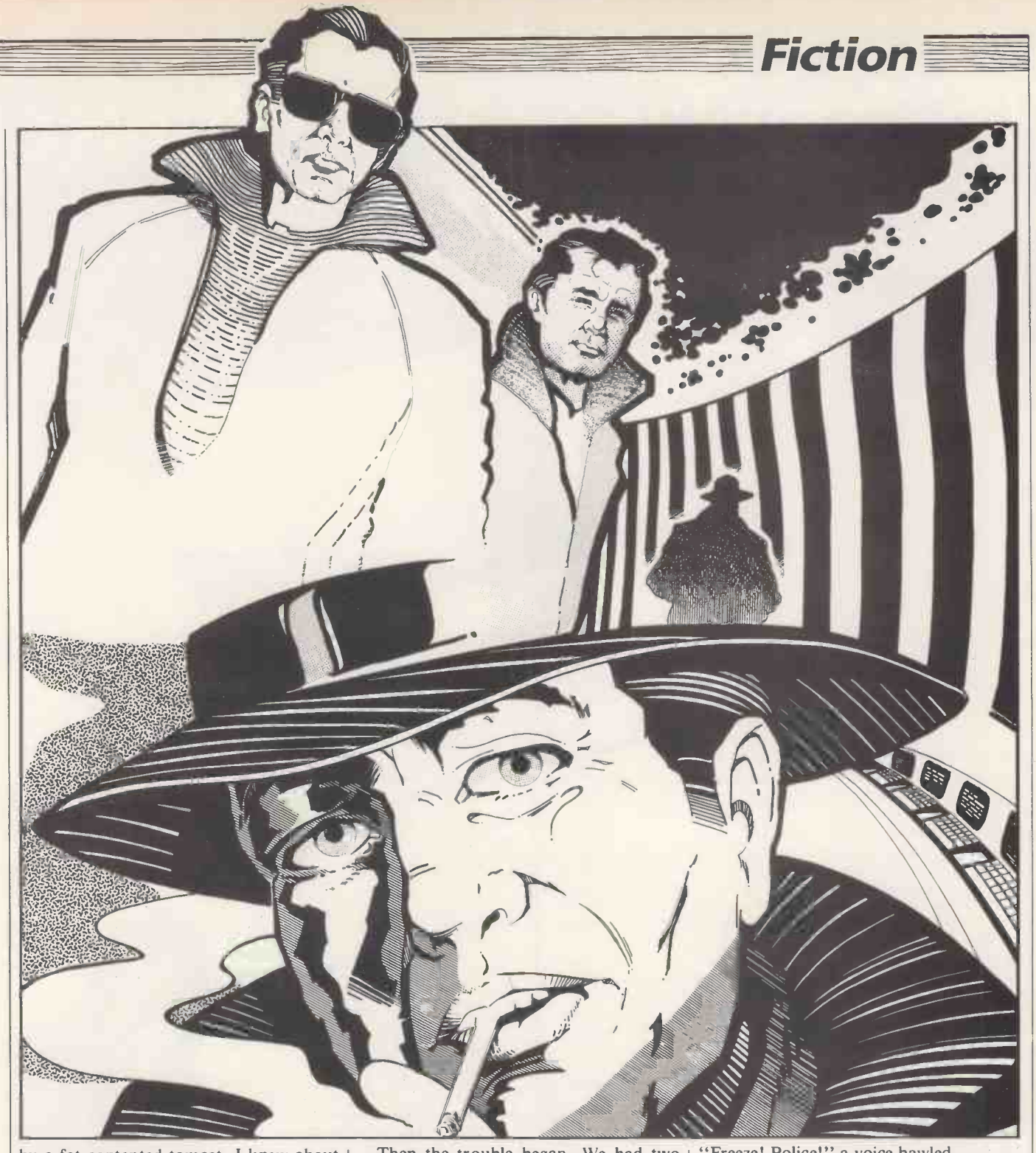
I looked Spider over. Al was right. Me, I can take or leave computers, no sweat, they're just a tool, like a monkey wrench. But I'd only to look at Spider's nervous twitching fingers, his stooped shoulders and red eyes, to see that he was in the last stages of addiction — a dangerous liability in Al's organisation.

"Boss," he whined, "You know I can't manage without . . ."

The two heavies carted him out like a sack of New Jersey potatoes.

"Benny," Al said, offering me a cigar, "You've been in the small-time league so far; welcome to the big!"

I felt like a mouse being offered a deal



by a fat contented tomcat. I knew about the claws underneath the facade, but had no choice but to go along with it.

All let me go on with my predictions, but only once a month so the bookies wouldn't get wise. I ran a computing den nights; my conscience gnawed at the back of my mind like an insomniac squirrel, but if it was what the public wanted . . .

I watched them rapt at the greasy keyboards: kids hooked on games, broads bored with secretarial day jobs, college professors after a kick they'd picked up at work and couldn't get at home. Even Spider, a broken man, came creeping in to shell out his last nickel to buy some self respect by tapping at the keys and running some feeble program again and again, fingers clenched like white crabs.

Then the trouble began. We had two raids by the cops. Each time we were safe; I pressed the panic button that folded the consoles into the floor and walls to be replaced by card tables and roulette wheels. But, of course, our master discs were formatted, and we paid plenty for new ones.

We had a stool pigeon. Maybe the boss though it was me, but he never said so. My career with the organisation ended one Saturday night, when me and the boys were in a warehouse unloading a consignment of Teletypes and circuit boards hi-jacked at the Canadian frontier. There was a rumble like a diesel locomotive, and an armoured truck burst through the wall.

I dropped the crate I was carrying, and made a run for it, but a spotlight fixed me like a moth on a lepidopterist's pin. "Freeze! Police!" a voice bawled.

I threw down my heater and held still until they came and put the cuffs on me. There were two men I recognised by the cops' truck. One I had seen only in the papers — Eliot Ness himself — but the other was Spider, the informer. I struggled and tried to slug him, but was dumped in the back of the truck. I almost cried when they took axes to the crates, and all that circuitry spilled to the floor like rare wine wasted. Maybe I was more than a little addicted too.

They sentenced me to five years in the can — I've served two. Not a computer in sight, of course, though one guy has put together some sort of abacus out of pieces of breadcrust. I'm just hoping that by the time I'm paroled, prohibition might be over. You can but wish.

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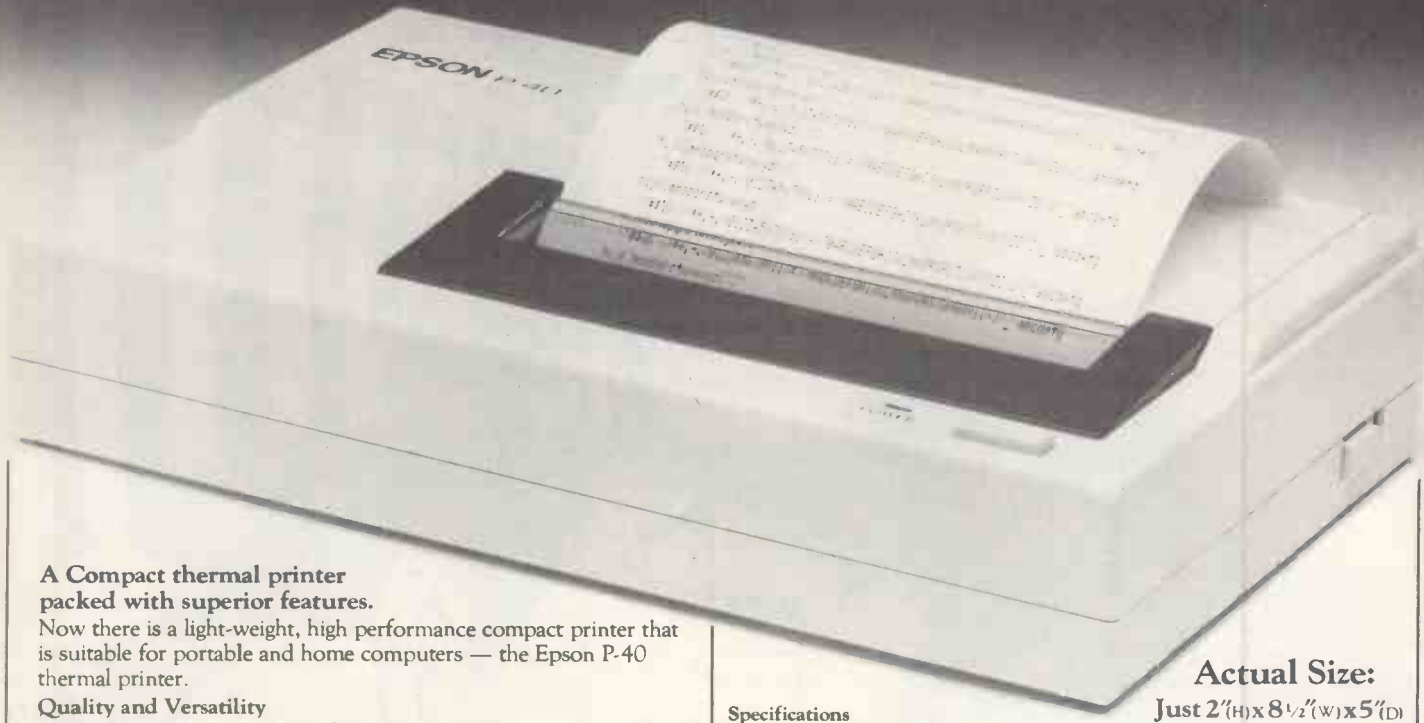

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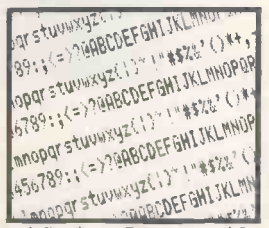

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Fifth generation fever

Tony Durham introduces this month's special section on artificial intelligence, as the world finally wakes up to its potential.

SOME TIME in the late 1970s the tide turned. Artificial intelligence researchers had always known that what they were doing was important. Now, in one of those mysterious shifts of opinion which signals that an idea's time has come, hard-boiled industrialists, cautious civil servants and military brass hats woke up to what AI was doing.

The last place to seek the reasons for this change is in the AI research centres themselves. There it is business as usual, with the added confidence that comes from knowing you are wanted. Today's hot new intelligent software products are sometimes based on work that was done, and ignored, 10 or 20 years ago. AI has been ready for the world for a long time. Now the world is ready for AI.

First-generation industrial robots have been in the factories long enough to pay for themselves, and to reveal their deficiencies. Production engineers who have never read an Isaac Asimov novel can now see the need for robots which can see, feel, make plans and adapt to unexpected circumstances.

Business has automated much of its clerical work, and made a start on computer-aided design and engineering. All eyes have now turned on the managers themselves. The first requirement of a manager's job is to know what is going on. Hence all those multi-coloured pie charts of regional sales figures, and hence the databases which tell you which of your £100,000-a-year customers in East Sussex has not ordered any widgets since April. Push the idea of computer support for managers much beyond that, and you are soon thinking of something which provides intelligent assistance, rather than just regurgitating information in palatable form.

Both the pace and the complexity of modern war have left the human nervous system behind. The U.S. Department of Defense is one of the main sources of funds for AI research. It is an uncomfortable fact that AI research was kept healthy in the U.S. through the 1970s by a military establishment which, unlike business, could afford a few failures.

Computers have become indispensable in the planning and management of war. Also, an awful lot of software goes into military hardware these days. Speech recognition, machine vision and other forms of pattern analysis, as applied to radar signals for example, are of particular interest to the armed forces, and this interest has benefitted others. For example, the cruise missile's Tercom guidance system, which matches hills and valleys with an internal map, is reportedly unreliable. But companies believed to have worked on the system are now profiting from their experience by marketing industrial vision systems.

ILLUSTRATION: STEPHEN WRIGHT

In Britain, AI has emerged from the cloud which fell over it in 1973 when Sir James Lighthill wrote his damning *Report on Artificial Intelligence* for the Science Research Council. The Lighthill report's main message was that AI could not succeed because of the so-called combinatorial explosion.

The argument is that AI programs which work in the laboratory may grind to a halt on life-size problems because they have to search through so many millions of alternative possibilities. The problem is real, but many AI programs have embodied efficient search strategies which at least partially control the explosion. Some encouragement is to be had from the fact that the human brain has got round the problem, though we have no idea how.

Artificial-intelligence research has forced us to reassess our own mental abilities. It has brought at least two big surprises. One was that in a limited, well-defined domain, such as geological prospecting or chemical analysis, a computer program could sometimes perform as well as a human being through sheer ruthless application of logic. The hard-learned skills of a human expert can often be summarised in a few hundred rules. And the machine may very well apply those rules more assiduously and thoroughly than the human expert from whom the rules were extracted.

On the other hand, the skills we apply unthinkingly, when we move through a cluttered room or answer a spoken question, have proved to be extraordinarily complex and difficult to program in a machine. Computer vision and the understanding of spoken and written language have been recognised as major challenges for AI research.

Human experts can rarely deliver cast-iron verdicts, and some expert systems have been equipped with mechanisms for handling vagueness, uncertainty and qualitative judgments. Fuzzy logic describes the world in shades of grey, rather than black and white; Bayesian statistics allow an expert system to assign prob-

(continued on next page)

Fifth generation fever

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abilities to alternative interpretations of the data. For example, a Bayesian system might decide that there is an 80 percent probability that the patient has bronchitis and a 20 percent chance that it is pneumonia.

Life and death decisions may be based on an expert system's advice. Ethical questions can then arise: for example, if a patient dies, is it the fault of the user of the system or its author? Donald Michie of Edinburgh University has repeatedly warned that expert systems should have human windows and should not be inscrutable. Michie, himself an active designer of expert systems, argues that the user should always be able to ask the program to explain its reasoning.

Large companies like Shell, ICI and Unilever are actively applying expert systems to their own problems. Many others are becoming interested, or already have hush-hush research programmes. New companies like Stanford spin-off Teknowledge Inc. are cashing in on industry's thirst for the new technology. According to Stanford's Edward Feigenbaum, there is a serious shortage of knowledge engineers. The knowledge engineer is not a programmer, but a person who is skilled in persuading experts to formulate their hunches as explicit rules.

Induction

To bypass the need for knowledge engineers, software houses have produced expert system builder packages such as Sage, AL/X and Expert-Ease. Some of them run on micros. Expert-Ease uses a technique known as induction. The idea is that experts find it easier to practise their skill than to explain it. Expert-Ease asks the author to offer an opinion on a number of sample cases, and then goes away and guesses at the general rules which underly the author's decisions.

Induction appears to work well in small domains, but the technique must be refined before it is suitable for building large expert systems. Induction can be regarded as learning by example. Learning has always been seen as an important issue for AI, closely linked with problem solving and creativity. Just how much the induction methods used in expert systems can contribute in other areas of AI remains to be seen.

The success of expert systems has made "knowledge" a buzz word. Once it was widely believed that the secret of human intelligence lay in our sophisticated reasoning skills. Now the fashionable view is that our reasoning skills may be nothing very special. But we do bring vast amounts of knowledge to bear on even the simplest problem.

Of course, knowledge has to be represented in a form which allows it to be used. You cannot cure a sore throat by chewing medical textbooks. And it could be that the essence of human intelligence is neither reasoning nor knowledge itself, but the extremely flexible and versatile way in which the brain encodes and represents knowledge.

It is easy to watch an AI program make a silly mistake. "It had the information, why didn't it use it?" you tend to ask. It is easy to forget that humans, too, possess knowledge which they may not be able to use for a particular purpose. I know how to ride a bicycle, but I cannot express that knowledge in English.

Rules are one way to represent knowledge. Others include frames, scripts and semantic networks. A frame can be regarded as a standard form describing a situation, with expected answers pencilled in. The concept was introduced by Marvin Minsky of the Massachusetts Institute of Technology. For example, a frame for a microcomputer might have "cathode-ray tube" pencilled in as the display device, but this could be changed to "LCD" if that is what the computer in question proved to have. The frame would be linked to a sub-frame on LCDs, and other sub-frames on keyboards, disc drives and so on.

Themes and scripts have been used by the psychologist R P Abelson to model human belief systems. Themes like betrayal and revenge express human situations with great generality. A script is essentially a frame with an added dimension of time, expressing a possible way a script could develop; for example, betrayal followed by revenge. This approach accords with the theory that there are only a few dozen basic plots for a play or novel.

Semantic networks express the relations between different concepts. A semantic network can be drawn as a mass of blobs and arrows. Or you can think of it as a richly cross-referenced card index. Roger Schank of Yale University has used semantic networks to express the common-sense knowledge we use to work out the most likely meaning of a sentence.

A specialised kind of semantic network called an inheritance lattice is supported by Xerox's Loops programming system. It expresses the idea that if an object belongs to a certain class, it inherits the general properties of that class of object. Such ideas could be applied to quite simple database systems including, of course, a card index.

Before the rise of the knowledge-based approach, there were many attempts to write general-purpose intelligent programs. At Carnegie-Mellon University, Allen Newell and Herbert Simon devised the ambitiously named General Problem Solver. The basic idea of GPS is simple. The program tries to transform the current situation A, say the kitchen at 7a.m., into a desired situation B, the kitchen plus one cup of hot coffee.

It begins by identifying the principal difference between A and B, which might be the presence of hot coffee. The program will think about putting it in a cup later. But first it selects an operation which will create hot coffee: to add boiling water to coffee grounds.

That does not solve the problem, because GPS now has to think about boiling some water. GPS simply applies itself to this as if it were a fresh problem. This goes on until the grand task of making coffee has been broken down into sub-tasks — pick up kettle, turn on tap and so on — which we already know how to perform. Unfortunately this little by little approach will not work on vicious problems like a Rubik Cube, where you have to deliberately mess up what you have just done in order to get any further. Later problem-solving programs incorporated extra tricks to cope with such difficulties, but as problem solvers became more powerful they became less general.

Language

The problem of getting machines to understand human language presents itself in two different forms: speech recognition, and natural language understanding. The two tasks are closely connected. The task of natural language understanding is to get the computer to respond appropriately to anything typed at the keyboard in English or some other natural human language.

Some programs give the illusion of understanding English by means of quite simple tricks. Joseph Weizenbaum's Eliza and a clutch of other programs in a medical or psychiatric vein make no attempt to understand the input, but simply scan it for a few key words. Mentioning the word "mother", for example, might prompt the program to ask, "Tell me more about your family." Adventure games commonly use similar tricks.

Many commercial programs now claim to have English interfaces, but most are fussy about what they choose to understand. Weizenbaum himself was appalled at people's willingness to treat a relatively crude program as though it were intelligent. He has tried to shift debates on AI from the question "Is it possible to make a program which is like a person?" to "Is it right to do so?" Weizenbaum believes it is wrong.

Genuine understanding of natural language calls for extensive knowledge of several kinds, including knowledge of how sentences are constructed, or syntax, of what words mean, or semantics, and

History of AI in fact and fiction

1854 — George Boole expresses logic in an algebraic form.
1929 — First performance of the play *R.U.R.* by Karel Capek, introducing the word "robot".
1942 — Isaac Asimov gives the first full statement of his Three Laws of Robotics in his story *Runaround*.
1943 — Colossus, the first electronic computer, built at Bletchley Park, England.
1950 — Alan Turing proposes a test for thinking machines. The tester attempts to distinguish the machine from a human being in the course of a teleprinter dialogue.
1956 — John McCarthy invents the term "artificial intelligence" and organises an AI conference at Dartmouth College.
1957 — *Syntactic Structures*, by Noam Chomsky.
1960 — John McCarthy develops Lisp.
1960 — Allen Newell and Herbert Simon develop the General Problem Solver.
1964 — First version of Dendral, an early expert system.
1965 — *Aspects of the theory of syntax*, by Noam Chomsky. Later to influence natural language understanding and machine translation programs.
1966 — Eliza reveals how easily a machine can imitate a psychiatrist.
1968 — Hal, an intelligent computer, portrayed in the film *2001*.
1971 — Intel 4004, the first microprocessor.
1971 — *Non Serviam* by Stanislav Lem. Perhaps the best fictional treatment of AI's philosophical implications.
1972 — Unimation, the first company set up specifically to make robots.
1972 — First implementation of Prolog, by Alain Colmerauer.
1972 — Terry Winograd of MIT describes SHRDLU natural language understanding program.
1973 — First commercial speech-recognition device from Threshold Inc.
1973 — The Lighthill report discourages government funding of AI in the U.K.
1978 — Taito Electronics introduces Space Invaders. For the first time an entire generation learns to think of the computer as a worthy opponent.
1980 — Untimely death of David Marr, source of influential ideas in computer vision.
1982 — Japan launches its fifth-generation computing programme.
1983 — Launch of the Alvey and Esprit programmes, respectively the U.K.'s and the European Community's responses to Japan's fifth generation.
1984 — John Searle, philosopher claiming that machines cannot think, chosen by BBC as Reith Lecturer.

common-sense knowledge about the situation being discussed. A variety of representations may be used for these different kinds of knowledge. Rules might be used to express the syntax, with scripts or frames providing the common-sense knowledge.

Machine translation is a closely related problem. Early efforts based on simple word for word substitution produced ludicrous results. It is now accepted that reliable translation requires a great deal of knowledge, and substantial understanding of the text. Commercial translation systems such as Logos and Weidner are good enough to be useful. They require some editing by someone who knows the target language; but then, human translations also usually need editing.

The sound patterns of the spoken word are much more variable than the patterns of written text. A single speaker may say the same word in many different ways, and of course different people talk differently. Some words are slurred together. At times, a silent gap intrudes in the middle of a word. Speech researchers have discovered that spoken sounds bear no simple relation to the written language. As with machine translation, no simple substitution process can succeed. Humans use every available clue to understand the spoken word, and even then when faced with a bad phone line or an unfamiliar dialect they sometimes fail.

Speech recognition is therefore a genuine AI problem. To approach the human level of performance, speech recognisers will probably have to use all the knowledge deployed in natural-language systems, plus specialised knowledge of phonetics. There are systems which can cope with large vocabularies, or unfamiliar speakers, or continuous speech, but no existing system can handle all three. In fact there are serious doubts about the concept of speaker independence. The best that most researchers hope to achieve is a system that adapts very rapidly to a new speaker without any explicit teaching.

Know the user

Speech and natural language provide a channel of communication between human and machine. But what is said matters too. It is becoming clear that a really friendly interface has to be quite intelligent. The intelligent front end will probably have its own internal model of you, the user. It will have a good idea of what you know about the software package you are using. It will quietly try to add to your knowledge, or gently put you right if you do something silly.

Like speech recognition, computer vision can be regarded as a two-tier process. An initial signal-processing stage extracts major features, and some kind of knowledge-based system attempts a meaningful interpretation of those features. In speech the features might be phonemes and in vision they might be edges. Vision is one area of AI where general-purpose techniques are currently in favour. The theory of human vision proposed by David Marr at MIT has influenced computer vision research.

Marr believed that the human eye and brain perform substantial pre-processing on a scene before the brain begins to look for any particular kind of object. Specifically, Marr suggested that the brain finds edges and surfaces, and determines roughly how far from the eye these features are, to create a two-and-a-half-dimensional sketch. Only then does it begin to look for human figures or dogs or aeroplanes.

Expert systems, speech, vision kits, and other manifestations of AI are all becoming available for microcomputers. Powerful, inexpensive chess computers have been on sale for several years. There is a flavour of AI about some computer games, such as Valhalla. Inevitably some people will argue that real AI programs cannot run on a micro, but they are probably the same people who said that micros are not real computers.

The philosophical issues raised by AI have been brought to the fore in the U.K. by the BBC's choice of the philosopher John Searle as this year's Reith Lecturer. Searle maintains that machines can only simulate thinking. Many AI researchers believe that Searle's distinction between real and simulated thinking is invalid. In practice most AI workers would call their efforts simulations of thought, but only because they are very crude and vastly simplified, not because they are qualitatively different from human thought. There are many shades of opinion on these questions, both within the AI community and outside it.

Artificial intelligence has not yet brought us face to face with machines which demand to be treated as persons. But already AI has become a rich source of ideas for philosophers and psychologists, and a touchstone for their theories.

Electronic oracle

Chris Naylor describes the joys of constructing programs to handle the subtle complexities of human knowledge.

AT FIRST SIGHT, nothing could be easier than producing an expert system. It is when you come to grips with the task in detail that the problems appear to grow and grow. And that, for some reason, is addictive to most computer people. Just as you thought you had cracked one bit of the problem, another snag appears — you try to crack that, and so on.

The first snag to crop up is one of definition. Everyone knows intuitively what an expert system is: it is one which will act as a computerised expert, replacing human experts and providing you with instant expertise on some chosen subject at the flick of a disc. But a more precise definition has proved hard to find, and to date the only consensus seems to be that there is no commonly accepted definition of an expert system.

Although a hard and fast definition of the subject is lacking, it is possible to make some headway by examining the aims of those who are trying to put together expert systems. Prime amongst these aims is the better use of human knowledge. Yet knowledge is not like data. It is notoriously difficult to define and analyse, and it is this which gives rise to some of the biggest problem areas within expert systems work: how to computerise human knowledge so that a computer can act upon it.

Book learning

Suppose you want an expert in telescope building. You yourself could become reasonably proficient in the subject just by reading a few books. The knowledge is already there and readily available. Yet you cannot just drop a few books on telescope construction into your computer and find that it has become expert in the subject.

The program must have some way of acquiring knowledge and to do so the knowledge must be represented in a way which the program can understand. Given that most human knowledge is very complicated, often uncertain and invariably heavily dependent on the context within which it appears this contrasts sharply with the traditional data with which most programs work. Typically, program data is relatively simple, certain and context-free.

Yet not only are expert systems expected to deal with knowledge — as distinct from traditional data — but they are expected to behave in a human-like fashion. A user-friendly system should be able to take time off from its deliberations to explain to the user just what it is doing and why.

A highly tentative working definition of the core feature of many expert systems is that they are systems which carry out user-transparent judgements. For "judgements" you could substitute "decisions",

Glossary

Backward chaining: A system of reasoning which starts by considering some conclusion and then trying to establish whether or not it is true.

Domain of enquiry: The subject in which the ES is expert.

Forward chaining: Sometimes called a data-driven strategy. A system of reasoning which starts from the beginning and then proceeds as best it can until it reaches a conclusion. Much easier to program than backward chaining.

Generate and test: A system which generates a conclusion and then tests it to see if it might be the correct conclusion. Useful when the total sum of all possible conclusions will not fit in memory all at once. Using this method you just have to hold a system in memory for generating the conclusions, rather than all of the conclusions themselves.

Intelligent knowledge-based system: Another name for ES.

Inference engine: The program that drives the knowledge base. Ideally it is sufficiently general to be able to drive knowledge bases of a similar type but in different domains of enquiry.

Knowledge acquisition: The process by which you gather the knowledge base together. It can be done manually and may be difficult. Sometimes it can be done automatically by means of a learning system built into the program.

Knowledge base: The data that the ES uses. It should be to some degree user-transparent so that a user can look at the KB and at a glance see that the knowledge in there is more or less reasonable in human terms.

Knowledge engineer: The person who assembles the KB, usually by interrogating a human expert in the subject while bearing in mind the likely constraints of the system being written.

Knowledge representations: The form in which the KB is structured, formerly called the data structure.

Production rules: The KB in many expert systems has its knowledge represented in terms of production rules. Often they are described as being in the form If-Then.

Rule-based systems: An ES which largely relies on production rules.

Rule values: A value assigned to each rule or question in the ES so that the highest-valued rule is dealt with next. An alternative strategy to forward and backward chaining. Rule-value systems operate by trying to reduce the amount of uncertainty that the ES is suffering from at any given moment.

Shell: An ES shell is a framework within which an ES can be fairly easily constructed as long as it is in a particular format. Typically, it provides the inference engine and some method of adding a knowledge base. In this respect shells have some similarity to program generators except that they generate expert systems.

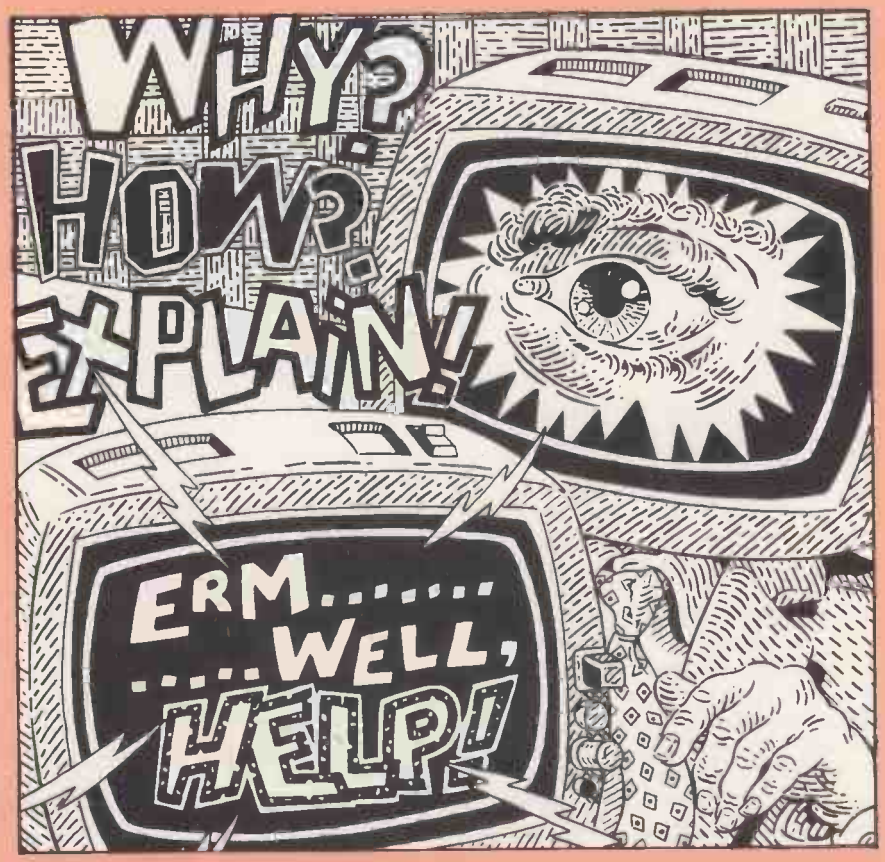

ILLUSTRATION: STEPHEN WRIGHT

to bring in decision-support systems, or "classification" and "discrimination", to acknowledge the debt which a lot of the work owes to conventional statistical systems.

So there are two distinct aspects to an expert system. There are the judgements themselves which have to be performed and the context in which these judgements are made. Some framework must be found to tie together the many individual judgements that add up to expertise in some particular field.

As far as the judgements themselves are concerned there are two main methodologies: probabilistic and deterministic. Probabilistic judgements cover a vast spectrum of techniques from standard classical statistics, through Bayesian statistics, to *ad hoc* methods which someone happened to think seemed reasonable at the time.

On the other hand, deterministic methods have the benefit of simplicity. Instead of allowing for the inherent uncertainty in many human judgements they rely on the fact that there are other human judgements which are not at all uncertain, or can reasonably be approximated by certain techniques, which helps to make the programming that much easier.

Exceptions

When it comes to the matter of the system within which such judgements are carried out it becomes much harder to produce neat categorisations, because as soon as you do so you have to start listing exceptions. An instance is forward and backward chaining, which is the method the program uses to move around from judgement to judgement before it finally comes to a conclusion. Forward-chaining systems are data driven. They start from the data provided by the user and gradually move forward through some reasoning chain until they come to a conclusion, requesting more information as necessary on the way. Backward-chaining systems tend to pick up a conclusion and then chain backwards through all the preceding relevant items, gathering information as they go in order to establish whether or not a particular conclusion is the right one. If it is not, they move on to consider another conclusion.

But if the chain of reasoning is not very complex, perhaps where there is only one single step of reasoning in the chain, then there is really no difference between the two systems. The difference only shows if there is a lengthy chain of reasoning involved, with several intermediate conclusions to be established.

It is possible to get by without using either method. The rule-value approach works in neither fashion. It simply asks questions of the user on the basis of what looks like an interesting question to ask, where "interesting" is defined as the extent to which the answer can reduce the current uncertainty within the system.

As with any human expert, you want to be able to ask an expert system to enlarge upon its judgements. If it asks a question, you want to be able to ask it why it is asking that question. If it comes to a conclusion, you want to be able to ask it how it came to that conclusion. To be able to do so can require extensive thought when the system itself is being designed, and the need for such questioning facilities can exert an important influence over the design of a system.

Expert systems in Basic

There is no reason why an expert system should not be written in Basic on a micro: in theory, any program can be written in any language. However, in practice, some languages are more convenient for specific types of task.

Basic is very good for handling uncertainty and calculations, which means that probabilistic systems are relatively easy. So quite complicated judgements can be made accurately in Basic. The main problems that appear involve the system, or the framework, within which the judgements occur. Essentially, very complex structures are out. Basic does not readily lend itself to complex interlinking of reasoning chains or complex reasoning strategies. Backward chaining, for instance, is almost definitely out because of the need for recursion as the backward chaining takes place. However, forward chaining and rule-value systems can be made to work well.

Simple Why? and How? questions from the user can be dealt with in a simple fashion. "Why did you ask that question?" and "How did you get that result?" can be answered by the system as long as it does not have to wade back through a long reasoning chain to find out the answers.

Deterministic systems can also be implemented in Basic. But a feature of deterministic systems is that while each individual judgement may be a simple one it may form part of a very complicated overall system. If the overall structure is particularly complicated in terms of linkages from one part to another then you can tie yourself in knots trying to keep track of it all in Basic.

A lot will depend though on whether or not you have discs, because you can use disc files to keep track of any particular linkages and chains of reasoning which develop, holding them as alterable data rather than within the program itself. However, the more detail you hold on disc the slower the program will be at run time.

ES/P ADVISOR

Chris Naylor reviews an expert system designed to extract a set of tailor-made instructions from a complex mass of rules and regulations.

TO DATE, much of the work carried out in expert systems has concentrated on trying to develop systems which, to some extent, can mimic human reasoning. High on the list of things which characterise human reasoning has been uncertainty. Human beings use uncertain information to reach uncertain conclusions, and they are very good at it. Expert systems are becoming pretty good at handling uncertainty too.

However, Expert Systems Ltd of Oxford has pointed out that while some human knowledge may be uncertain, much of it is very certain indeed. There is a vast amount of human knowledge around which is precise, exact and quite certain. So, why not develop expert systems that are specifically designed to deal with certain information?

The result of such thinking is ES/P Advisor, an expert-systems shell which is designed to handle certain knowledge. Its designers refer to its activities as "text animation" or the conditional outputting of text. ES/P Advisor enables users to easily produce a knowledge base in some domain which can then be run with a standard inference engine to offer advice to the user, conditionally outputting text depending on the user's response.

For example, PAYE regulations are a body of human knowledge, but there is nothing uncertain about them. The Government produces booklets for employers to guide them through every step of the PAYE maze. The problem is that the booklet itself is heavy going. The information is all there but not all the information is relevant to every situation in which employers find themselves, and not every employer wants to read the whole booklet every time they have a PAYE problem.

So by converting the PAYE regulations into an ES/P Advisor knowledge base, it is possible to animate the regulations so that employers are asked only those questions which are relevant to their current problem, and only those sections of text which need to be displayed on the screen are displayed. It is like having individual, personalised documentation produced for you to match each specific situation.

For review purposes, we were provided with Release 0.93 of ES/P Advisor to run on the IBM PC. It came on one floppy disc with a substantial manual. For the review a fictitious manual was created to guide commissioning editors when faced with the problem of whether or not they should buy a particular article for the magazine. We then converted this fictitious manual into a knowledge base, and ran it under ES/P Advisor.

The domain in which the system is to be expert is that of buying an article for *Practical Computing*. The first thing the user has to do is to ensure that they have an article, and the next thing they have to do is to find out if the article is suitable. The system has to work out whether the article is the right length, the right price, and if it is interesting or not. Each of the items are variables and can be defined as facts, numbers, categories or phrases. Their definitions may include other variables which are defined in turn and the value of each variable may be established by reference to other variables or by interrogating the user directly.

The end result of each run is always the conditional outputting of some section of text to advise commissioning editors what they should do with the article they have before them. During the course of the consultation session the user can ask for an explanation of each question and ask for the system to outline its reasoning so far.

Domain

Going through the example knowledge base, the first thing displayed on the screen was the contents of the domain statement so that the user knows what the session is about. The Ensure Article instruction sends the system to Article in order to determine whether or not the fact

```
domain 'Buying an article for Practical Computing'.
'This is to guide commissioning editors'&
'in their decisions to buy or not buy'&
'a submitted article for the magazine Practical Computing'.

{ensure article}
reference suitable.

article:'an article has been subitted'
        fact
        askable'Has someone subnitted an article ?'.

author:'the name of the author'
       phrase
       askable'What is the name of the author ?'.


section suitable:
'This section determines whether or not the article is suitable for Practical Co
mputing'.
{right_price and right_length and interest<>boring}
'Use'.. @author..'s article '&
'and pay '.. @author..'the sum of '.. #price.

{not right_price and right_length and interest<>boring}
'Ask '.. @author..' to charge less '&
'maybe '.. #suggest_price..' would be fair'.

{right_price and not right_length and interest<>boring}
'Ask '.. @author.. ' if it would be possible to'&
're-write the article to about '.. @suggest_length.. ' words'.
,
{interest=boring}
'Make your excuses to '.. @author.. ' and return the article'.

right_price:'the article is priced reasonably'
            fact
            rules
            price<20,
            price#1000/words=<standard_rate,
            price#1000/words=<2*standard_rate and interest=outstanding.

right_length:'the article is the right length'
             fact
             rule
             words>1000 and words<3000.

interest:'the extent to which the article is interesting'
         category
         explanation
         'You need to have some idea of how interesting'&
```

The knowledge base PC.KRL used in testing ES/P Advisor.

that an article has been submitted is true.

Reference Suitable sends the system to the Section Suitable, at which point the system tries to establish the truth of the statement "right price and right length and interest not equal to boring". To do so it has to know if the article is the right price so it moves to the Right Price statement, where it finds it first needs to know the price of the article. It goes to the Price statement, where it finds the rule

words * standard rate/1,000

will apply if the author is not specifying a price for the article. So it goes to the Own Price statement where it finds an askable clause, which leads the system to ask the user if the author is asking for a specific price for the article.

At this point, if the user wanted an explanation of the question the system would display the Explanation clause which tells the user that if the author is asking for a specific sum of money then the standard rate of payment may not apply. If the user replies no to the Own Price question, the system returns to the Price statement and finds it needs a value for Words. So it goes to the Words statement and asks the user how long the article is, specifying that it must fall in the range 50 to 5,000 words.

When it has got the length in words it can calculate a price for the article simply by referencing the Standard Rate statement, which gives the standard rate as 50, for £50 per 1,000 words. At this point Right Price can be established, and it can make a decision about Right Length because it already has the variable Words. All it then needs to know is how interesting the article is, so it goes to the Interest section and displays a three-item menu ranging from Outstanding to Boring, from which the user can choose an option. The system can then offer the user its final advice and, in the case of Joe Bloggs, who offered *PC* a short, interesting article ES/P Advisor advised that the article be used and Joe Bloggs be payed £9.46.

Easy to create

Probably the most striking point about the knowledge base in this system is the comparative ease with which it can be created. Items do not have to appear in any particular order. You can specify some fairly large item, such as the need for an article to be the right price, right length and not boring, and then tack on additional definitions to define just what you mean by "right price", and so on. If further definitions are required they can be tacked on later. The inference engine itself will take care of the flow of reasoning at run time and make sure that only those items which need to be considered are, and that nothing is left out of the consultation session.

Some difficulties were encountered when testing the system. First, you have to create the knowledge base using a text editor or word-processing package. The first attempt, using Microsoft's Word, failed miserably because Word embeds control characters in its text file, which upset ES/P Advisor. You have to use a package which gives a clean text file, such as WordStar. In the case of this review, having bashed in the knowledge base using Word and found it didn't work, I used the IBM PC's Edlin line editor to clean up the file and carry out any alterations due to keying errors. Another small snag arose because the IBM PC has to be set up with the file Config.Sys containing the command

DEVICE = ANSI.SYS

on the boot disc.

Once the knowledge base was in the text file called PC.KRL, it was compiled with the command KRL, which comes acronymically from Knowledge Representation Language. All went well, though life would have been easier if there had been a facility to send any compilation error messages to the printer when syntax errors were spotted.

With compilation over, ES/P Advisor is called by keying Esp, after which the system displays a menu of current knowledge bases for you to choose from. Choosing PC KRL produced the guide for commissioning editors.

```
          @author..'s article is'
          options
          outstanding-'an outstanding article',
          interesting-'an interesting article',
          boring-'a boring article'
          askable
          'How interesting would you rate the article ?'.

price:'the price of the article'
      number
      rule
      words*standard_rate/1000 if not own_price
      askable
      'How much is '.. @author.. ' charging for this article ?'.

words:'the length of the article in words'
      number
      explanation
      'You must know the length of ' .. @author.. 's article'&
      'to know if it will fit the magazine'
      range 50 .. 5000
      askable
      'How long is '.. @author.. 's article in words ?'.

standard_rate:'the standard rate of payment for the magazine'
              number
              rule
              50.

own_price:'the author is asking for a specific sum of money'
          fact
          explanation
          'If '.. @author.. ' is asking for a specific sum'&
          'of money then the standard rate of payment '&
          'for the magazine may not apply'
          askable
          'Is '.. @author.. ' asking for a specific price for this article ?'.

suggest_price:'the suggested price you should pay for this article'
              number
              rules
              words*standard_rate/1000 if interest=interesting,
              2*words*standard_rate/1000 if interest=outstanding.

suggest_length:'the suggested length for this article'
               number
               rules
               1500 if interest=interesting and right_price,
               3000 if interest=outstanding and right_price,
               1000 if interest=outstanding and not right_price.
```

Conclusions

● ES/P Advisor is one of the most interesting products seen around in a long time. The idea of automating manuals is so simple that it just has to catch on. Screens are more easily manipulated than their paper equivalent. If spreadsheets can make it, then text animators can make it commercially too.

● It is fairly easy and quick to create a knowledge base to run under ES/P Advisor and, once created, the system can be run by a user with no prior knowledge of the system. Its prime market is expected to be firms who want to automate standard procedures and regulations for use by less skilled staff. But it could also be used in conjunction with the actual development of procedures as an active check that the procedures were reasonable in actual use.

● It is not possible to describe all of the features built into ES/P Advisor because it is genuinely surprising how many different things might sensibly be done with text animation. But text animation itself should become a new software category and this British product is the first item in that category.

● ES/P Advisor costs £600 and is available for machines running CP/M-86, MS-DOS and PC-DOS from Expert Systems Ltd, 9 West Way, Oxford, OX2 0JB. Telephone: (0865) 242206.

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Small steps

Chris Naylor discusses how computers can be made to do more than their programmers have specifically instructed them to do.

ILLUSTRATION: STEPHEN WRIGHT

A GREAT DEAL of time and effort could be saved if computers could learn for themselves. Instead of having to program each individual step for a task which we might barely understand ourselves, all we would need to do would be to point the machine at an example, tell it to learn it, then sit back and let the wretched engine get on with it.

So it came about that computer people, always in the forefront of the search for an easy life, came to spend some 25 hours a day busting their brains apart figuring out how to get machines to learn. The fact that you still have to dream up your program in fine detail shows that, as yet, success has been only partial.

Two aspects of machine learning seem to be crucial. The first is that of a suitable description language for the task to be learned. Whether you want your machine to learn how to predict the weather, to learn concepts or to learn how to walk across a room without falling over, the data coming into the machine has to exist in some format, and this format is the description language. A good description language can make learning easy, and a bad description language can make it almost impossible.

Help the machine

Suppose you want your machine to learn how to parse English sentences — a reasonable aim which has already been attempted with some success. If you give the machine input data on sentences which consist solely of the Cartesian co-ordinates of the letters on the page it might not get very far because the description language would contain little of the essential information which you want the machine to learn. It is better to give it a string of sentences and some initial directions as to how sentences are already arranged and parsed. You describe the problem in a way which is helpful to a machine trying to learn it.

Another aspect to be considered is the proposition that machines and people only learn things which they nearly know already — which might make you think that machine learning never gets very far beyond the starting point. But it does seem to be true that machines can learn by adapting their current state, as long as each adaptation is not far removed from the present state.

So for a machine to be able to learn, the program as it exists immediately prior to learning something must be written in such a way that the things to be learned are described in a way which is relevant to the learning process. Also, the program must be able very nearly to do what it is that you want it to do. It just has to adapt itself a little.

A classic example of this is the learning algorithm which is able to judge between any number of objects by being presented with examples of them. The algorithm consists of a series of functions of the form

$$y = b_1x_1 + \ldots + b_nx_n$$

and the objects to be identified are described in terms of the measures on each x_i. As the learning process proceeds, the b_i values are progressively adjusted until the functions can accurately identify the objects in question.

As long as the learning problem matches this description language the process is very simple. Specifically, the objects must be capable of being described in this way and they must be linearly separable in the description language. If these conditions hold, then the algorithm works, and because of the way it was set up it very nearly worked before any learning at all took place: the program nearly knew how to do the set task from the beginning.

But if you try to use such a method to get your machine to learn how to parse sentences or recognise visual objects, you will find that it does not work. The description language is wrong in that it puts the machine in a position where what it knows is too far removed from what it has to learn. It does not almost know what it has to learn.

To learn visual perception you need a description language that brings out the key features in the learning problem. Similarly, for language parsing you need a description language that brings out the key features in that problem. So you write the program so that it is as near as possible to being able to perform a particular task immediately, and just needs some extra facilities written into it so that it can adapt itself a little and learn the parts it does not know already.

Vital spark

All of which leads back to the most basic question in the field of learning: How do you learn anything? After all, children do not come into the world equipped with a nice, neat description language. If there were found to be one vital spark which enables human infants to learn, then the field might start to crack right open — see *Practical Computing* June 1982 for an attempt which was made in the field of language learning.

However, there may not be just one vital spark. Human beings might be learning in the same way that machines learn, continually making small steps in an ever-growing description language. In which case, there is no such thing as machine learning, just learning.

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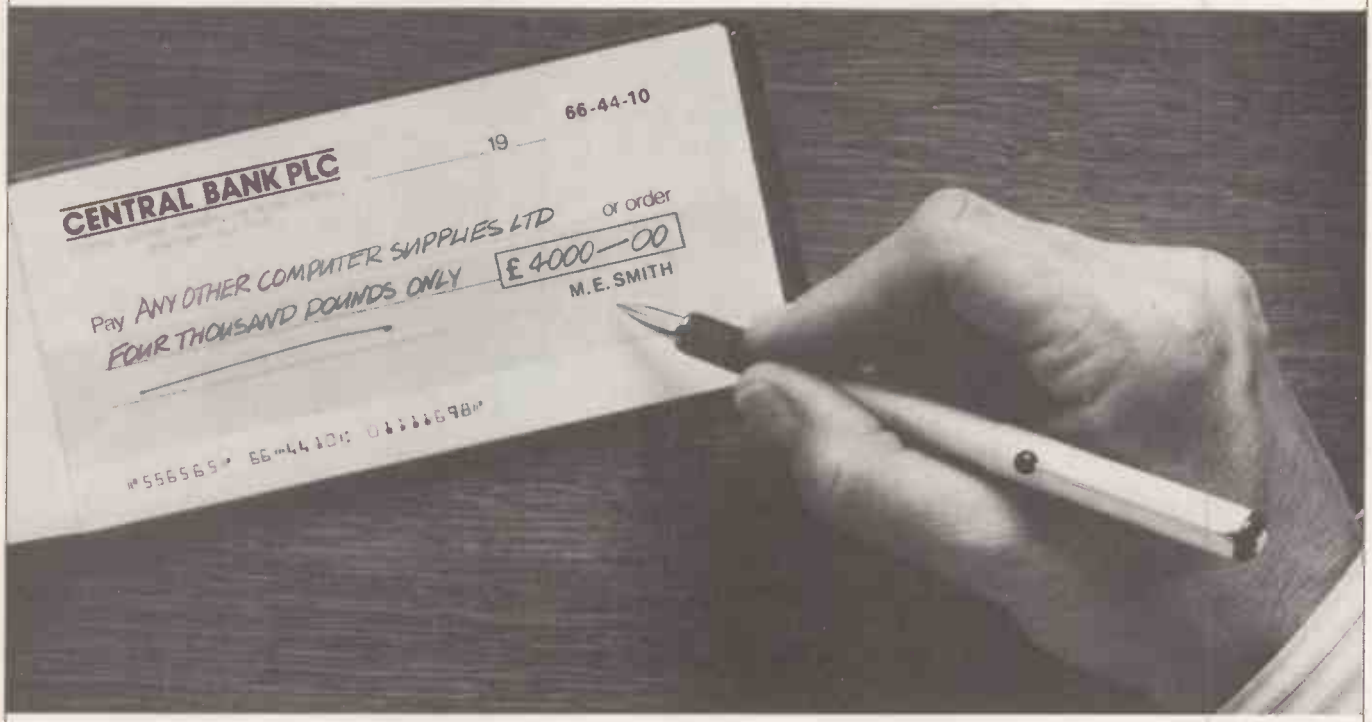

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Tongue-tied

An average human three-year-old has more highly developed language skills than the most able machine. Chris Naylor explains why.

IT USED TO BE SAID that the one thing that truly distinguished humans from animals was language. Nowadays, plenty of people would disagree with such a sweeping statement, and in fact psychologists have found some rudimentary language abilities in many species of animals. Nevertheless a strong language barrier does exist between humans and the rest of creation, and that applies to the computer as much as it does to the more animate section of the world.

In general, your computer cannot talk to you and you cannot talk to it, except by resorting to some highly stylised conventions. The problem is that of natural language, namely the language you use as soon as you learn to talk. So if the problem of natural language could be cracked then computers would become easier to use, moving them a step closer to humans. That should appeal to AI researchers.

Apart from natural language there is another class of languages, known as formal languages. Formal languages have to be invented. Everyone probably knows some formal languages, because all programming languages are formal languages and so is mathematics.

Evolved

Natural languages have not been invented; they have evolved as a means of communication among people. Although we understand them easily, it is not because we have a formal definition of them. The reason why we understand natural languages is a matter about which there is much philosophical dispute.

Several attempts have been made to treat natural languages as super-complicated formal languages and to program appropriate definitions into a machine, and these attempts fall into several broad categories. For example, attempts have been made to split the field up into language production versus language recognition, and into the keyboard and screen versus voice and audio.

Language production is one of the easiest things a computer can be requested to do. In Basic if you take a natural-language sentence and enclose it in a Print statement you have natural-language output on the screen. With a bit of thought the machine can appear quite human indeed. A database system can be made to appear chatty as it responds to queries, as Eliza has shown.

It is also relatively straightforward to get a machine to convert words into sounds. Speech synthesisers exist for many machines, most of which work using the basic elements of speech called phonemes. A word is split up into its constituent phonemes, which are fed into the computer in a suitable form. The corresponding sounds are then produced using simple digital to analogue devices. More sophisticated programs which attempt to work directly from the words themselves must also cope with the vagaries of English spelling.

Less variation

Language synthesis requires rather more. The computer must understand, in some sense, what it is saying, and not just convert one kind of code into another. For this reason it is a limited domain of knowledge, where the number of possible variations is much smaller.

The problem of language recognition is hard for the same reasons that language production is relatively easy. You might want to say almost anything to the computer, and so the problem is not inherently restricted in any particular way. Also, instead of you having to understand the machine — in which case you can fill in gaps, guess at unclear meanings and so on — the computer has to do all this interpretative work on what it receives.

The problem of Natural-language input via a keyboard shows signs of being solved. natural-language query systems as a front end for databases are a prime example of this. If you want to query a database you just key in what you want in natural language and the machine will take care of the problem.

The reason why this is so easily resolved is because of the bounds which are inherent in such systems. The machine is only ever going to be asked about the contents of its database and most people ask fairly simple, well-structured questions when sitting at a keyboard. So to a large extent, in this area natural language can be treated as a formal language and all that is needed is an interpreter analogous to the Basic interpreter in your machine. Systems like this can be made to run into trouble if you ask a question outside the scope of the database, or in a particularly complex form, or in language the machine does not understand.

The major problem remains the recognition of spoken natural languages. The recognition systems now available mostly rely on matching an incoming voice pattern with a stored voice pattern, and they immediately run into trouble if the system cannot find a good match in its memory. The more things the machine is expected to recognise the less likely it is to be able to be sure about any given match.

In general, such systems cannot cope with a large variety of speech, and they cannot cope with continuous speech as we normally speak it, with words running into each other. Entered through the keyboards. "It's a nice summer day" is clear enough, but orally "itsan ice ummderday" is much less clear.

So the machine needs to have some idea of what it is that you are trying to say, and in order to reply to you it has to have some idea of what might constitute an acceptable response. Preferably it should know everything about the context in which these utterances occur so that it can form hypotheses concerning what you might say next and why you might be saying it. At this point the extent of the problem becomes clear since you are demanding that the computer have knowledge equivalent to your own.

Learning speech

Finally, there is the field of language acquisition. It would be desirable if computers could learn language production and recognition in much the same way human infants. Then there would be no need for complicated programming and all you would have to do would be to expose the machine to people talking and it would learn by itself. Theoretically, there is some reason for thinking that this might be possible since human infants themselves have some such mechanism.

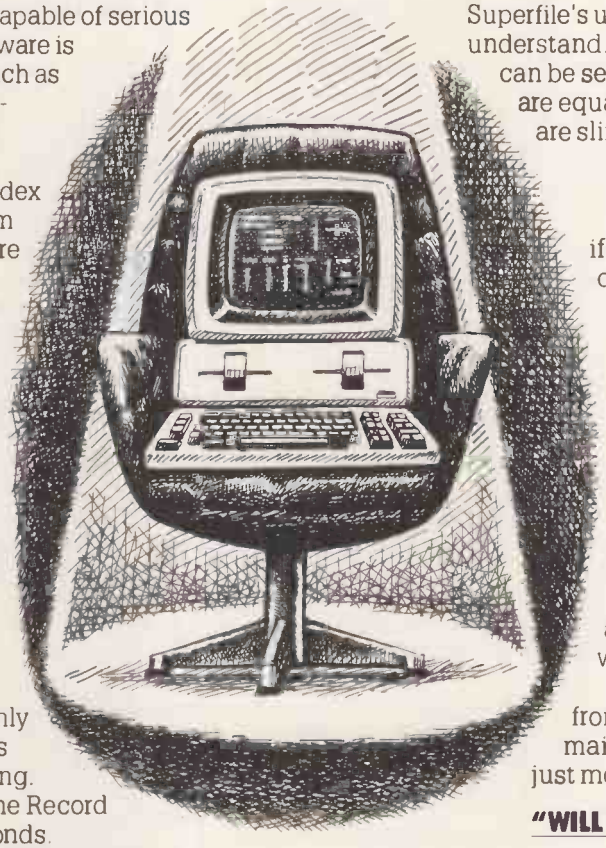
In practice, progress has not been fast. Some keyboard systems do have the ability to add to their basic lexicon as new words and phrases appear, and some parsing systems have the ability to develop new rules of parsing simply by being presented with unfamiliar constructions. But as yet there is no single system which looks likely to sweep the field.

At present it seems likely that progress will stem from an attack on the problem from many different angles. Workable systems will be developed as a result of the combination of several different approaches being applied to an area of natural language that is intentionally restricted in what it can do.

SOME SEARCHING QUESTIONS TO ASK A DATABASE MANAGER

Now that microcomputers are capable of serious data storage, the hot phrase in software is 'database manager.' A good one, such as Superfile, turns a micro into a hyper-intelligent filing cabinet, combined with an amazingly deft assistant.

Any business that uses a card index or a filing cabinet would benefit from a database manager. It could do more for an enterprise than hiring a new executive – but it is necessary to be just as careful when interviewing candidates for the job. Vast sums of money are lost by companies investing in software that doesn't work hard enough. So it's vital to ask the right questions – and get the right answers.



"ARE YOU CAPABLE OF DOING A WORTHWHILE JOB?"

"You may do well with a small database, but how much can you store? How fast are you when full?"

Superfile's capacity is limited only by the hardware. The 8 bit version is fast, but the 16 bit version is lightning. On a suitable machine it can find one Record out of a hundred thousand in 3 seconds. A lot of main-frame computers would like to do as well.

"DO YOU KNOW THE FACTS OF LIFE?"

"In real life, everyone changes their minds about the structure of their databases. Can you adapt? Can you hold many different sorts of information at once? Can you find someone who says they're called 'Smith' when they're actually 'ssmythe'?"

Superfile has a completely flexible structure. A user can change the shape of Records after he has started to enter data. He can store as many different kinds of Record as he wants. Superfile also has a unique 'sounds-like' searching facility – very useful for anyone who deals face to face with the public.

"ARE YOU ECONOMIC?"

"Do you insist on storing everything in fixed length spaces, so that 'Mr Ho' takes up as much room on the disk as 'Miss Featherstonehaugh-Willoughby-Fanshawe-Tupman'?"

Superfile has variable length Records that can double or treble the useful space on your expensive disks.

"ARE YOU FRIENDLY?"

"Do your users need a PhD in computer science? Are your manuals as thick as telephone books and as tedious to read?"

Superfile's underlying concepts are simple to understand. Its screen Forms for data entry can be set up in minutes. Its paper Reports are equally straightforward. The manuals are slim and concise.

"ARE YOU MULTI-USER?"

"A database is vastly more useful if several people can consult it at once. Can you cope with many hands on your keys without hysterics?"

Superfile is available in single and multi-user versions. Very few others can make this claim.

"CAN YOU KEEP PACE WITH TECHNOLOGY?"

"Hardware is changing and improving so fast – can you keep up with improvements? Or will all my database work be wasted when I buy a new computer?"

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Ways of seeing

Relating images to real objects is a complex task, as Andrew Blake explains

DISCIPLINES as far apart as psychology and physics have been brought to bear on the study of human and machine vision. Near one end of the range, physiologists have had some exciting successes in identifying the function of some of the brain's vision hardware. At the other end, considerable research effort has been devoted to endowing computers with the ability to recognise objects seen by their TV-camera eyes. There was little communication between ends until the relatively recent work of the late David Marr. Vision is complex, Marr argues, so it is hopeless to try to understand it simply in terms of hardware, either electronic or biological. It would be no more sensible to try and hard wire any other complex computer system, such as a compiler or a word processor. Rather, before designing any software — let alone hardware — vision must be understood as an information-processing task.

The information to be processed takes the form of images of some scene, or image-pairs for stereo vision. A TV camera can send a steady time sequence of images to be processed by the computer. Each image is presented to the computer as a large array of numbers — usually between 10,000 and 1,000,000 of them — representing the light intensity from different points in the scene. The processing task is first to reduce this torrential flow of information to a concise form. The image arrays are to be converted to a terse description of the objects in the scene and their positions relative to one another.

Questions

Current research in computer vision, in Britain, the U.S., Japan and elsewhere, is addressing a number of important questions. What gives things their appearance? How can multiple images of a single scene be exploited? How can image features be represented in the computer? How can a description of the scene be represented in the computer?

The appearance of a scene depends on how a source of light interacts with flat, curved, corrugated, creased or crumpled surfaces of various shapes, and on their reflective properties — such as red, transparent, matt, glossy, rough — to generate a TV camera image. Physics provides some answers, and the result can be seen in the spectacular images in films like *The Empire Strikes Back*, with their artificially generated shots of spaceships and weird terrain. They use principles of physics to simulate the generation of an image. This may even involve simulating individual light rays from a light source, bouncing off one or more objects before they reach the camera. Vision can be thought of as inverting this simulation, working back from an image to a description of a scene.

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A typical computer-generated blocks-world scene.

ILLUSTRATION COURTESY OF G BRELSTAFF

Stereo vision uses two images of a scene taken from slightly different viewpoints. It is well known that stereo vision enables us to see in depth, but it is only fairly recently that computers have been able to extract depth information from stereo images of natural objects.

Television cameras, like eyes, work in real time. They deliver not merely single images but whole sequences of them. If the scene is static but the viewer is moving, the sequence shows the scene from a whole sequence of viewpoints. In principle, it should be possible to use this flow of images to help deduce the positions and motion of objects in the scene. Moreover, if the viewer does not know its own position and motion, the image flow could help compute that too.

Image features such as edges of objects can be represented by marking them in the image, with bright blobs, for example. Alternatively, exactly the same information could be represented by an assertion like

edge(212,304,N)

to denote an edge pointing north, passing through the point whose co-ordinates in the image are 212,304. Collecting edge and other features proves to be an essential part of a full description of the scene.

Descriptions of objects in the scene and their relationships to one another have to be respresented in the computer in some way. For instance, they could be described as a composition of simple shapes stuck together, but the question then arises what set of simple shapes would do for the purpose? A set consisting of cuboids and cylinders might do very well to describe chairs and tables but less well for flowers and trees.

Much of the progress that has been made in computer vision has been achieved by using so-called mini-worlds. The best known is blocks world, in which scenes contain only polyhedral solids. Work in the 1960s and 1970s established powerful techniques for locating individual blocks in blocks-world scenes even when some blocks stand on or obscure others.

Insights

The hope is that principles discovered in a mini-world will be capable of extension to more general worlds. This is not always the case: some of the techniques used in blocks world that work perfectly with the plane-faced blocks cannot easily be extended to deal with curved faces. However, some important insights have undoubtedly been gained by experimenting in this and other mini-worlds.

One promising mini-world that is beginning to attract attention is the world of industrial components. They can be described in terms of compositions of simple solids like cylinders and cuboids. This idea is already being applied to computer-aided design of machined metal parts. Now the aim is to use computers to deduce descriptions of such parts from images of them. Research of this sort promises to be directly applicable to robot vision. It is hoped that it will illuminate our understanding of natural vision too.

Food for thought

Basic and Fortran are fine for programming strings of calculations but are ill suited to more diffuse problem solving. Chris Bidmead looks at two languages which make better tools for the thinking computer.

WHEN IT COMES to logical problems, as opposed to the number-crunching activities that gave the computer its name, the micro or mainframe ought to work like a modern university seminar. But while what is needed is a free exchange of discourse between the elements, what you get is the worst kind of Dickensian classroom, where a single authoritarian figure, the central processing unit, spells out the intricate detail of each task.

This arrangement has worked convincingly for the past 40 years because of the speed with which the CPU can push through its sequence of tasks. And ever since the invention of Fortran in the late 1950s this strictly linear von Neumann architecture has been reflected in the mainstream computer languages.

But now von Neumann's days are numbered. Bodies like Japan's Institute for New Generation Computer Technology, and the Alvey Programme in this country, are separately embarked on a radical alternative. A general vision is emerging of the so-called fifth-generation computer as a system based around a team of interlinked interdependent processors sharing delegated sub-tasks. As in a well-managed human work environment, problem solving is carried out by teamwork. Rather than detailed how-to-do-it job definitions, only what-to-do job descriptions are handed out among the team members.

This research has spotlighted a pair of related computer languages, hitherto the jealously guarded property of the artificial intelligence community. The senior language, first developed in the early 1960s, is Lisp. Prolog, which arrived some 10 years later, is very much son-of-Lisp, an honour it shares with Logo.

Using a language like Basic is very like painstakingly talking a rather dim office boy through the job of filing an invoice: "Look at the invoice. If it is not marked Paid, return it to the Bought Ledger desk. Otherwise look at the invoice again and find out the name of the supplier. If the supplier's name begins with a letter that lies in the range A to M, go to the filing cabinet marked A to M. . . " and so on, down to whatever level of detail our office boy's IQ demands.

Limited

Eventually the office boy will develop a subroutine called "filing", and certain things can be taken for granted. But the particular office boy represented by the Basic language will never rise to be managing director or even personal assistant, because it only understands the steps along the way, never the complete task. This shortcoming is common to all the so-called procedural languages.

The descriptive languages Lisp and Prolog give the programmer the tools to set up the parameters of the problem, leaving the choice of steps required to solve it to the discretion of the internal workings of the language. Both are also known as logic languages, although historically Lisp is based on computational theory and only Prolog is rooted in formal logic.

Lisp officially acquired its name from the phrase list processing language, but in honour of the way brackets proliferate in the source code the acronym has been given the unofficial subtext of Lots of Infuriatingly Stupid Parentheses. Lisp's

Lisp and Prolog sources

- Good books on Lisp are not easy to come by. The cheapest and most readily available is the one published by Acornsoft. The standard reference book for Prolog is by Clocksin and Mellish, published by Springer-Verlag, but it is not light reading. Hoarders of *PC* back numbers might look out the excellent short discussion of Prolog in the April 1983 issue.
- Several Lisps and Prologs have recently appeared on the micro scene. Acornsoft's Lisp for the BBC Micro is available on disc or as a ROM, and Mulisp from Microsoft comes wrapped up as a full AI development system — somewhat unfortunately called Aids — for CP/M and MS-DOS systems. An excellent cheap Lisp from Software Toolworks, the company responsible for C/80, can be had in the U.K. through Transam.
- There are two approaches to Prolog on micros. Frank McCabe's brilliant and compact micro-Prolog comes with a number of friendly shells for the beginner, and quite large projects can be developed on a small CP/M micro, thanks to its use of modules, reminiscent of UCSD Pascal. The dialect was originally developed at Imperial College to run on the Z-80, and was field tested at Park House Middle School on 10-year-old children during the course of a project called "Logic as a Computer Language for Children".
- Micro-Prolog's documentation, consisting of two paperback books, makes good reading for the Prolog beginner. The only caveat is that the syntax of the dialect is rather more Lisp-like than the Edinburgh Prolog standard. The more mainstream alternative is Prolog-1 from the Oxford-based company Expert Systems. Prolog-1 comes with less documentation for the beginner, but it ties in very well with Clocksin and Mellish and generally appears to be more commercially orientated in its approach. Particularly helpful is the copiously documented demonstration software provided with the system, including a database query program, a compiler creator and a symbolic differentiation program. This software is all in Prolog-1 source code and gives a valuable insight into how Prolog works.

origins can be traced to Dartmouth College, where in the summer of 1956 the first major workshop on artificial intelligence was held.

A visiting professor from MIT, John McCarthy, listened attentively to a paper on a now-forgotten language, IPL-2. Its low-level pseudo code and assembler-like syntax suggested to him the idea of an algebraic list-processing language along the lines of the new Fortran 1 compiler.

The important step McCarthy took in developing what was originally known as FLPL was to add an If-Else construct to the single-argument If construct of Fortran. By 1958 McCarthy had discovered the power of recursion in conjunction with this kind of conditional expression. Recursion, not permitted in Fortran or its other offspring, Basic, became a very important idea in McCarthy's definition of list processing. We will come back to recursion in a moment — it all comes back to recursion!

Lisp emerged with only two data types: simple entities called atoms, and lists. An item in a list is either another list or an atom. There is not even really a separate entity called a program. It is just another list to be evaluated as an expression.

The appealing thing about lists is that although they can be any length, they all have no more than two elements. Consider the list

Tom Dick Harry Angela Perry Simone

You might say it had six elements, but Lisp says: "I see a list consisting of Tom and another list".

What it is doing is to split the list into a head and a tail. Does that mean that only Tom is known to the Lisp interpreter? No, because the tail, which is also a list, is amenable to the same process: "I see a list consisting of Dick and another list . . . " and so on. This repeated application of the head-and-tail principle is another manifestion of recursion.

Lets us now look at the creation of a recursive function, using Microsoft's Mulisp-80. When you enter Mulisp's function editor to create a new function, say Pwr, you find the following definition waiting:

```
(defun pwr nil)
```

which is not hard to translate as "the current definition of Pwr is nil". Defun is a function definer, the head of a list whose tail is Pwr nil. You can tell it is a list because it is wrapped in brackets.

Let us begin by creating a simplified version of the function

```
(pwr x y)
```

to return the value of x raised to the power of y. The value of

```
(pwr x 0)
```

will always be 1, irrespective of x, because any real number to the power of 0 is unity. So as a first step you can write

```
(defun pwr (lambda (x y) ((zerop y) 1) dunno)))
```

This is about the simplest non-null Lisp function imaginable, and it needs five pairs of brackets. If your brain seizes up at the sight of parentheses, Lisp is not for you. But if you can cope, the translation is quite easy as long as you remember that it is only a list of three items, headed by the function name Pwr.

The third item on the list is itself a list, headed by the mysterious item Lambda. The name of this standard Lisp function derives from lambda calculus, the mathematical theory that forms the basis of Lisp. All it does here is to announce that the two-item list that follows consists of

- a list of the parameters for the function you are defining, here represented by (x y); and
- a list of items making up the body of the function; in this case this list consists of a pair of items, though it could be more or fewer:

```
((zerop y) 1)
dunno
```

Like variables

Dunno is an ad hoc atom invented just by writing the name. In Mulisp, atoms created like this behave like variables pointing to themselves, rather as if in Basic you were to say

```
LET DUNNO$ = "DUNNO".
```

Now call Pwr with the appropriate parameters, for example

```
(pwr 2 0)
```

A Lisp function represents a quest, a search through the provided list for truth. As the function goes to work Lambda begins by mapping the two members of the tail, 2 and 0, to x and y. The next item on the list is the list

```
((zerop y) 1)
```

The interpreter opens this list and inspects the first item, the list (zerop y) — or rathter (zerop 0), as the variable has been filled.

Zerop is an in-built Lisp function that tests its single parameter for equality with zero and in this case it provides Lisp with the truth it seeks. Satisfied, the interpreter goes no further and the function stops, returning the value that immediately follows, which happens to be 1.

In action it looks like this

```
* (pwr 2 0)
1
```

When the function is called with a different value for y you get a different result

```
* (pwr 3  2)
dunno
```

indicating that the function does not yet know how to cope with powers that are not zero. Now you can add that feature, using the recursive principle that for positive powers a number raised to a power is the same as the number times the number raised to one less than the power or, to put algebraically,

```
x^y = x * x^(y - 1)
```

This is recursive because Pwr is being defined in terms of Pwr. But this definition will not keep tumbling forever downwards, because there is a safety net in the form of a definition of Pwr for y equal to 0.

The expanded function looks like this

```
(defun pwr (lambda (x y) ((zerop y) 1)
  (times x (pwr x (difference y 1)))))
```

The built-in functions Times and

(continued on next page)

Predicate calculus and Prolog

Here, with some translation into manageable symbols, is a predicate calculus version of a familiar proverb

```
all(X, dog(X)  →  exists(Y, day_of(X,Y)))
```

This roughly translates as: it is true of all X, where X is a dog, that there exists a Y such that Y is the day_of that particular dog.

By applying a number of transformations to the structure of propositions like this, predicate calculus shows that it is always possible to arrive at a clause that is a collection of terms with the following shape:

```
<t1>;<t2>;<t3>... :-<ta>,<tb>,<tc>...
```

where the semicolons stand for Or, the commas stand for "and" and the ":-" means something like If. An English-like interpretation of the clause above might be: it is true that t1, or that t2, or that t3, if ta is true and tb is true and tc is true.

The point of this symbol juggling is that a principle called resolution can now be applied to a set of these clauses to derive or test conclusions for them. Resolving a set of clauses is analogous to solving a set of simultaneous algebraic equations and, happily for Prolog, is something that can be done mechanistically by a computer.

Resolution by computer is greatly helped if the clauses are gathered into a special form called Horn clauses. A Horn clause either has only one head:

```
<t1> :- <ta>,<tb>,<tc>...
```

or none

```
:- <ta>,<tb>,<tc>...
```

As you can guess, the headed clause, sometimes called a Horn implication, means that <t1> is true if all the rest of the terms are true. The second, headless clause simply asserts the truth of <ta>, <tb> and <tc>. In other words, it is a database, and something has been generated that is very like the form of a Prolog program, consisting of a set of facts, and a set of rules — the headed clauses.

(continued from previous page)

Difference are self-explanatory. This revised definition gives the following result

```
* (pwr 2 0)
1
* (pwr 2 2)
4
* (pwr 2 3)
8
* (pwr 2 6)
64
* (pwr 2 8)
256
```

Perhaps a definition for negative values of y should be added. You can separate out positive y values by using the built-in function

(lessp x y)

which returns True if x is less than y. Unfortunately the only numbers understood by the current version of Mulisp are integers, though floating-point arithmetic is planned for the next version. As negative powers produce fractions, the best that can be done without a great deal of special programming is

```
(defun pwr (lambda (x y) ((zerop y) 1)
  ((lesp 0 y) (times x (pwr x (difference y
  1 ))) ) (print (sorry, mulisp can't handle
  decimals)) ))
```

The logic of this code should be clear if you have managed to follow the argument so far. But is the code program or data? What we have called the "quest for truth" turns the function into something very like a miniature database of rules for dealing with different kinds of powers. The quest scans the database for a match of the initial condition and provides an answer accordingly.

This absence of a clear distinction between data and program is emphasised in Lisp by the fact that the same list structure is used to represent both. Though confusing for the beginner, it turns out to be particularly useful in AI programming, where the simplest solution to a complex problem may be to write a program that creates another program and then runs it.

Existential

This handy ambiguity was never deliberately designed into Lisp, but its wide use has lead to the creation of other languages that exploit the idea more directly. Prolog is the prime example. If a Basic program is about doing, a Prolog program is about being. Somewhat simplistically, you can think of a program in Prolog as a database hanging about waiting to be enquired into.

The language was invented by Alain Colmerauer at the beginning of the 1970s to provide a means of allowing the programmer to specify tasks in terms of logic, rather than the "do this and then do that" requirements of the hardware, to which other languages have to pander. The logic inquestion is predicate calculus, a precise formulation for discussing logical propositions by the manipulation of symbols.

Prolog was first implemented in Marseilles in 1972 in the form of an interpreter written in a version of Algol, although Fortran subsequently proved more efficient for the purpose. During the mid-1970s Prolog spread through the AI and university community in Europe and the U.S., inevitably evolving into a number of distinct dialects. Of these, the Edinburgh DEC 10 Prolog, the first to incorporate a compiler, is likely to emerge as some sort of standard, as it is the version exported to Japan to form an important part of the fifth-generation project.

Prolog handles problems in terms of collections of facts about the relationship between objects, and collections of rules about the relationship between facts. A very simple example might be

```
/* a database of boys and girls */

boy(tom)
boy(dick)
boy(harry)
girl(angela)
girl(perry)
girl(simone)

/* a rule */

loves(X,Y):- boy(X)
             girl(Y)
             likes(X,Y)

/* a statement of fact */
likes(dick,simone)
```

the implication of which you can probably work out for yourself.

This article should provide a handle for you to get your own grip on these fascinating languages, though it falls far short of a comprehensive overview. In discussing Lisp, for example, I have made no mention of the way you can attach properties to atoms, and nothing has been said about the control Prolog gives the programmer over the input and output statement, making it very easy to develop command-line parsers. Both these features are important to a proper understanding of the languages.

The theoretical underpinnings of both languages are simple and elegant, but a good deal of experience is necessary before you can read the source code like a book. Unfortunately, the programmer is often driven to kludge the descriptive nature of the language to do exactly what it is not designed to do — make the machine execute a series of steps. Consequently, programs are typically an uneasy mixture of descriptions and procedures, and what in theory should be a collection of goal-seeking clauses in no particular order often has to be read as a sequence of steps where the side effect — printing something out on the console, say — is the real purpose, and the goal is a dummy.

```
% muLisp Tower of Hanoi program, (c)  The Soft Warehouse %

(loop (print *) (eval (read)) ((null rds)) )

(putd defun (quote (nlambda (nam func)
  (putd nam func) )))

(defun hanoi (lambda (num a b c tab1 tab2)
  (setq a (mktower num alphabet))
  (setq tab1 (plus (length (pack a)) 4))
  (setq tab2 (times 2 tab1))
  (printtowers)
  (xfer num (quote a) (quote b) (quote c))
  " " ))

(defun mktower (lambda (num alphabet tower)
  (loop
    ((zerop num)
      (reverse tower) )
    (push (pop alphabet) tower)
    (setq num (sub1 num)) ) ))

(defun xfer (lambda (num source dest spare)
  ((zerop num))
  (xfer (sub1 num) source spare dest)
  (move source dest)
  (xfer (sub1 num) spare dest source) ))

(defun move (lambda (source dest)
  (set dest (cons (car (eval source)) (eval dest)))
  (set source (cdr (eval source)))
  (printtowers) ))

(defun printtowers (lambda nil
  (terpri)
  (prinhanoi a)
  (tab tab1)
  (prinhanoi b)
  (tab tab2)
  (prinhanoi c) ))

(defun prinhanoi (lambda (lst)
  (loop
    ((null lst))
    (print (pop lst)) ) ))

(defun sub1 (lambda (num)
  (difference num 1) ))

(defun tab (lambda (num)
  (spaces (difference num (spaces))) ))

(setq alphabet (a b c d e f g h i j k l m n o p q
  r s t u v w x y z))

(hanoi 8 (rds))
```

```
/* Main Database Command Service Procedure */

dbaql :-
    repeat,
      new,
      nl,nl,write('DBAQL> '),
      once read( Q ),
      once call( Q ),
    fail.

/* Database Query Procedures */

all T:-
     goallist( T,6,Search ),
     formgoal( G,Goal,Term ),nl,
     solve( Search,Goal,Term ).

/* Separate into report and search specifiers */

goallist( T, [G1], Search ):-
     T =.. [G1,T1],
     T1=.. [V,Search],
     verb(V).
goallist( T, [G1|G2], Search ):-
     T =..[G1,T1 ],
     goallist( T1, G2, Search ).

/* Use constructors to insert text */

formgoal( [], true,'  ').
formgoal( [G1|G2], S1, T1 & T2 ):-
     constructor(G1,T1),
     formgoal( G2, S1, T2 ).
formgoal( [G1|G2], (S1,S2), T1 & ' ' & T2 ):-
     S1=..[G1,T1],
     formgoal( G2, S2, T2 ).

/* Check for match. If successful, bind Term  */
/* accordingly and print. Backtracking causes */
/* select to be resatisfied.                  */

solve( Search,Goal,Term ):-
     select,
     Search,
     Goal,
     writef( Term \),
     fail.
solve(_,_,_).
```

Sample listings in Lisp and Prolog.

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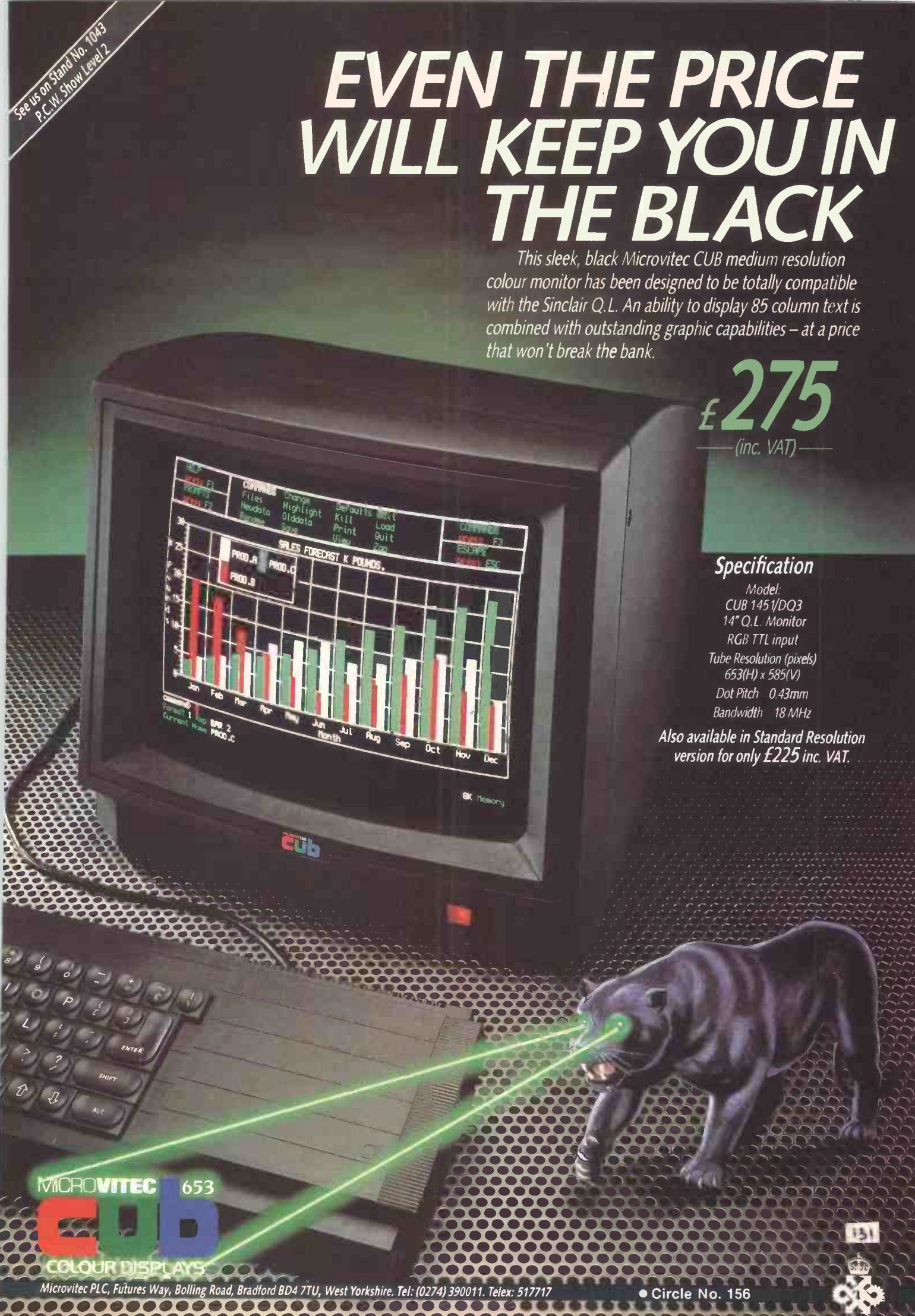

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In place of brute force

David Levy shows how a more human-like approach to analysing possible moves can be applied to game-playing programs.

THE THOUGHT PROCESSES of human beings and computer programs are very different in a number of ways. Yet the fundamental problem posed to each species is the same.

A strategy game is usually represented by a tree structure in which the root of the tree represents the position from which the next move in the game is to be made. Each branch of the tree represents a move in the game and the merit of a game position is measured by an evaluation function, sometimes called a scoring function, which assigns a numerical score to a position. The science of intelligently growing the tree in such a way as to find a good — hopefully the best — move from the current position is known as tree searching, and there is a rich literature on the subject.

Human beings tend to grow and search rather small game trees. In the three minutes or so taken to make a move in a competition game of chess, the world's best chess programs may need to evaluate more than 35 million chess positions. In the same time a human chess master will look at a tree containing something of the order of 100 positions. The big difference, of course, and one of the reasons why human chess masters can still defeat the world's best programs, is that experienced human players know which moves are worthy of serious consideration and which can be discarded as being obviously useless.

This is the first of a new series of articles by David Levy on strategy games. In a previous series, which was subsequently published as a book, he described the traditional tree-searching techniques which have been in use for at least three decades. He also dissected a number of well-known strategy games in order to show how they might be susceptible to programming. The present series starts by looking at some modern methods of tree searching. This will be followed by a number of articles on interesting strategy games, including word games and card games. Nothing from the original series will be repeated here, and the interested readers are referred to the author's book *Computer Gamesmanship*.

Among the computer-chess cognoscenti there are two opposing schools of thought. One group favours what is known as brute force search, in which the speed of the computer is used to examine every possible move by each player up to some predetermined depth, such as four or five moves by each side. After that point there is usually a capture search, in which all captures and checks are examined in order to determine whether some tactical disaster is in the offing. The advantage of brute force searching is that nothing shallow is overlooked. The big disadvantage is that almost all of the computer's time is wasted on moves that a human master would immediately and instinctively reject.

The other school of thought is called selective search. As its name implies, this approach supposes that computer programs should think like humans and examine only the sensible parts of the game tree. The selective search school is very much in the minority among those who have been involved with the writing of chess programs, but its supporters include three chess masters: Mikhail Botvinnik, World Champion, with two short breaks, from 1948 to 1963; Hans Berliner, a former World Correspondence Chess Champion; and myself. Although most of the successes scored by chess programs up to now have been by those using brute force search techniques, I feel that this method is approaching its limits and that the next big advances in computer chess will come from selective searching techniques.

One of the most exciting developments in tree searching during the past quarter century has been the invention by Berliner of a technique called B*. In addition to being a distinguished chess master, Berliner is also a Professor of Computer Science at Carnegie-Mellon University in Pittsburgh, and the author of a backgammon program which won a match against the human World Champion. The inspiration for Berliner's B*algorithm is clearly his understanding of how human chess masters analyse.

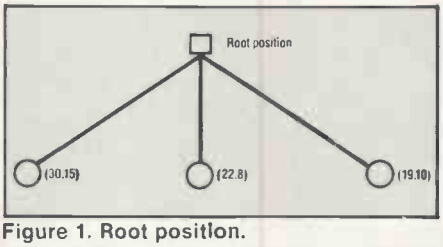

Figure 1. Root positlon.

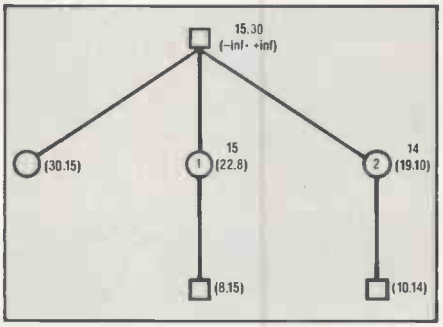

Figure 2. DisproveRest strategy.

Suppose that a game is being contested by two players called Max and Min. It is Max's turn to move from the root of the game tree, and Max is trying to reach a position with the highest possible score. His opponent, Min, attempts to reach positions with the lowest possible scores.

As the game tree is grown, most tree searching methods will assign a single score to the positions in the tree, that score being an estimate of the true merit of the position. In contrast, Berliner assigns two distinct values to each position: an optimistic value and a pessimistic value.

Figure 1 shows the start of a B* search. Max has a choice of three moves in the root position. The first figure in brackets next to each of the three resulting positions represents the optimistic score and the second figure the pessimistic score from Max's point of view. These scores will be updated as the search progresses.

The B* algorithm must now decide:
(a) whether or not to terminate the search process; and if not, then
(b) which position to expand next.

In order to terminate the search, the algorithm needs to show that the pessimistic value of one of the moves from the root of the tree is no worse than the optimistic value of any of the other moves from the root position. Here the best pessimistic value — which is not necessarily the same as the pessimistic value of the most optimistic move — is 15, for the leftmost move, while the worst optimistic value of the other root moves is 19. Since 15 is worse, from Max's point of view, than 19, the search will not terminate. So which of the three positions should it expand next?

There are two different strategies for making this decision. One is called the ProveBest strategy: it tries to raise the pessimistic bound of the most optimistic position so that it is not worse than the optimistic bound of any of its brother positions. The other is the DisproveRest strategy, which tries to lower the optimistic bound of all the other positions at depth 1, so that none of them are better than the pessimistic bound of the most optimistic position.

ProveBest

Figure 3 shows the effect of applying the ProveBest strategy on the small tree in figure 1. The numbers inside the positions indicate in which order the positions have been expanded, while the numbers in square brackets next to each position show the optimistic and pessimistic scores for the position. As the program acquires information about positions deeper in the tree, it backs up information about these deeper positions, and the backed-up scores are shown above the bracketed values they replace.

The ProveBest strategy tries to raise the pessimistic bound of 15 for the most optimistic position, position 1. First the algorithm replaces the scores of −infinity and +infinity — the original pessimistic and optimistic values — at the root of the tree with the new values of 15 and 30, the highest of the pessimistic and optimistic values respectively. Note that the pessimistic value for Min at position 1 becomes the optimistic value for Max at the root, and vice versa.

The program next expands position 1 by growing the three branches to position 2 and its siblings, all three of which then have optimistic and pessimistic scores assigned to them. In order to back up the tree to provide more accurate information at position 1, the optimistic score at position 1 — which was 30 — is now replaced by the most optimistic, from Min's point of view, of the pessimistic scores for position 2 and its siblings, namely 25. Thus the optimisitc score at position 1 now becomes 25, while a similar process leads to a new pessimistic score at position 1 of 22 — the maximum of 15, 19 and 22.

ProveBest next decides to expand position 2, since the optimistic score of 15 for position 2 is better for Min — whose turn it is to move from position 1 — than the optimistic scores of 19 and 22 for the siblings of position 2. Note that ProveBest always expands the position with the best optimistic value. If there is more than one move with the same best optimistic value the ProveBest strategy will not be used.

Max now finds a successor to position 2, which provides an optimistic score of 26 and a pessimistic score of 22, and so this pessimistic 22 now updates the optimistic score of 15 at position 2. The optimistic 26 does not affect the pessimistic score at position 2, which is the same.

Next to be expanded is position 3, because the optimistic score of 19 at position 3 is better from Min's point of view — lower that is — than the optimistic score for either of position 3's sibling positions, which now are both 22. Max finds a successor to position 3, which has an optimistic score of 25 and a pessimistic score of 23, and since this pessimistic 23 is better for Max than the optimistic 19 at position 3, the score of 23 is backed up and replaces the 19.

Turning now to the three successors to position 1, you can see that the pessimistic score for position 1, from Min's point of view, is 25; this is the lowest of the optimistic scores for the three successors 26, 25 and 30. The optimistic score for position 1 from Min's point of view is 22, the lowest of the pessimistic scores for the three successors 22, 23 and 22. The pessimistic 30 for position 1 is therefore replaced by 25, while the optimistic 15 is replaced by 22.

The pessimistic score from Max's point of view for position 1, which is now 22, is no worse than the optimistic score for either of position 1's sibling positions, which are 22 and 19. Therefore the search can terminate, with the pessimistic 15 at the root being replaced by the pessimistic 22 from position 1, and the optimistic 30 at the root being replaced by the optimistic 25 from position 1.

The conclusion, therefore, is that Max should choose the move to position 1, and the true score for that position will lie in the range 22 to 25. There is no need to search the tree any further, since Max cannot achieve more than 22 with any other move from the root, and Min cannot achieve any better than 22 after Max moves to position 1.

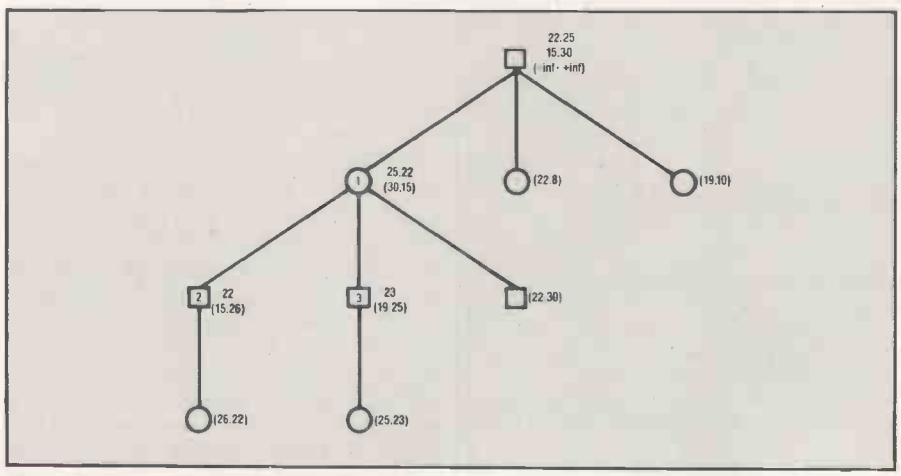

Figure 3. Effect of ProveBest strategy.

DisproveRest

The expanded tree for the DisproveRest strategy is shown in figure 2. Here the algorithm expands position 1 first because it is trying to lower the optimistic bounds of all but the leftmost position. The program finds a successor to position 1 with a pessimistic score of 15, which allows it to update the optimistic score of 22 at position 1. The pessimistic score of 8 at position 1 is not changed, since the optimistic score at position 1's successor is also 8.

Next the algorithm expands position 2, since DisproveRest always expands the position with the second-best optimistic score, and here it finds a successor with a pessimistic score of 14. This updates the optimistic score of 19 at position 2, but the pessimistic 10 at position 2 is not changed because the optimistic score for its successor position is also 10.

Now, after expending less effort than was the case with the ProveBest strategy, DisproveRest has shown that the pessimistic value of the leftmost successor to the root position, which is 15, is no worse than the optimistic value of either of its sibling positions, which are 15 and 14. The correct move can be seen to be to the leftmost position from the root of the tree, and the true score for this position lies within the range 15 to 30, which is consistent with the range of 22 to 25 found by ProveBest. Remember, it is not necessary to find a backed-up score for the root position; it is sufficient to know what move is best.

A relatively simple way to find optimistic and pessimistic scores in a game such as chess is to pretend that one player can make two moves in succession. For example, if you make a move that threatens your opponent's queen, your

(continued on next page)

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optimistic score will assume that he will allow you to take his queen next move. Conversely, if it is your turn to move and you assume that you waive the right to move, then your opponent's best move will lead to a position that is commensurate with your pessimistic score.

If you are programming a game where the onus of making a move is a disadvantage, remember that your optimistic score will be associated with the assumption that you can waive the right to move if you wish, while your pessimistic score will come from the assumption that you must move when it is bad to do so, but may not move when it is good to do so.

Andrew Palay, a colleague of Berliner's at Carnegie-Mellon University, has shown that the correct choice of strategy can have a substantial effect on reducing the search effort. A detailed discussion of Palay's work is beyond the scope of this article, but I shall present his decision rules as they will be of great use to anyone wishing to use the B* search algorithm.

Suppose that there are i moves available at the root of the game tree. For each of the positions that may arise from these moves there is a range of values [a1.b1], [a2. b2], . . . [ai. bi]. Suppose also that a1 is the best optimistic value, a2 is the next best, and so on.

Rule 1: If there are two or more positions with the same highest optimistic value the DisproveRest strategy should be chosen. The position to be chosen as the benchmark should be the one with the lowest pessimistic value from that group of positions which share the highest optimistic score.

Rule 2: If the range of scores of a position lies entirely within the range of scores of the best position, the ProveBest strategy should be chosen.

Rule 3: If both of the above conditions hold, use either strategy.

Rule 4: In all other cases, calculate

$$PFP = (a2 - b1)/(a1 - b1)$$

which is the probability of failure using the ProveBest strategy on the position with range a1 to b1. Also calculate PFD, which is the sum over all values of x from 2 to i of

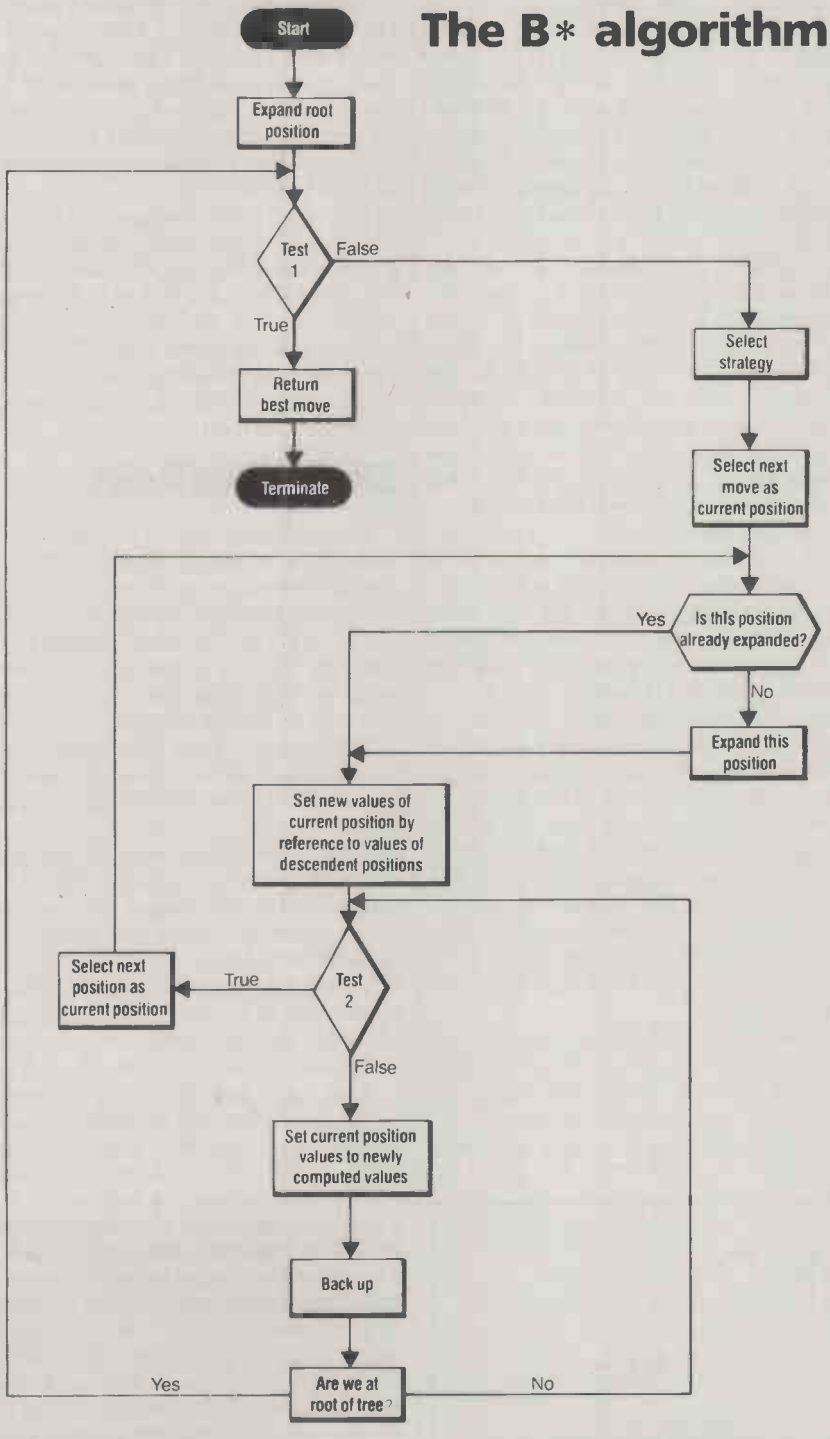
$$(ax - bi)/(ax - bx)$$

If PFP < PFD then choose the ProveBest strategy, otherwise choose the DisproveRest strategy.

The principal difficulty in implementing the B* algorithm in a home-computer program is the lack of sufficient storage to cope with the whole of the game tree. If you are programming in assembler this can be a very real problem, since your program will execute quickly and will generate a tree which is probably too big for your machine, unless you have a lot of disc storage available. But most readers who write their own programs will be using Basic, and because of the relatively slow speed of execution the program will be unlikely to create enormous trees.

If your program does run out of storage it can create more by pruning off the least useful parts of the tree, and if it ever reaches a situation in which there is only one branch left at the root, the search can terminate and the program plays the move corresponding to that branch. It is also possible that the program might not be able to prove that a particular move from the root of the tree is best within a permitted time frame, in which case it will make the move leading to the most optimistic score.

The B* algorithm



Test 1: Is the pessimistic value of the best move from the root position at least as great as the most optimistic value of the alternative moves from the root position?

Test 2: Is the new optimistic value not equal to the optimistic value of the current position *and* is the new pessimistic value not equal to the pessimistic value of the current position? This means that when there is no longer any change in the bounds the program backs up.

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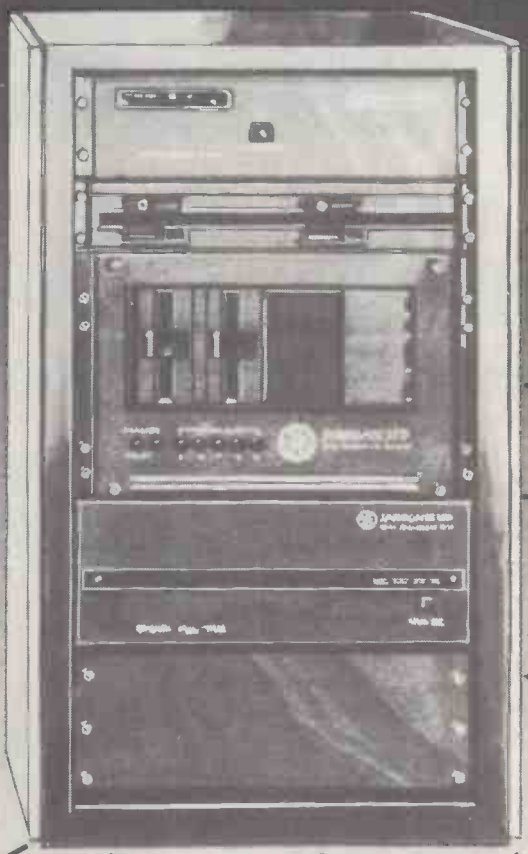

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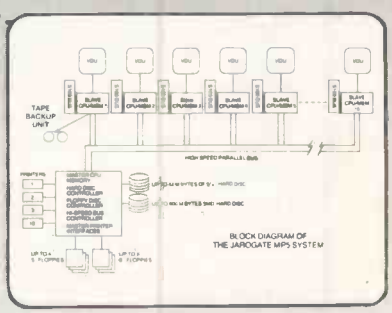

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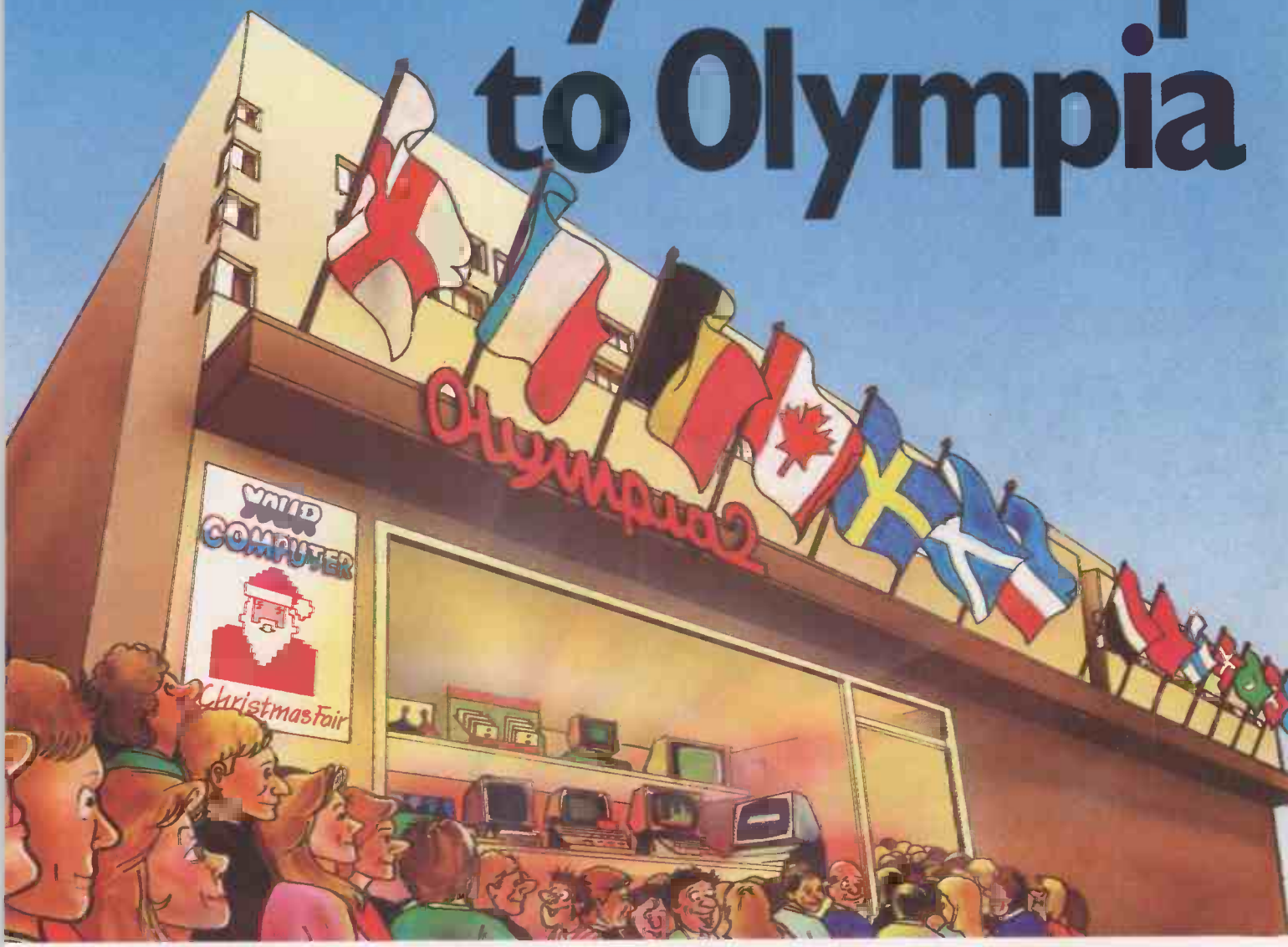

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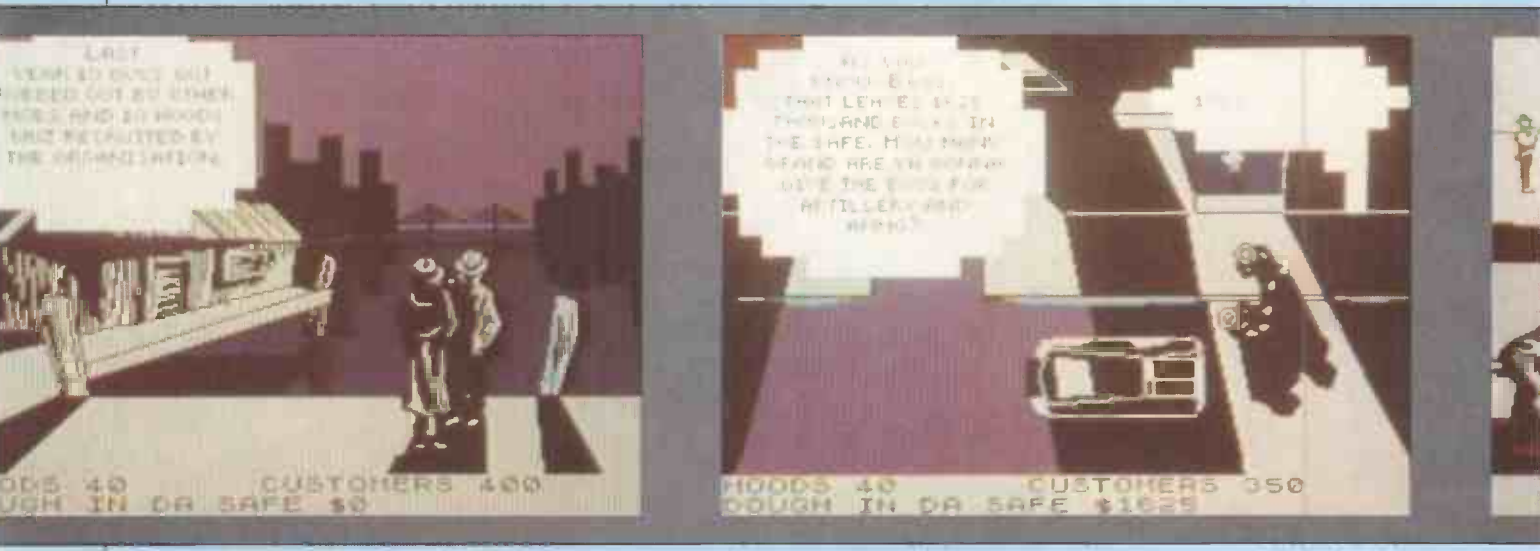
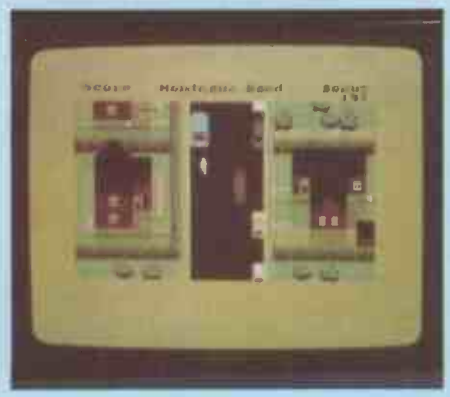
137 PC

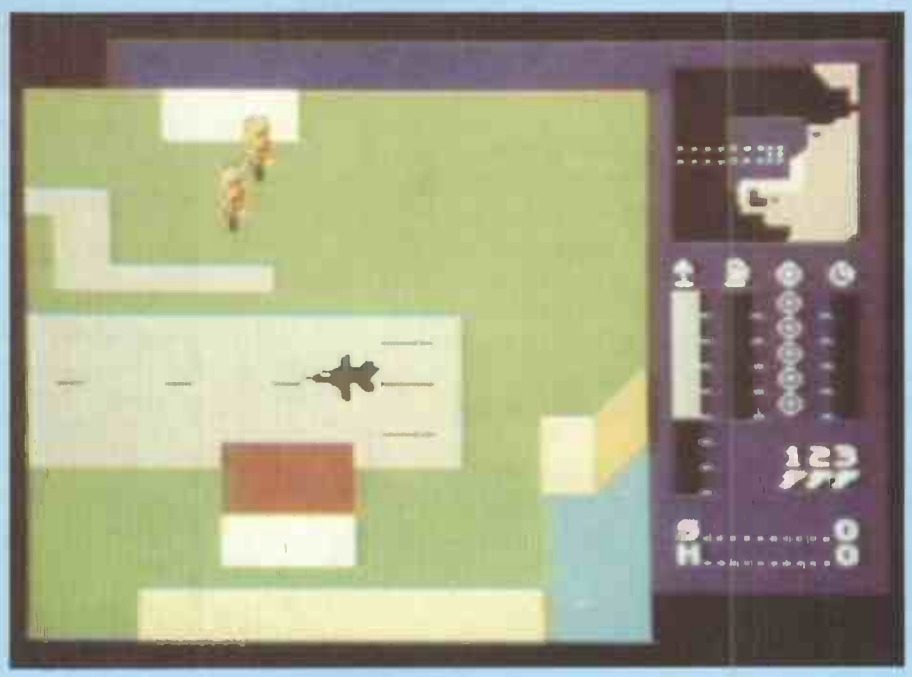
Essential buys

Sinclair's Spectrum remains the pre-eminent micro for cheap, high-quality games, as Jack Schofield found when he played his way through the latest crop.





Left: Match Point's graphics are not as good at Atari Tennis but it plays well.
Below left: New Generation's Trashman is a reasonable novelty game.
Below: An essential buy — Costa Panayi's excellent Tornado Low Level.



DON'T READ THIS column unless you have a few quid to spare, because the last few months have been quite kind to Spectrum games players. There are now another three essential buys — TLL, Codename Mat and Sabre Wulf — and quite a few other games that are worth considering, such as Jet Set Willy.

Also, I have upgraded my Spectrum a lot by adding a couple of gadgets, both of which I can recommend. First, I installed the Compusound Telesound, a tiny PCB which fits inside the Spectrum case. What it does is route the normally feeble sound output to the TV set — which is what Sinclair would have done in the first place if the Spectrum were not of such cheapskate construction. On the TV set the sound is really loud and clear. It adds a lot to the excitement of the best games, although the old Spectrum now seems to get even hotter than ever.

Second, I have added a new Protek Switchable Joystick Interface. This is the usual boring interface for providing a standard Atari-type joystick port, which was one of the other things accidentally on purpose left off the Spectrum. The neat thing is that it has a three-position switch on the back which offers

1. Cursor, Protek or AGF compatibility,
2. Kempston type, and
3. Sinclair Interface-2 type of operation.

You can simply switch between the three, and the one interface now copes easily with almost all joystick-operated games.

TLL

Tornado Low Level was the game hit of the Earls Court Computer Fair, where the young author Costa Panayi could be seen demonstrating his expertise. Those Spectrum owners who have looked enviously at Blue Max on the Atari and Commodore micros can relax: Tornado Low Level is virtually as good.

Using the keyboard or joystick you have to take off then manoeuvre your swing-wing fighter around a large three-dimensional landscape. You find and then bomb some very small targets. The plane casts a shadow, as with Blue Max and Zaxxon. Again, this is not a flight simulator, it's better.

Those who have Android II, also from Vortex, will recognise Panayi's blocky graphics style, which is not particularly realistic but very three-dimensional. The action itself is very smooth and well controlled. TLL is an essential buy: worth twice the asking price!

Above: Mugsy from Melbourne House features brilliant comic-strip graphics.
Below: More an arcade game than an adventure, Sabre Wulf — yet another classic from Ultimate Play the Game — is also a must.

Codename Mat

Another essential buy is Codename Mat by Derek Brewster from the normally reliable Micromega. This is a Spectrum version of what is — in Jeff Minter's opinion, and mine — the greatest microcomputer game ever written, Star Raiders on the Atari. And Star Raiders is itself, of course, merely a high-speed, three-dimensional graphics version of that great old computer favourite Star Trek.

A few of the names have been changed in Mat, and you command the USS *Centurion* instead of the *Enterprise*. The enemy star bases look a bit like purple hamburgers, while the long-range scan and galactic charts lack detail.

So Codename Mat is not nearly as good. The graphics are inferior, the action is not as fast or precise, the sound is well down on Atari standards, and the game does not have as much variety or as many levels. Also it needs 40K, whereas the Atari original is an 8K game.

However, considering the quality of Star Raiders it is amazing to find a

(continued on page 141)

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(continued from page 139)
comparable game being done on the Spectrum at all. Certainly, Codename Mat knocks Timegate and most other Spectrum offerings into a cocked hat, and thus it is an essential purchase.

Is it fun to play? The Star Raiders type of game is so hard to learn and so very hard to master that, like chess and bridge, it transcends mere notions of "fun". It is not for kids — it's for maniacs.

Sabre Wulf

If you liked Atic Atac you will also like Sabre Wulf. It is much more of an arcade game, less of a graphics adventure, and the action is different every time.

You are an explorer, armed with a sword and placed in a huge, colourful, beautifully drawn maze. The action is extremely fast and furious. You are not given the least idea what is going on, and you get killed frequently by a weird and wonderful collection of monsters.

Personally, I am not convinced it is as good as other masterpieces from Ultimate such as Pssst! and Atic Atac, but perhaps that is because my tactical approach has not yet developed beyond using the orchids, collecting red voodoo dolls and then running like hell. Certainly it is a very compulsive game and another essential purchase.

Match Point

Perhaps the tennis season finished with Wimbledon, but computer tennis is here for the winter with Psion's Match Point. It is a three-dimensional version of the game, which is rather similar to Atari Tennis except that the graphics are not as good. The Match Point tennis players are awkward stick figures of the sort that Mervyn Peake might have put in Gormenghast on an off day. Also, everything is green, just like some awful Dragon game.

However, it must be said that Match Point is a lot harder to play than Atari's Tennis, and it has ball-boys too. While playing against the computer is a pretty mind-numbing exercise, Match Point is well worth having for the two-player option, guaranteed to have you paralysed with laughter and frustration inside 15 minutes.

Mugsy

Melbourne House claims that Mugsy has "da best graphics ever seen on the Spectrum", and it is hard to disagree. Rather than try for stunning realism and fail, Mugsy uses comic-strip graphics, and they are brilliant. It is claimed they were done by Russell Comte with the Melbourne Draw program, which is quite a recommendation for that too.

Apart from the graphics, Mugsy is a rather tedious management game of the Hammurabi type. You have to buy guns and ammo, buy clients for your protection racket from the syndicate — or, better still, sell them — and get as much dough in the safe as possible. You get assassinated and given a percentage score at the end. It is not a morally uplifting scenario, which is a good excuse for those of us who are hopeless at it.

Also rans

Pogo from Ocean is a better-than-average version of Q-Bert with better-than-average sound, by Spectrum standards at least.

Full Throttle from Micromega is a motorcycle race game, like Atari's Pole Position on two wheels. Though it lacks the brilliant colour, the sharpness, the detail and the sound of Atari's game, it plays almost as well.

Revenge of the Killer Tomatoes from Visions is a cabbage-patch story. You grab the weeds while making sure the tomatoes don't "ketch-up" with you. Mildly amusing.

Blade Alley from PSS is a disappointing three-dimensional trench game, reminiscent of the end of the *Star Wars* film. You use shadows to judge the height of enemy fighters coming towards you and blast them. Boring.

Orc Attack from Creative Sparks — formerly Thorn-EMI — has you defending the battlements of your castle against Orcs scaling them with ladders. It has very detailed graphics. Heads get lopped off and other gory things happen. I did not like the original Atari version much. This is just as good and just as nasty.

Trashman features an unappealing dustbin on the cassette of what is a reasonable novelty game in which you are a dustman. You start off collecting five dustbins in Montague Road, and after a few minutes you are fired for being too slow. Is there more to life than this? I think I have better things to do, such as play ....

Automania from Mikro-Gen — a platform, ladders and jumping game featuring Wally Weeks and set in a car factory. You have to collect all the bits to build a series of cars. The graphics are excellent and the sound is awful, but you can turn the sound off. It may not be another Donkey Kong, but it ain't half bad.

Frank N Stein from PSS is much more like Manic Miner. The idea is to collect all the bits to make a body, while avoiding a range of nasties. The game claims to have 50 screens but I could not get past the first one.

Jet Set Willy

Matthew Smith's follow-up to Manic Miner is a graphics adventure with 60 rooms, most of which are in Willy's mansion. The idea is to collect all the objects scattered around so that Maria will let you get to bed. The bedroom is, of course, just a couple of screens from the bathroom where you start, but you have to trace a very long and troubled route to get there. And you'll never do it without a map.

The graphics are perhaps not as wildly imaginative as those in Manic Miner, and the music is tedious, but the game requires lots of experiment and some hard thought to get very far. You certainly get your money's worth in play values. You also get a good game that is not a substandard derivation of an Atari original.

	Publisher	Price	Rating
Automania	Mikro-Gen	£6.95	14/20
Blade Alley	PSS	£5.95	10/20
Codename Mat	Micromega	£6.95	16/20
Frank N Stein	PSS	£5.95	13/20
Full Throttle	Micromega	£6.95	14/20
Jet Set Willy	Software projects	£5.95	17/20
Match Point	Sinclair/Psion	£7.95	14/20
Mugsy	Melbourne House	£6.95	12/20
Orc Attack	Creative Sparks	£6.95	10/20
Pogo	Ocean	£5.90	15/20
Revenge of the Killer Tomatoes	Visions	£5.95	8/20
Sabre Wulf	Ultimate Play the Game	£9.95	17/20
TLL	Vortex	£5.95	17/20
Trashman	New Generation Software	£5.95	12/20

All games are available on cassette for the 48K Spectrum. Automania, Orc Attack and Trashman are available for the Commodore 64, and Orc Attack for the Atari.

Hardware

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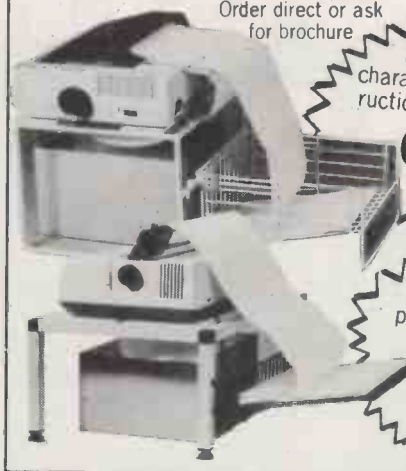

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Open File is the part of the magazine written by the readers of *Practical Computing*. All aspects of microcomputing are covered, from games to serious business software and utilities. Fully-debugged programs can be submitted for any micro, and for standard CP/M machines such as the Osborne and Superbrain. Programs can be in machine code or any language.

Submissions should include a brief description which explains what your program does, and how it does it. If possible it should be typed, with lines double-spaced. We need a printed program listing. Hand-written listings cannot be accepted. A tape or disc of the program helps if it is in a standard format.

When printing listings, please remember to use a new ribbon or double-intensity printing — faint listings reproduce badly. Use plain paper only, and try to list the program across either a 35-character or a 70-character width. Also, make sure all special graphics or inverse-video characters are either listed correctly or else include Rem statements to explain them fully.

Each program listing, tape or disc must have your name and address on it, or we cannot promise its safe return.

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>BBC

150 KEYWORD SEARCH
E K Kam's routine searches for specified Basic keywords.

150 TEXT FORMATTER
Tidy up your screen text displays with Richard Clarke's machine-code utility.

151 KEYLIST
A routine by Robert Turner to display the current definitions of all 15 function keys.

152 DEMOLITION
A new variation on a well-tried theme.

>ATARI

159 AUTO NUMBER
Automatic line numbering of Basic programs comes to the Ataris.

159 SEARCH
An ultra-fast machine-code routine to find a specified string anywhere in memory.

>COMMODORE

163 CRASHPROOF INPUT
Another way round the problem of the naked Return key press.

163 MORSE CODE
A practice program for would-be Morse operators.

>SINCLAIR

167 REVISION TESTER
O-level physics candidates will appreciate this study aid written by M Coombes to run on the Spectrum.

>SHARP

169 FLOWER FUN
A demo for the PC-1500 pocket micro.

169 CATALOGUE
Robert Kesler has written a directory to help you identify programs stored in the PC-1500.

Keyword search

```
   10  REM ZOEKCODE2 C8,350 840206
   20  REM Text input: Search start at
 &E00
   30  REM **********************
   40  REM *     E.K.KAM.         *
   50  REM * Kraaijenberg 91-25 *
   60  REM *  Wijchen  6601 PL  *
   70  REM *      HOLLAND  (C)   *
   80  REM **********************
   90  MODE 7:CLS:GOTO 110
  100  PRINT"Incorrect input !!"
  110  INPUT "Basic-word ",Z$
  120  D%=&806D:Zo$="":Token=0
  130  IF D%>&8359 THEN 100
  140  REPEAT:Zo$=Zo$+CHR$(?D%):D%=D%+
1:UNTIL ?D%>&7F
  150  IF Z$=Zo$ THEN 170
  160  Zo$="":D%=D%+2:GOTO 130
  170  Token=?D%:GOTO 190
  180  GOTO 100
  190  PRINT "Start":I%=&E00:TEL=0
  200  IF I%?1=&FF THEN 280
  210  N%=I%?+3:M%=I%+3
  220  M%=M%+1:IF M%>I%+N%THEN 270
  230  IF ?M%<>Token THEN 220
  240  TEL=TEL+1+N% DIV 40:@%=5:IF TEL
 MOD 20<>0 THEN 260
  250  PRINT"Hit any key ":O=GET:PRINT
 CHR$(11)CHR$(11)
  260  PROCDisplay
  270  I%=I%+N%:GOTO 200
  280  IF TEL<>0 THEN 300
  290  PRINT "No code "Z$". ";
  300  PRINT "Ready":END
  310  DEFPROCDisplay
  320  J%=256*I%?1+I%?2
  330  @%=5:PRINT J%;
  340  FOR TTT =I%+4 TO I%+N%:Ttt=?TTT
  350  IF Ttt>31 AND Ttt<127 THEN PRIN
T CHR$(Ttt);
  360  IF Ttt<128 THEN 490
  370  IF Ttt<>&8D THEN 430
  380  Ltt=TTT?1:Lno=TTT?2+256*(TTT?3-
64)
  390  IF Ltt= 84 THEN Lno=Lno-64
  400  IF Ltt=100 THEN Lno=Lno+128
  410  IF Ltt=116 THEN Lno=Lno+64
  420  @%=0:PRINT Lno;:TTT=TTT+3:GOTO
490
  430  E%=0:D%=&806D
  440  E%=D%:IF D%>&8359 THEN 490
  450  REPEAT:D%=D%+1:UNTIL ?D%>&7F
  460  IF ?D%=Ttt THEN 480
  470  D%=D%+2:GOTO 440
  480  FOR B%=E% TO D%-1:PRINT CHR$(?B
%);:NEXT
  490  NEXT:PRINT
  500  ENDPROC
```

THIS SEARCH program by E K Kam of Wijchen in the Netherlands helps you locate any Basic keyword. You type in the word you are looking for, and the program prints out the numbers of all the lines on which it occurs. It was written on a machine running OS 1.2.

The variable I% in line 190 sets the starting point in memory for the search. It should be set to &1900 if you have a disc system.

To use the routine, bring the target program into memory and then set Page to an address after the end of it. Here you load the search program and run it.

Text formatter

A machine-code routine sent in by Richard Clarke of South Croydon, Surrey allows text to be formatted to any mode width and displayed. He calls it Sprint. The program, when assembled, can be called from Basic by

CALL SPRINT, <stringvar>

Text formatter.

```
   10 DIM CDE% 300
   20 paddr=&70   : REM address in CAL
L parm block
   30 saddr=&72   : REM actual address
 of string
   40 slen=&74    : REM Length of stri
ng, minus 1
   50 chars=&75   : REM Number of char
acters this word
   60 pointer=&76 : REM pointer to sta
rt of word in string
   70 posx=&77    : REM horizontal pos
ition of cursor (POS)
   80 spcpos=&78  : REM position of sp
ace in string
   90 cbfroff=&79 : REM offset in CALL
 buffer
  100 swidth=40   : REM 80 for modes 0
 & 3, 20 for modes 2 & 5.
  110
  120
  130 FOR pass=0 TO 2 STEP 2
  140 P%=CDE%
  150 [       OPT pass
  160 \**
  170 \**           SPRINT    Super-Pr
inter  Utility
  180 \**           ------    --------
------  --------
  190 \**
  200 \**  This program uses no featur
es specific to any one OS or
  210 \**  version of BASIC.  It occup
ies fewer than 256 bytes of RAM
  220 \**  and will, therefore, run on
 any BBC Microcomputer.
  230 \**
  240 \**  Text is passed in the form
of a string variable in a CALL
  250 \**  statement. Text is not spli
t when the end of a line is
  260 \**  reached, as would happen us
ing PRINT statements.
  270 \**
  280 \**  Call Format:
  290 \**
  300 \**       CALL sprint,<STRING VAR
IABLE LIST>
  310 \**
  320 \**  Including a CHR$(27) in the
 string forces a new-line and 3 spaces
,
  330 \**  i.e. a new paragraph.  Eith
er form of string may be passed, both
  340 \**  those at a defined address
($X) and the normal Z$.
  350 \**
  360 \**  (C) 11/4/1984 Richard Clark
e
  370 \**
  380 .err     BRK
  390          BRK
  400          EQUS"Parameter error"
  410          BRK
  420 .sprint LDA &600
  430          BEQ err
  440          LDX #1
  450          STX cbfroff
  460 .getstr LDA &602,X
  470          CMP #128
  480          BCC err
  490          JSR sproc
  500          DEC slen
  510          JSR outstr
  520          INC cbfroff
  530          INC cbfroff
  540          INC cbfroff
  550          LDX cbfroff
  560          DEC &600
  570          BNE getstr
  580          RTS
  590 .outstr LDY #0
  600          STY pointer
  610          DEY
  620          STY chars
  630 .fndlp   INY
  640          INC chars
  650          LDA (saddr),Y
  660          CMP #32
  670          BEQ spcfnd
  680          CMP #27
  690          BEQ spcfnd
  700          CPY slen
  710          BNE fndlp
  720 .spcfnd STY spcpos
  730          JSR hpos
  740          CLC
  750          LDA posx
  760          ADC chars
  770          CMP #swidth
  780          BCC P%+5
  790          JSR &FFE7
  800          LDY pointer
  810 .pstr    LDA (saddr),Y
  820          CMP #27
  830          BNE not27
  840          JSR &FFE7
  850          LDA #32
  860          JSR &FFEE
  870          JSR &FFEE
  880 .not27   JSR &FFEE
  890          INY
  900          CPY spcpos
  910          BCC pstr
  920          BEQ pstr
  930          LDA #0
  940          STA chars
  950          LDY spcpos
  960          CPY slen
  970          BNE P%+3
  980          RTS
  990          INY
 1000          STY pointer
 1010          JMP fndlp
 1020 .strerr BRK
 1030          BRK
 1040          EQUS "Null String"
 1050          BRK
 1060 .sproc  PHA
 1070          LDA &600,X
 1080          STA paddr
 1090          LDA &601,X
```

where <stringvar> can be any legal Basic variable name.

When you have keyed the program into your machine and recorded it, you run it. Then enter

```
line$ = "This line is going to be more
  than 40 characters in length."
```

followed by

```
CALL SPRINT,LINES$
```

This will produce an output of:

```
This line is going to be more than 40
  characters in length.
```

Many applications require a large volume of text to be displayed on screen. The text can, unfortunately, be printed so that a word is split in two at the end of a line, thus spoiling the output. The text to be printed must be in a string variable attached to the Call as parameters; for example

```
CALL SPRINT,AXE$
```

or

```
CALL SPRINT, TEXT$(I%),CONTROL$
  (J%)
```

Inclusion of a CHR$(27) in the text will result in a paragraph setting for the next line of text. A Linefeed plus Carriage Return and three spaces are then printed before the following text.

The routine is written in Basic 2 assembler, but once assembled is independent of OS. The EQU family of commands must be replaced with indirection operators outside the assembler.

```
1100          STA paddr+1
1110          PLA
1120          LDY #0
1130          CMP #128
1140          BEQ defstr
1150          LDA (paddr),Y
1160          STA saddr
1170          INY
1180          LDA (paddr),Y
1190          STA saddr+1
1200          INY
1210          INY
1220          LDA (paddr),Y
1230          BEQ strerr
1240          STA slen
1250          RTS
1260 .defstr  LDA paddr
1270          LDX paddr+1
1280          STA saddr
1290          STX saddr+1
1300 .find0D  LDA (saddr),Y
1310          CMP #13
1320          BEQ eostr
1330          INY
1340          BNE find0D
1350 .eostr   CPY #0
1360          BEQ strerr
1370          STY slen
1380          RTS
1390 .hpos    PHA
1400          TYA
1410          PHA
1420          LDA #134
1430          JSR &FFF4
1440          PLA
1450          TAY
1460          PLA
1470          STX posx
1480          RTS
1490 ]NEXT
1500 END
```

Keylist

This useful utility from Robert Turner of Northwich, Cheshire will help anyone who has trouble in remembering how function keys have been defined. It will display the current definitions of all 15 keys. The program when assembled can be called at any time by typing

```
CALL &C00
```

or whatever address you have chosen to assemble it at.

Function-key definitions are stored in page &0B. The first 17 bytes are pointers to the start of each definition. The key definitions may not be stored in ascending order but depend upon the order in which they were defined. The program first sorts the pointers into ascending order. The output format is the same as that used when the key was defined.

Keylist.

```
   5 *KEY10?&D00=&60|M
  10 REM *********  KEYLIST  ********
*
  20 REM **** ROBERT S. TURNER ******
*
  30 REM *******  APRIL 1984  *******
*
  40 REM *******  COPYRIGHT  ********
*
  50 FOR PASS=0 TO 2 STEP 2
  60 P%=&C00
  70 [OPT PASS
  80 LDA #&0B
  90 STA &8B
 100 LDA #0
 110 STA &86
 120 STA &88
 130 STA &8A
 140 STA &8C
 150 STA &8D
 160 STA &8E
 170 JSR sort
 180 .J3
 190 JSR nextkey
 200 CPY #2 \ finished if Y=2
 210 BNE J5
 220 JMP end
 230 .J5
 240 JSR keyprint \ print "KEY " and
no.
 250 CPY #1
 260 BEQ J6
 270 LDA &86
 280 STA &8A \ &8A contains current l
ocation
 290 .J4 \ &8B contains &0B
 300 LDX #0
 310 LDA (&8A,X) \ get content of cur
rent location
 320 CMP #32 \ is it control code ?
 330 BCS J1 \ no
 340 PHA \ yes
 350 LDA #&7C \ ASC "|"
 360 JSR &FFEE \ print
 370 PLA
 380 CLC
 390 ADC #64 \ convert from control c
ode to appropriate letter
 400 .J1 \ no control
 410 JSR &FFEE \ print letter
 420 LDA &8A
 430 CMP &88 \ present key print fini
shed ?
 440 BNE J2 \ no
 450 .J6
 460 INC &8C \ yes
 470 LDA #&0D \ carriage return
 480 JSR &FFE3
 490 JMP J3 \ next key
 500 .J2
 510 INC &8A \ next address
 520 JMP J4
 530 .sort
 540 LDX #0
 550 .L1
 560 LDA &0B00,X \ transfer from
 570 STA &70,X \ &0B00 to &70
 580 INX
 590 CPX #18
 600 BNE L1
 610 .L2
 620 LDX #0 \ do a bubble sort
 630 LDY #1
 640 .L3
 650 LDA &70,X
 660 CMP &70,Y
 670 BCC less
 680 .greater
 690 PHA
 700 LDA &70,Y
 710 STA &70,X
 720 PLA
 730 STA &70,Y
 740 .less
 750 INY
 760 INX
 770 CPX #16
 780 BNE L3
 790 INC &8E
 800 LDA &8E
 810 CMP #17
 820 BNE L2
 830 RTS
 840 .nextkey
 850 LDX &8C
 860 CPX #16 \ is it finished ?
 870 BNE ntequal
 880 LDY #2 \ Y=2 if finished
 890 RTS
 900 .ntequal
 910 LDY #0
 920 LDA &0B00,X
 930 CMP &0B10
 940 BNE jump
 950 LDY #1
 960 RTS
 970 .jump
 980 PHA
 990 LDA #0
1000 STA &8D
1010 PLA
1020 STA &86 \ &86 contains start loc
ation of present key - 1
1030 JSR endaddress \ find end locati
on of present key
1040 RTS
1050 .endaddress
1060 LDX #0
1070 .L6
1080 CMP &70,X
```

(continued on next page)

(continued from previous page)

```
 1090 BEQ J8 \ found start address
 1100 INX
 1110 JMP L6
 1120 .J8
 1130 INX \ inc X to point to start ad
dress of next key
 1140 LDA &70,X
 1150 STA &88 \ put into &88
 1160 INC &86 \ point to start locatio
n of present key
 1170 RTS
 1180 .keyprint
 1190 LDA #&20
 1200 JSR &FFEE
 1210 LDA #&2A
 1220 JSR &FFEE
 1230 LDA #&4B \ ASC "K"
 1240 JSR &FFEE
 1250 LDA #&45 \ ASC "E"
 1260 JSR &FFEE
 1270 LDA #&59 \ ASC "Y"
 1280 JSR &FFEE
 1290 LDA #&20 \ ASC " "
 1300 JSR &FFEE
 1310 LDA &8C
 1320 CMP #10 \ is number less than 10
?
 1330 BCC J10 \ yes
 1340 PHA \ no
 1350 LDA #&31 \ ASC "1"
 1360 JSR &FFEE
 1370 PLA
 1380 ADC #38 \ convert to ASCII
 1390 JSR &FFEE
 1400 JMP J11
 1410 .J10
 1420 PHA
 1430 LDA #32 \ print extra space
 1440 JSR &FFEE
 1450 PLA
 1460 CLC
 1470 ADC #48 \ convert to ASCII
 1480 JSR &FFEE
 1490 .J11
 1500 LDA #32
 1510 JSR &FFEE
 1520 JSR &FFEE \ print two spaces
 1530 RTS
 1540 .end
 1550 LDA #&0D
 1560 JSR &FFE3
 1570 RTS
 1580 ]NEXT
```

Demolition

Demolition is a game sent in by David Buxton of Fen Ditton, Cambridge. The object is to blast your way through a wall by dropping bombs on to it. The trick is to keep dropping your bomb into the hole left by the last drop. Once one wall is finished off there is another close behind.

Yes, admittedly it does sound like yet another of those dreaded Space Invaders. But this implementation is a fresh enough approach to merit you keying it into your computer.

Demolition.

```
  10 REM # # # Demolition # # #
  20 REM
  30 REM   *  By: D Buxton  *
  40 REM
  50 REM # #   April 1984   # #
  60
  70
  80 ON ERROR MODE7:REPORT:PRINT" at
line ";ERL:END
  90 high_score=500
 100 REPEAT
 110 MODE7
 120 PROCinstructions
 130 MODE1
 140 PROCinit
 150 REPEAT
 160 PROCbomb
 170 REPEAT
 180 VDU5
 190 PROCmove
 200 UNTIL INKEY(-99)
 210 PROCdrop
 220 FOR delay=0 TO 500:NEXT
 230 IF H>J THEN H=0:PROCscroll
 240 UNTIL die
 250 PROCfinish
 260 PRINT''TAB(10)CHR$133"Another ga
me ?":REPEAT:Y$=GET$:UNTIL Y$="Y" OR Y
$="N"
 270 UNTIL Y$="N"
 280 END
 290
 300 DEF PROCdrop
 310 VDU127:H=H+1:X=X-X MOD 32:Y=928
 320 IF POINT(X,928)=1 THEN 370
 330 MOVEX,Y:IF POINT(X+8,Y-40)=1 THE
N VDU10,9,127:score=score+1:VDU4:SOUND
0,-15,6,2:COLOUR3:PRINTTAB(13,0);score
:VDU5:COLOUR1:ENDPROC
 340 Y=Y-16:MOVEX,Y:VDU224,127:IF POI
NT(X+3,Y-28)=1 THEN 370
 350 IF POINT(X+4,Y-48)=1 THEN 370
 360 IF Y<=16 THEN ENDPROC ELSE 340
 370 VDU10,9,127:SOUND0,-15,6,2:score
=score+1:Y=Y-32
 380 Q=POINT(X-16,Y+16):W=POINT(X+40,
Y+16)
 390 IF (Q=-1 OR Q=0) AND (W=-1 OR W=
0) AND POINT(X+4,Y-48)=1 THEN VDU10,9,
127:SOUND0,-15,6,1:score=score+1:Y=Y-3
2
 400 Q=X-16:W=Y+16
 410 IF POINT(Q,W)=1 THEN VDU11,127:S
OUND0,-15,6,1:score=score+1:Q=Q-32:W=W
+32:GOTO410
 420 MOVEX,Y
 430 Q=X+40:W=Y+16
 440 IF POINT(Q,W)=1 THEN VDU11,9,9,1
27:SOUND0,-15,6,1:score=score+1:Q=Q+32
:W=W+32:GOTO440
 450 VDU4:COLOUR3:PRINTTAB(13,0);scor
e:VDU5:COLOUR1
 460 ENDPROC
 470
 480 DEF PROCmove
 490 GCOL0,3
 500 IF D=0 THEN X=X-16 ELSE X=X+16
 510 IF X<16 AND D=0 THEN D=1
 520 IF X>1264 AND D=1 THEN D=0
 530 VDU127
 540 MOVEX,928:VDU224
 550 ENDPROC
 560
 570 DEF PROCbomb
 580 P=P+1:IF P>3 THEN P=0
 590 IF P<2 THEN D=1 ELSE D=0
 600 IF D=0 THEN X=1279 ELSE X=0
 610 MOVEX,928:VDU224
 620 ENDPROC
 630
 640 DEF PROCscroll
 650 VDU4:PRINTTAB(0,0)"
                        "
 660 J=J-.1:IF J<2 THEN J=2
 670 PRINTTAB(0,30)'
 680 K=K+1:IF K>J+10 THEN K=0
 690 IF K>J AND K<J+11 THEN PRINTTAB(
0,30);:FOR F=1 TO 40:VDU225:NEXT
 700 FOR F=20 TO 1266 STEP 32:IF POIN
T(F,924)=1 THEN die=TRUE
 710 NEXTF
 720 PROCscore
 730 VDU5
 740 ENDPROC
 750
 760 DEF PROCfinish
 770 VDU19,0,13,0,0,0,19,1,12,0,0,0
 780 TIME=0:REPEAT UNTIL TIME>350
 790 VDU22,7:PRINTTAB(9,8)CHR$141CHR$
129"You scored ";score;TAB(9)CHR$141CH
R$129"You scored ";score
 800 IF score=high_score PRINT''TAB(2
)CHR$131"You have equalled the high sc
ore."
 810 IF score<high_score PRINT''TAB(7
)CHR$131"The high score is ";high_scor
e
 820 IF score>high_score PRINT''TAB(2
)CHR$131"You have beaten the high scor
e.":high_score=score
 830 ENDPROC
 840
 850 DEF PROCinit
 860 VDU19,3,6,0,0,0
 870 VDU19,1,2,0,0,0
 880 VDU19,2,5,0,0,0
 890 VDU23,224,0,126,126,126,126,126,
126,0
 900 VDU23,225,127,127,127,127,127,12
7,127,0
 910 GCOL0,2
 920 die=FALSE
 930 D=0:H=0:score=0:K=0:J=6:P=-1
 940 PROCscore
 950 VDU4:PRINTTAB(0,22);
 960 FOR F=1 TO 359:VDU225:NEXT
 970 ENDPROC
 980
 990 DEF PROCscore
1000 COLOUR3:PRINTTAB(5,0)"Score:  ";
score:COLOUR2:PRINTTAB(25,0)"High:  ";
high_score:COLOUR1
1010 ENDPROC
1020
1030 DEF PROCinstructions
1040 VDU23,1,0;0;0;0;
1050 PRINTTAB(12)CHR$141CHR$133"Demol
ition"TAB(12)CHR$141CHR$133"Demolition
"
1060 PRINT'''CHR$131"  The idea of th
is game is to destroy"'''CHR$131"the a
dvancing walls before they reach"
1070 PRINT''CHR$131"the top of the sc
reen.  When the bomb"''''CHR$131"is abo
ve the point where you want it"
1080 PRINT''CHR$131"to land, press th
e"CHR$134"SPACE BAR."
1090 PRINTTAB(7,22)CHR$130"Press any
key to start":Y=GET
1100 ENDPROC
```

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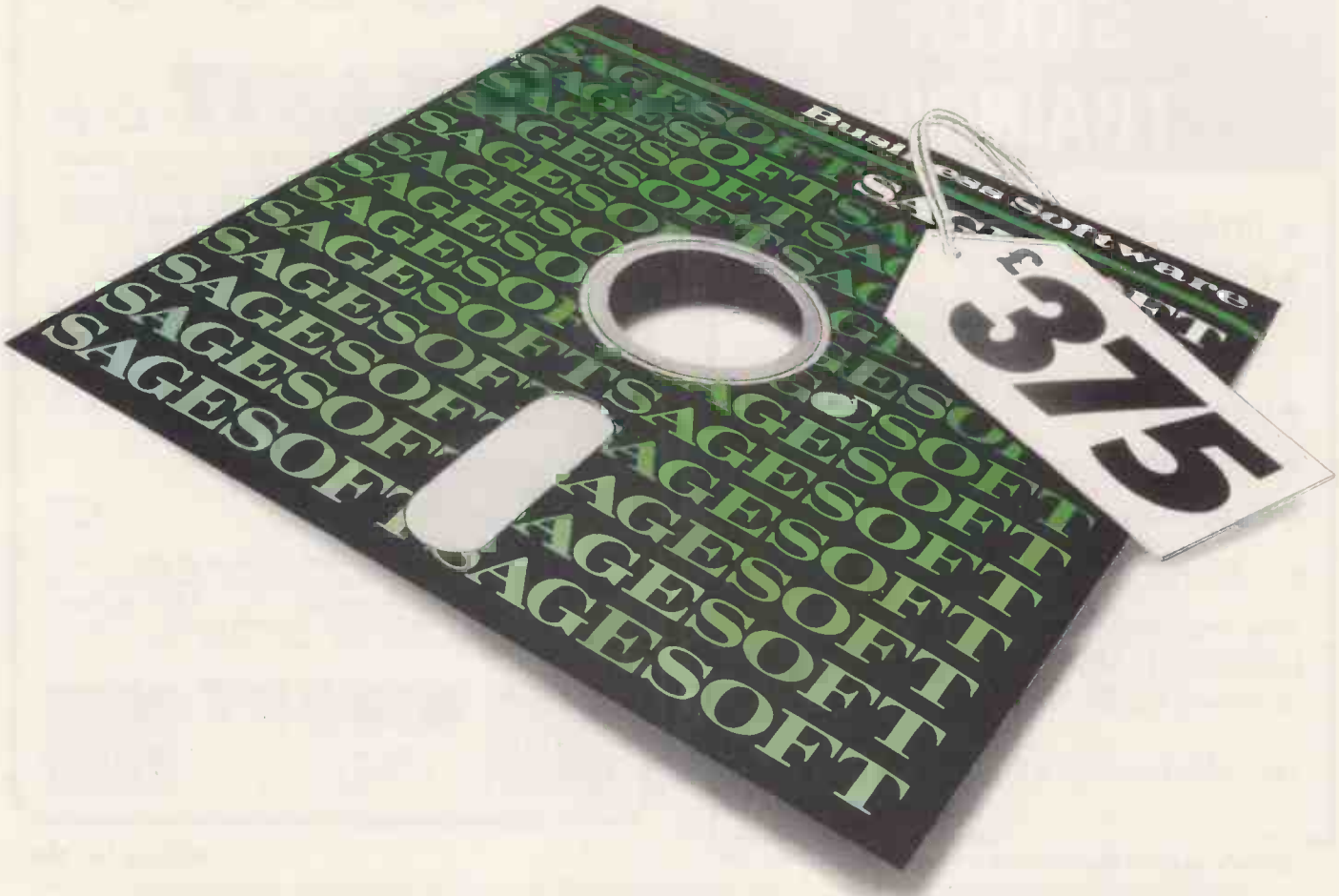

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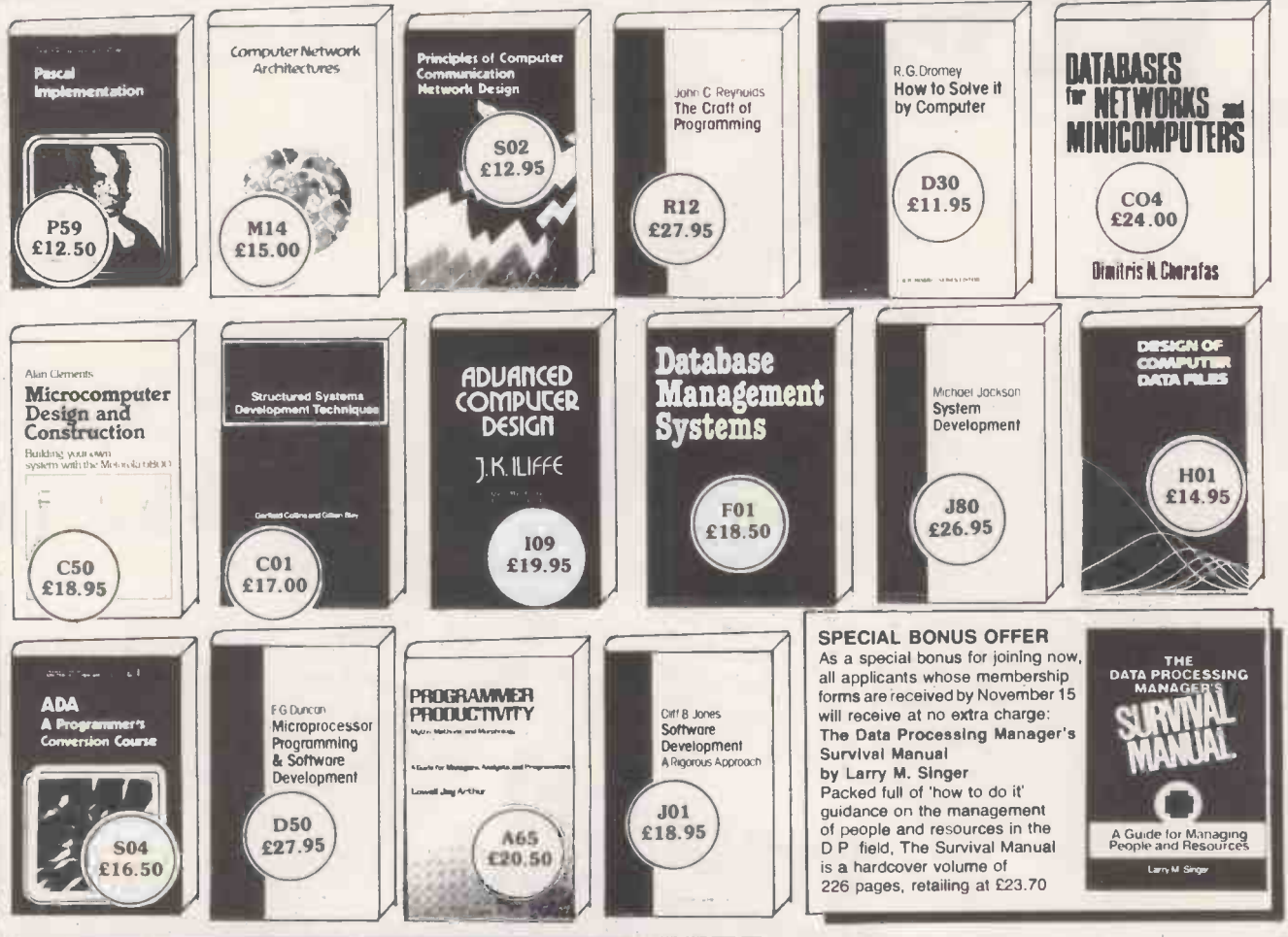

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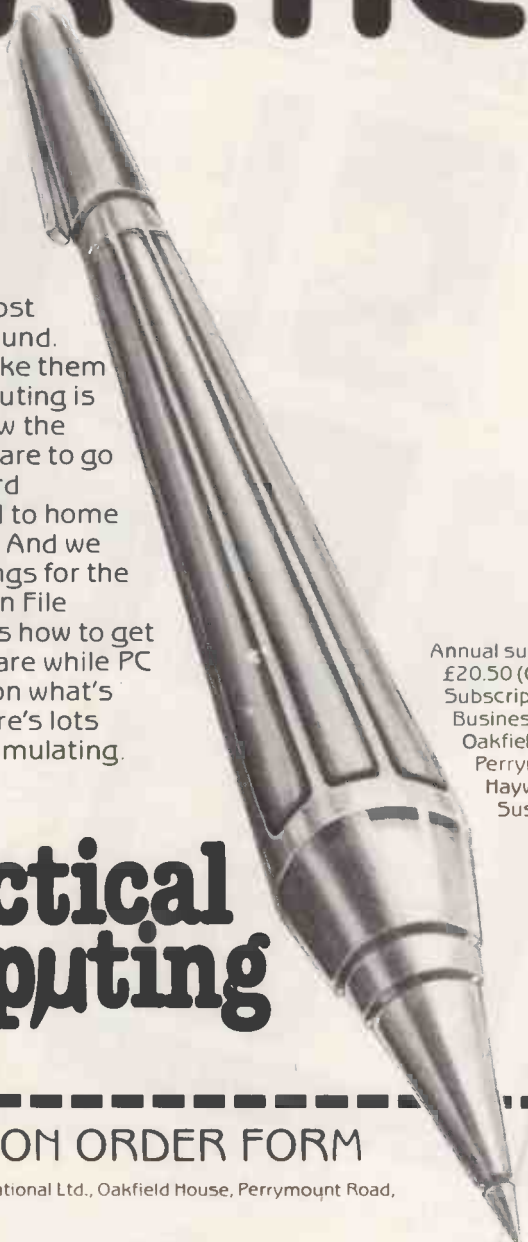

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Auto-number

IF YOU EVER wished Atari had included automatic line numbering in Basic, then fret no more because F M O'Dwyer of Dublin has supplied it.

It is a fast, machine-language program which is entered in the form of Data statements. The numbers are Poked into the free area of page 6, starting at 1536. The program is run and then deletes itself.

At the Ready prompt you can then call auto line numbering. Entering

X = USR(1536)

provides auto line numbering in increments of 10 starting at line 10; entering

X = USR(1536, start)

provides line numbers in increments of 16 from whatever number you put in for Start; and entering

X = USR(1536,start,inc)

provides line numbers in increments of Inc starting at Start.

All commands report Ready. You can then start typing in your line, and the line number will appear automatically. You keep getting line numbers until you press Return twice, but as the program is still sitting undisturbed in page 6, you can recall it again with a USR(1536) call.

Auto-number will not produce a line number of zero, but that is no great limitation for what is one of the most useful little routines yet to appear in Atari Open File.

```
10 FOR N=0 TO 253:READ B:POKE 1536+N,B
:NEXT N:NEW
1000 DATA 173,8,2,133,206,173,9,2,133
1010 DATA 207,169,64,141,8,2,169,6,141
1020 DATA 9,2,169,10,133,208,133,203,1
69
1030 DATA 0,133,209,133,204,104,170,24
0,23
1040 DATA 104,133,209,104,133,208,202,
240,14
1050 DATA 104,133,204,104,133,203,202,
240,5
1060 DATA 104,104,202,208,251,169,1,13
3,205
1070 DATA 96,152,72,138,72,174,9,210,2
36
1080 DATA 242,2,208,5,173,241,2,208,42
1090 DATA 224,159,208,11,173,255,2,73,
255
1100 DATA 141,255,2,76,123,6,142,242,2
1110 DATA 142,252,2,164,205,208,28,224
,12
1120 DATA 208,4,162,1,134,205,169,3,14
1
1130 DATA 241,2,169,0,133,77,169,30,14
1
1140 DATA 43,2,104,170,104,168,104,64,
224
1150 DATA 12,240,93,24,165,208,133,186
,101
1160 DATA 203,133,208,165,209,133,187,
101,204
1170 DATA 133,209,162,0,160,0,165,187,
221
1180 DATA 245,6,240,4,144,26,176,7,165
1190 DATA 186,221,244,6,144,17,165,186
,253
1200 DATA 244,6,133,186,165,187,253,24
5,6
1210 DATA 133,187,200,208,221,138,72,1
52,208
1220 DATA 4,165,205,208,9,105,48,32,16
4
1230 DATA 246,169,0,133,205,104,170,23
2,232
1240 DATA 224,10,208,193,169,32,32,164
,246
1250 DATA 169,0,133,205,240,139,165,20
6,141
1260 DATA 8,2,165,207,141,9,2,76,114
1270 DATA 6,16,39,232,3,100,0,10,0
1280 DATA 1,0
```

Search

Another routine to Poke into page 6 is this Search utility from Roy Smith and Keith Mayhew. If the names are recognisable, it is because they help produce the excellent Atari Owners Club magazine — details from PO Box 3, Rayleigh, Essex.

This ultra-fast 100-byte machine-code routine searches for and compares a set of given characters anywhere in memory. If a match is found then the relative position from the start of the search is returned.

It could be used for searching for a correct spelling in a word-processing package or spelling checker. Although this program is capable of searching anywhere in memory, it is shown in the demo Basic listing searching within a Basic string for a specified string of characters, and this is probably the most likely way it would be implemented. It can also search for literally any character at all, including space, control and graphic characters, anywhere in memory, including the operating-system ROM.

To find the first occurrence of the set of characters to be found, called the sub-string, in the specified area of memory, called the main string, you simply have, as a Basic statement, the following line

X = USR(ADR(SEARCH$),A1,L1,A2,L2)

A1 to L1 are the address and length of the main string and A2 and L2 are the address and length of the sub-string. The address of the machine code is found by

ADR(SEARCH$)

where the machine code is held within a string called Search$.

The machine code could equally be fixed in memory, such as page 6, address 1536 onwards. The length of the sub-string, L2, must be less than 256 as this greatly simplifies and speeds up the routine.

After the first call to the routine the program returns to Basic with the variable X containing the relative position in the string of the first occurrence. If the sub-string is found at the beginning of the main string then 1 is returned, so the convention is compatible with that used for Basic strings, where the first character is also designated 1. If you are searching outside Basic strings, then to compute the address of the match you would add the returned position to the main string's address minus 1, as the first position is actually 0.

If search fails to find an exact match for the sub-string, the value of zero is returned in the variable X. If a match is found, a second search can be implemented to continue from the last position by a second entry point in the routine, to see if a second match can be found. This can be repeated for as long as X is greater than zero to find as many matches as there actually are in the main string. The second call is of the form

X = USR(ADR(SEARCH$) + 71)

(continued on next page)

Search. Listing 1.

```
10 DIM M$(500),S$(255)
20 ? CHR$(125);"Please wait while mach
ine code"
30 ? "is read into 'SEARCH$'..."
40 GOSUB 31000
50 M$="THIS IS THE STRING THAT WILL BE
 SEARCHED FOR A MATCH BY THE MACHINE C
ODE."
60 ? :? :? "Please enter the character
s you wish"
70 ? "to find in the following string:
"
80 ? :? M$
90 INPUT S$
100 L1=LEN(M$):L2=LEN(S$)
110 A1=ADR(M$):A2=ADR(S$)
120 X=USR(ADR(SEARCH$),A1,L1,A2,L2)
130 IF X=0 THEN 200
140 GOSUB 1000
150 X=USR(ADR(SEARCH$)+71)
160 IF X=0 THEN 200
170 GOSUB 1000
180 GOTO 150
200 ? :? :? "End of search...":? :? :?
 :GOTO 60
1000 REM Print results.
1010 ? :? :? "Match found at position
";X
1020 ? :? "String from there reads:"
1030 ? M$(X,L1)
1040 RETURN
31000 REM Load 'SEARCH$' with machine
code.
31010 DIM SEARCH$(109)
31020 FOR I=1 TO 109
31030 READ X
31040 SEARCH$(I,I)=CHR$(X)
31050 NEXT I
31060 RETURN
32000 DATA 104,104,133,204,104,133,203
,104
32010 DATA 141,241,6,104,141,240,6,104
32020 DATA 133,206,104,133,205,104,104
,141
32030 DATA 242,6,240,74,169,1,141,243
32040 DATA 6,169,0,141,244,6,238,240
32050 DATA 6,208,3,238,241,6,160,0
32060 DATA 177,203,209,205,208,18,200,
204
32070 DATA 242,6,208,244,173,243,6,133
32080 DATA 212,173,244,6,133,213,96,10
4
32090 DATA 238,243,6,208,3,238,244,6
32100 DATA 230,203,208,2,230,204,173,2
44
32110 DATA 6,205,241,6,208,208,173,243
32120 DATA 6,205,240,6,208,200,169,0
32130 DATA 133,212,133,213,96
```

Search. Listing 2.

```
0100 ;Written by Keith Mayhew.
0110 ;Relocatable machine code.
0120 ;Search for a sub-string,
0130 ;in a main string.
0140 ;Called from BASIC by:
0150 ;X=USR(ADR(SEARCH$),A1,L1,A2,L2)
0160 ;Where A1 is the address of the
0170 ;main string and L1 is its
0180 ;length, similarly for the
0190 ;sub-string; A2 and L2.
0200 ;If 0 is returned string was
0210 ;not found.  Second entry point
0220 ;continues search for the next
0230 ;occurence of the string called by:
0240 ;X=USR(ADR(SEARCH$)+71)
0250          *=     $CB
0260 STRING   *=     *+2      Indirect pointers
0270 SUBSTR   *=     *+2      to the two strings.
0280          *=     $06F0
0290 STRNGL   *=     *+2      Main string length.
0300 LEN      *=     *+1      Sub-string length.
0310 PNTR     *=     *+2      Position in string.
0320          *=     $0600    Locate in page 6.
0330          PLA             Clear stack.
0340          PLA             String pointer HI,
0350          STA    STRING+1 store.
0360          PLA             String pointer LO,
0370          STA    STRING   store.
0380          PLA             String length HI,
0390          STA    STRNGL+1 store.
0400          PLA             String length LO,
0410          STA    STRNGL   store.
0420          PLA             Sub-string pointer HI,
0430          STA    SUBSTR+1 store.
0440          PLA             Sub-string pointer LO,
0450          STA    SUBSTR   store.
0460          PLA             Sub-string length HI,
0470          PLA             Sub-string length LO,
0480          STA    LEN      Store LO byte.
0490          BEQ    NOTFND   If zero then not found.
0500          LDA    #$01     Set pointer
0510          STA    PNTR     to '1'
0520          LDA    #$00     and HI
0530          STA    PNTR+1   byte to zero.
0540          INC    STRNGL   Increase string
0550          BNE    SEARCH   length by
0560          INC    STRNGL+1 one.
0570 ;Search for sub-string.
0580 SEARCH   LDY    #$00     Set index to zero.
0590 LOOP1    LDA    (STRING),Y Get main character.
0600          CMP    (SUBSTR),Y Compare to other.
0610          BNE    NXTCHR   If not equal try next.
0620          INY             Increment index
0630          CPY    LEN      and compare to length,
0640          BNE    LOOP1    go back if not at end.
0650 ;Found sub-string.
0660          LDA    PNTR     Set BASIC
0670          STA    212      variable
0680          LDA    PNTR+1   equal to
0690          STA    213      pointer
0700          RTS             and return to BASIC.
0710 ;Entry for continuing search.
0720 CONT     PLA             Just clean stack.
0730 ;Point to next position in
0740 ;the main string.
0750 NXTCHR   INC    PNTR     Increment
0760          BNE    SKIP1    pointer
0770          INC    PNTR+1   by one.
0780 SKIP1    INC    STRING   Increment
0790          BNE    SKIP2    string pointer
0800          INC    STRING+1 by one.
0810 SKIP2    LDA    PNTR+1   Compare pointer HI
0820          CMP    STRNGL+1 to string HI.
0830          BNE    SEARCH   If not equal go back.
0840          LDA    PNTR     Compare pointer LO
0850          CMP    STRNGL   to string LO.
0860          BNE    SEARCH   If not equal go back.
0870 ;String not found.
0880 NOTFND   LDA    #$00     Store zero
0890          STA    212      in BASIC
0900          STA    213      variable.
0910          RTS             Return to BASIC.
```

(continued from previous page)

Listing 1 is a demonstration of a string search incorporating the two USR calls to find all the matches in the main string. Type in the program, double-checking the Data statements. When you are satisfied you have made no errors, save the program to cassette or disc in the usual way with a CSave or

SAVE"D:SEARCH.BAS"

Run the program and take note of how fast it finds all the occurrences of the specified sub-string.

If you want to use the machine code in your own programs, List the appropriate line numbers to cassette or disc using

LIST"C:",31000,32130

or

LIST"D:SEARCH.LST",31000,32130

This can then be Entered over another program. Experiment with the demo listing to find different sections or lengths of the string so that you are familiar with how to change the parameters.

When the program is run it takes a few seconds to load the machine-code search routine held in the Data statements, but once this has been done the routine executes extremely fast. The program then displays the main string M$ and asks you to enter a group of characters for it to find.

First enter "Them", and the program will report End of Search, as no match was encountered.

Now try entering a character or a group of characters which are in the main string. The program tells you that a match has been found, and what position in the string it occurs. It also prints the rest of the string from that position.

If there is more than one occurrence of your chosen characters then all of them are printed out in a similar manner. When the program finds a large number of matches, you can use Control-1 to pause the listing of the results and press Control-1 again to resume.

The program Dimensions M$ and S$ to 500 and 255 respectively, though M$ can be as large as the free memory in your machine will allow. To give you an idea of the speed of the machine-code routine, you could place more characters into M$ on line 50, or you could dimension M$ to a larger number — say a few thousand — and then set the last few characters to your name. For example try the following changes:

```
10 DIM M$(2000),S$(255)
55 M$(1196,2000)="KEITH"
```

When this is Run the program will print M$, containing a series of dummy characters from the full stop after Code to the name Keith, since you have not told Basic to clear these characters. When you are asked to enter the characters you wish to find, type Keith, and it should find it very quickly.

Listing 2 shows the machine code, including comments for those who wish to follow the flow of the routine.

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Crashproof input — again

IT IS ONE of the great sports in the Commodore world to produce routines which get round the problem of the Basic Input command aborting if only the Return is pressed. Added to this is the problem of the inability of Basic to accept commas and so on, unless they are within quotes.

The subject last had an airing in the June issue of *PC* with M Pike's routine for Basic 4 machines. Now David Barratt of Blackpool has come up with another which allows the maximum number of characters to be specified. It can cope with moving the cursor left and right as well as inserting and deleting characters.

The program builds up two strings, A$ and B$, which are the characters to the left and right of the cursor. When the control keys are used, these two strings are manipulated by the routine at lines 250 to 300. They are added together in line 190 when the Return key is pressed to produce the final output string, D$. Commas, colons and so on can be included in the input string, but normal double quotes are disallowed and replaced by the single quote in line 220.

I had to rewrite some of David Barratt's code to make the routine work properly, but it is a clever idea which allows some scope for alteration to suit a specific application. The variable Max determines the maximum number of characters allowed in the input, and TD is the time delay between cursor flashes.

```
100 R$=CHR$(146): L$=CHR$(157)
105 I$=CHR$(148): S$=CHR$(160)
110 A$ ="": B$=S$: MAX=80
130 CU=0:TD=TI+25

140 IF TD<TI THEN CU=NOT CU: TD=TI+25
150 T$=LEFT$(B$,1)+L$: PRINT MID$(R$+
    CHR$(18),CU+2,1);T$;
155 GET C$:IF C$=""THEN 140
180 A=LEN(A$):B=LEN(B$):C=ASC(C$)

190 IF C=13 THEN PRINT R$;B$: D$=A$+B$
    : D$=LEFT$(D$,LEN(D$)-1):RETURN
200 IF (C AND 127)<31 THEN GOSUB 250
    : GOTO 130
210 IF A+B>MAX AND B=1 THEN 140
220 IF C=34 THEN C$="'"

230 PRINT R$;C$;: A$=A$+C$
    : IF B$<>S$ THEN B$=MID$(B$,2)
240 GOTO 130

250 C$=R$+T$+C$
260 IF C= 29 AND B>1 THEN A$=A$+LEFT$
    (B$,1): B$=RIGHT$(B$,LEN(B$)-1)
    :PRINT C$;
270 IF C=157 AND A>0 THEN B$=RIGHT$(A
    $,1)+B$:A$=LEFT$(A$,LEN(A$)-1)
    :PRINT C$;
280 IF C= 20 AND A>0 THEN A$=LEFT$(A$,
    LEN(A$)-1):PRINT C$;
290 IF C=148 AND A+B<=MAX THEN B$=" "
    +B$:PRINT R$;T$;I$;" ";L$;
300 RETURN
```

Morse code practice

There must be many who are interested in learning to read Morse code — or CW as radio amateurs refer to it — either to sit the Morse test to obtain a class A amateur licence or simply to make listening around the short waves more interesting. M Hibbert from the University of Sussex has written a program which sends five letter

(continued on next page)

Morse code practice.

```
0 GOTO 10

2 REM ********************************
3 REM ***                          ***
4 REM *** MORSE CODE BY M.HIBBETT ***
5 REM ***          APRIL 1984      ***
6 REM ***                          ***
7 REM ********************************
8 PRINT " SAVING 'MORSE CODE'"
  :SAVE"MORSE CODE":END

10 PRINT "[CLEAR]":REM CLEAR SCREEN
20 PRINT "       ** MORSE CODE TUTOR *
   *"
30 PRINT:PRINT " IN THIS PROGRAM,
    GROUPS OF RANDOM FIVE  CHARACTER
   CODE ARE";
40 PRINT " EMITTED BY THE        LOUDS
   PEAKER.";
50 PRINT "THE NUMBER OF GROUPS SENT
    AND THE SPEED AT WHICH";
60 PRINT " THEY ARE EMITTED CAN BE CO
   NTROLLED AT THE START OF"
70 PRINT " EXECUTION."
80 PRINT:PRINT " AFTER THE CHARACTERS
    HAVE BEEN SENT,     THEY ARE";
90 PRINT " PRINTED ON THE SCREEN SO T
```

(listing continued on next page)

(listing continued from previous page)

```
   HAT  THE ACCURACY OF RECEPTION CAN
    BE"
100 PRINT " DETERMINED BY THE USER."

110 REM ***** START OF MAIN PROGRAM
120 DIM A$(35,5),B$(999)
130 FOR A = 0 TO 35
140 FOR B = 0 TO 5
150 READ A$(A,B)
160 NEXT B
170 NEXT A

180 PRINT:INPUT " INPUT NUMBER OF GRO
    UPS, 1 TO 200 ";N%
185 IF N%<1 OR N%>200 GOTO 180

190 PRINT:INPUT " INPUT SPEED OF MORS
    E, 1 TO 20 ";S%:S%=S%+3
195 IF S%<4 OR S%>23 GOTO 190

200 PRINT:PRINT " INPUT TYPE OF CHARA
    CTERS SENT:"
210 INPUT " LETTERS(1), NUMBERS(2),
     BOTH(3) ";T%
215 IF T%<1 OR T%>3 GOTO 210
220 PRINT:PRINT " DO YOU WANT A DELAY
     BETWEEN CHARACTERS"
230 INPUT " ANSWER Y/N ";Q$
240 IF Q$= "Y" THEN DELAY%= 300
    :GOTO 270
250 IF Q$= "N" THEN DELAY%= 0:GOTO 270
260 GOTO 230

270 PRINT "[CLEAR]"
280 PRINT:PRINT "          PRESS ANY K
    EY TO START":PRINT
290 GET Q$:IF Q$= "" GOTO 290
300 PRINT "          WELL, HERE WE GO!"
305 PRINT
310 BASE= 54272
320 FOR A = 4 TO 6:POKE BASE+A,0:NEXT
330 POKE BASE+24,0
340 POKE BASE+5,0
350 POKE BASE+6,128
360 POKE BASE+4,17
370 POKE BASE+1,34:POKE BASE,85

380 FOR A = 1 TO N%
400 FOR C = 0 TO 4
420 IF T%= 1 THEN D%= INT(RND(1)*26)
430 IF T%= 2 THEN D%= INT(RND(1)*10)+
    26
440 IF T%= 3 THEN D%= INT(RND(1)*36)

450 FOR E = 0 TO 4
460 FOR B = 1 TO 667/S% :NEXT B
470 F= VAL(A$(D%,E))
480 IF F= 0 GOTO 585
490 IF F= 1 GOTO 550

500 REM *****  SOUND DAH OR DIT
510 POKE BASE+24,15
520 FOR B = 1 TO 2000/S% :NEXT B
530 POKE BASE+24,0
540 GOTO 580

550 POKE BASE+24,15
560 FOR B = 1 TO 667/S% :NEXT B
570 POKE BASE+24,0
580 NEXT E

585 PRINT A$(D%,5);
588 FOR B = 0 TO DELAY%*40/S% :NEXT B
589 FOR B = 1 TO 2000/S% :NEXT B
590 NEXT C

595 PRINT " ";
597 FOR B = 1 TO 4000/S% :NEXT B
600 NEXT A

610 PRINT:PRINT:PRINT " DO YOU WANT A
    NOTHER TRY? Y/N";
620 GET Q$
630 IF Q$= "N" THEN END
640 IF Q$= "Y" GOTO 270
650 GOTO 620

2000 REM START OF MORSE CHARACTER DATA
2010 DATA 1,3,0,0,0,A, 3,1,1,1,0,B
2014 DATA 3,1,3,1,0,C, 3,1,1,0,0,D
2016 DATA 1,0,0,0,0,E, 1,1,3,1,0,F
2020 DATA 3,3,1,0,0,G, 1,1,1,1,0,H
2024 DATA 1,1,0,0,0,I, 1,3,3,3,0,J
2030 DATA 3,1,3,0,0,K, 1,3,1,1,0,L
2034 DATA 3,3,0,0,0,M, 3,1,0,0,0,N
2036 DATA 3,3,3,0,0,O, 1,3,3,1,0,P
2040 DATA 3,3,1,3,0,Q, 1,3,1,0,0,R
2044 DATA 1,1,1,0,0,S, 3,0,0,0,0,T
2050 DATA 1,1,3,0,0,U, 1,1,1,3,0,V
2054 DATA 1,3,3,0,0,W, 3,1,1,3,0,X
2060 DATA 3,1,3,3,0,Y, 3,3,1,1,0,Z
2070 DATA 1,3,3,3,3,1, 1,1,3,3,3,2
2074 DATA 1,1,1,2,2,3, 1,1,1,1,3,4
2080 DATA 1,1,1,1,1,5, 3,1,1,1,1,6
2084 DATA 3,3,1,1,1,7, 3,3,3,1,1,8
2090 DATA 3,3,3,3,1,9, 3,3,3,3,3,0
```

(continued from previous page)

groups of Morse on the Commodore 64 at any speed from one to 20 words per minute.

The program stores coded Morse characters in the Data statements in lines 2000 onwards. A character is represented by 1 and a dash by 3, all padded out to five elements with 0 and followed by the character itself.

The program keys the tone by switching the sound volume between 15 and 0, lines 500 to 580. This could produce a click, and an alternative would be to amend the program to trigger the voice on and off again directly. To do so change line 360 to

POKE BASE + 24,15

which sets the volume to maximum. The original line 360, which initially triggered the voice, is no longer needed. Lines 510 and 550 become

POKE BASE + 4,17

and lines 530 and 570 become

POKE BASE + 4,0

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Revision tester

M COOMBES of Caerleon, Gwent has sent a useful revision aid for those studying O-level physics. As it stands, it is confined to electrical problems.

As written the program suffers from a fatal bug. In the second topic "Costing" you can enter the correct answer only to find that the program will respond by saying that the answer is wrong. To make matters worse, it goes on to tell you that the correct answer is exactly same as the one you entered.

The origin of this particularly infuriating fault is the machine's inability to recognise that two visibly equivalent values are equal, since it does not multiply or divide precisely. The result of these calculations is often a millionth or so out. So if the answer is entered correctly as, say, 13.7, the computer may have calculated it as 13.69999999, which it does not regard as equal to 13.7. But because it rounds the value up it will print the answer as 13.7.

The solution to the problem is a careful use of the Int function, which will lop off the unwanted fractions. In Mr Coombes' program replacing line 2060 with

LET ans = INT(wa * h *p)/1000

cures the problem.

```
  10 REM PHYSICS
           by M.Coombes (11/83)
  12 REM
           #INITIALISATION#
  14 LET ru=0
  16 DIM s(5): DIM b$(52)
  20 REM
           #SET UP DISPLAY#
  30 BRIGHT 0: BORDER 5: PAPER 5
: INK 1: CLS
  40 FOR f=2 TO 4: PRINT AT f,10
; INVERSE 1;b$( TO 13): NEXT f:
PRINT AT 3,13; INVERSE 1;"PHYSIC
S"
  50 LET a$="##################
##########": PRINT AT 0,0;a$;
AT 6,0;a$: FOR f=1 TO 6: PRINT A
T f,0;"#";AT f,31;"#": NEXT f
  60 IF ru=1 THEN GO TO 120
  70 REM
           #INTRODUCTION#
  80 PRINT '"This program is des
igned to testyou on some of the
 calculations involved with basic
  electrical physics."
  90 PRINT '"You will first be a
sked twenty questions on variou
s topics,and at the end of the t
est,a report will be printed out
 to show which topics will n
eed further revision."
 100 PRINT '' INK 2;"PRESS ANY K
EY TO START THE TEST"
 110 IF INKEY$="" THEN GO TO 110
 115 FOR f=8 TO 21: PRINT AT f,0
;b$: NEXT f
 120 FOR f=8 TO 10: PRINT AT f,0
; PAPER 2; BRIGHT 1;b$: NEXT f
1000 REM
           #TOPIC 1#
1005 LET u$="ohms"
1010 LET to=1: LET t$="RESISTOR
NETWORKS": GO SUB 8500
1020 FOR q=1 TO 2: GO SUB 7000
1040 PRINT AT 12,0; INK 0;"The f
ollowing resistors are"'"connect
ed in SERIES:"''
1050 LET ans=0: FOR f=1 TO (RND*
2)+2: LET r=INT ((RND*5)+1)*10:
LET ans=ans+r: PRINT TAB 2;r;" "
;u$: NEXT f
1060 INPUT "WHAT IS THE TOTAL RE
SISTANCE?"'"■ ";t
1070 GO SUB 8000
1080 NEXT q
1090 FOR q=1 TO 2: GO SUB 7000
1100 RESTORE 1900
1110 FOR f=1 TO INT (RND*6)+1: R
EAD r1,r2,ans: NEXT f
1120 PRINT AT 12,0; INK 0;"The f
ollowing resistors are"'"connect
ed in PARALLEL:"''TAB 2;r1;" ";u
$'TAB 2;r2;" ";u$
1130 INPUT "WHAT IS THE TOTAL RE
SISTANCE?"'"■ ";t
1140 GO SUB 8000
1150 NEXT q
1900 DATA 20,5,4,12,3,2.4,100,25
,20,40,10,8,60,15,12,140,35,28
2000 REM
           #TOPIC 2#
2005 LET u$="pence"
2010 LET to=2: LET t$="COSTING O
F ELECTRICITY": GO SUB 8500
2020 FOR q=1 TO 4
2030 GO SUB 7000
2040 LET wa=INT ((RND*10)+1)*100
: LET p=INT (RND*4)+2: LET h=INT
 (RND*5)+2
2050 PRINT AT 12,0; INK 0;"What
is the cost of running a"'wa;" w
att appliance for ";h;" hours"'"
at ";p;" pence per unit?"
2060 LET ans=(wa/1000)*h*p
2070 INPUT "■ ";t: GO SUB 8000
2080 NEXT q
3000 REM
           #TOPIC 3#
3010 LET to=3: LET u$="volts": L
ET t$="OHMS LAW": GO SUB 8500
3020 FOR q=1 TO 2
3030 GO SUB 7000
3040 LET r=INT ((RND*9)+1)*50: L
ET i=INT (RND*5)+1
3050 IF r=8 THEN GO TO 3040
3060 PRINT AT 12,0; INK 0;"What
is the voltage across a"'r;" ohm
 resistor when a current"'"of ";
i;" amps flows through it?"
3065 INPUT "■ ";t
3070 LET ans=r*i: GO SUB 8000
3080 NEXT q
3090 LET u$="ohms"
3110 GO SUB 7000
3120 LET i=INT (RND*5)+1: LET v=
INT ((RND*30)*10)+10
3130 IF v/i<>INT (v/i) THEN GO T
O 3120
3140 PRINT AT 12,0; INK 0;"What
value of resistor gives a"'"curr
ent of ";i;" amps when there"'"a
re ";v;" volts across it?"
3150 INPUT "■ ";t
3160 LET ans=v/i: GO SUB 8000
3180 LET u$="amps"
3195 GO SUB 7000
3200 LET v=INT ((RND*40)*10)+10:
 LET r=INT (RND*40)+1
3210 IF v/r<>INT (v/r) THEN GO T
```

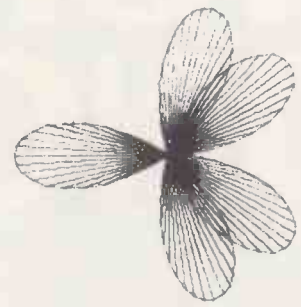
(continued on next page)

(continued from previous page)

```
0 3200
3220 PRINT AT 12,0; INK 0;"What
current flows through a";r;" ohm
 resistor with ";v;" volts"'"acr
oss it?"
3230 INPUT "■ ";t
3240 LET ans=v/r: GO SUB 8000
4000 REM

        #TOPIC 4#

4010 LET to=4: LET u$="watts": L
ET t$="POWER": GO SUB 8500
4020 FOR q=1 TO 2
4030 GO SUB 7000
4040 LET i=INT (RND*5)+1: LET v=
INT (RND*20)+2
4050 PRINT AT 12,0; INK 0;"What
is the power of a light"'"bulb i
f ";i;" amps flow through"'"it w
hen there are ";v;" volts"'"acro
ss it?"
4060 INPUT "■ ";t
4070 LET ans=v*i: GO SUB 8000
4080 NEXT q
4090 LET u$="amps"
4100 FOR q=1 TO 2
4110 GO SUB 7000
4120 LET p=INT ((RND*10)*10)+50:
 IF p/12<>INT (p/12) THEN GO TO
4120
4130 PRINT AT 12,0; INK 0;"What
current flows through a";p;" wat
t appliance connected to"'"a 12
volt supply?"
4135 INPUT "■ ";t
4140 LET ans=p/12: GO SUB 8000
4150 NEXT q
5000 REM

        #TOPIC 5#

5010 LET to=5: LET u$="turns": L
ET t$="TRANSFORMERS": GO SUB 850
0
5020 FOR q=1 TO 2
5030 GO SUB 7000
5040 LET iv=INT ((RND*10)*10)+20
: LET ov=INT ((RND*10)*2)+20: IF
 iv/ov<>INT (iv/ov) THEN GO TO 5
040
5050 LET ts=INT ((RND*10)*10)+10
5060 PRINT AT 12,0; INK 0;"If a
transformer has a input of";iv;"
 volts,an output of ";ov;" volts
 and a secondary coil"'"of ";ts;
" turns,how many turns are"'"the
re on the primary coil?"
5080 INPUT "■ ";t
5090 LET ans=(iv*ts)/ov: GO SUB
8000
5100 NEXT q
5110 LET u$="volts"
5115 FOR q=1 TO 2
5117 GO SUB 7000
5120 LET tp=INT ((RND*8)*50)+100
: LET ts=INT ((RND*20)*2)+30: IF
 tp/ts<>INT (tp/ts) THEN GO TO 5
120
5130 LET ov=INT ((RND*10)*5)+10
5140 PRINT AT 12,0; INK 0;"If a
transformer has an output";"of "
;ov;" volts and has ";tp;" turns
"'"on its primary coil and ";ts;
" turns"'"on its secondary coil,
what is";"the input voltage?"
5150 INPUT "■ ";t
5160 LET ans=(tp*ov)/ts: GO SUB
8000
5170 NEXT q
5180 GO TO 9000
7000 REM
   #CLEAR SECTION OF DISPLAY#
7010 FOR f=11 TO 21: PRINT AT f,
0;b$: NEXT f
7020 RETURN
8000 REM
        #CHECK ANSWER#

8005 BEEP .1,10
8010 IF t=ans THEN PRINT AT 20,0
; INK 1;"WELL DONE!": FOR f=1 TO
 10: BEEP .01,f: BEEP .01,f*2: B
EEP .01,f*4: NEXT f: PRINT "That
 is correct": LET s(to)=s(to)+1:
 GO TO 8200
8020 IF INT t=INT ans THEN PRINT
 AT 19,0; INK 2;"Close Enough!";
 FOR f=1 TO 5: BEEP .02,10: BEEP
 .02,20: NEXT f: PRINT "The exac
t answer is:";ans;" ";u$: LET s(
to)=s(to)+1: GO TO 8200
8030 PRINT AT 19,0; INK 2;"NO!";
 FOR f=10 TO 0 STEP -1: BEEP .1,
f: BEEP .1,f-2: NEXT f: PRINT AT
 19,4; INK 1;"That is incorrect.
"
8040 FOR f=1 TO 50: NEXT f: PRIN
T "Correct answer: ";ans;" ";u$
8200 FOR f=1 TO 200: NEXT f
8210 IF t<>ans THEN FOR f=1 TO 2
00: NEXT f
8220 RETURN
8500 REM #PRINT TOPIC TITLE#
8510 GO SUB 7000: PRINT AT 9,1;
PAPER 2; BRIGHT 1;b$;AT 9,1; INK
 7;"TOPIC ";to;": "; INK 7; FLASH
 1;t$
8520 FOR f=1 TO 20: BEEP .01,10:
 BEEP .01,20: BEEP .01,30: NEXT
f
8530 PRINT AT 9,9; PAPER 2; BRIG
HT 1; INK 7;t$
8540 RETURN
9000 REM
        #PRINT OUT RESULTS#

9010 PAPER 7: BORDER 7: CLS
9020 PRINT TAB 10; INK 2; PAPER
6; FLASH 1;"TEST REPORT"
9030 FOR f=1 TO 20: BEEP .05,20:
 BEEP .05,30: NEXT f
9040 PRINT '"TOPIC 1"' INK 2;"R
esistor Networks"
9050 PRINT '"TOPIC 2"' INK 2;"Co
sting Of Electricity"
9060 PRINT '"TOPIC 3"' INK 2;"Oh
ms Law"
9070 PRINT '"TOPIC 4"' INK 2;"Po
wer"
9080 PRINT '"TOPIC 5"' INK 2;"Tr
ansformers"
9090 FOR f=1 TO 5: PRINT AT (f*3
)+1,28;s(f);"/4": NEXT f
9095 LET tot=0: FOR f=1 TO 5: LE
T tot=tot+s(f): NEXT f
9100 PRINT INK 0'"OVERALL SCORE:
 "; INK 2;tot;"/20  =  ";(tot/20
)*100;"%"
9110 BEEP 5,20
9120 PRINT AT 20,0;"WOULD YOU LI
KE A HARD-COPY OF  THE RESULTS?
 (press Y or N)"
9130 LET i$=INKEY$: IF i$="n" OR
 i$="y" THEN GO TO 9150
9140 GO TO 9130
9150 PRINT AT 20,0;b$;b$
9160 IF i$="y" THEN COPY
9165 BEEP .3,20
9170 PRINT AT 20,0;"WOULD YOU LI
KE ANOTHER TEST?"'"(press Y or N
)"
9180 IF INKEY$="y" THEN LET ru=1
: GO TO 16
9190 IF INKEY$="n" THEN CLS : ST
OP
9200 GO TO 9180
```

Flower fun

```
10:"FUN"REM
   T LEGOVIC 1984
20:CLEAR :RADIAN
   :GRAPH :SORGN
30:INPUT "N=";N:
   INPUT "M=";M:
   INPUT "COLOUR"
   ;C
40:D=2*Π/M:L=1:CX
   =100:CY=-100:P
   =100:XX=CX:YY=
   CY
50:"LS"GLCURSOR (
   CX,CY)
60:FOR K=0TO M
70:IF L=2LET XX=X
   :YY=Y
80:T=D*K:R=P*SIN
   (N*T)
90:X=R*(COS T)+CX
100:Y=R*(SIN T)+CY
110:LINE (XX,YY)-(
   X,Y),0,C
120:NEXT K
130:IF L=1LET L=2:
   GOTO "LS"
140:TEXT :LF +7:
   LPRINT "N=";N;
   "  M=";M:
   LPRINT
150:END
```



N= 2.5 M= 100

HERE, for a change, is a program for the PC-1500 and printer. Dr Tarzan Legovic from Zagreb, Yugoslavia, has improved somewhat upon the flower and graphics programs in the PC-1500 applications manual with his aptly named Fun program. It draws charming petalled and spoked patterns.

In Radian mode you choose the number of lobes — more as N increases — and the smoothness of the curve, which becomes greater as integer M increases, and the colour. The machine first draws the spokes, when L is equal to 1, and then the envelope, when L is equal to 2.

I suggest you try at least the following pairs of values, for N and M: 0.25, 30; 4, 40; and 1.5, 100. Also experiment with adding a Step of L/2 to line 60, and making the envelope and spokes different colours.

Catalogue

It is not hard to stuff your PC-1500 full of labelled programs and then forget which label you have used for what. Robert Kesler of Novi Sad in Yugoslavia offers some help in avoiding the irritating Error 11 messages that a poor memory entails.

His Catalogue program works like the Cat function on the HP-41C. When run, the program lists all the program names

(continued on page 173)

Catalogue.

```
 5:REM SCROLLING-
   CATALOGUE

10:"CAT"S=14533:
   POKE &7902,
   PEEK &7865,
   PEEK &7866,0

11:REM MACHINE CO
   DE LOADER-DELE
   TE 11 TO 19 AF
   TER FIRST RUN

12:REM FOR 4K OR
   NO MODULE CHAN
   GE 14533 TO 16
   581

13:POKE S,165,121
   ,2,40,165,121,
   3,42,165,121,4
   ,253,234,165,1
   20,103

14:POKE S+16,166,
   129,8,137,12,1
   65,120,104

15:POKE S+24,38,1
   31,6,181,0,174
   ,121,4,154,181
   ,255,39

16:POKE S+36,137,
   1,100,164,174,
   121,2,36,174,1
   21,3

17:POKE S+47,100,
   100,37,221,221
   ,221,174,121,4
   ,100

18:POKE S+57,181,
   34,39,153,62,9
   0,1,253,40,68,
   84,7,139,4

19:POKE S+71,94,2
   6,153,9,20,186
   ,237,0

20:PRINT "hold EN
   TER to scroll"

30:"cat"IF ASC
   INKEY$ <>13
   THEN "cat"

40:WAIT 15:CLS :
   CALL S:IF PEEK
   &7904<>0PRINT
   :GOTO "cat"

50:A=0:END
```

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MIGHT BUY
WRONG COM
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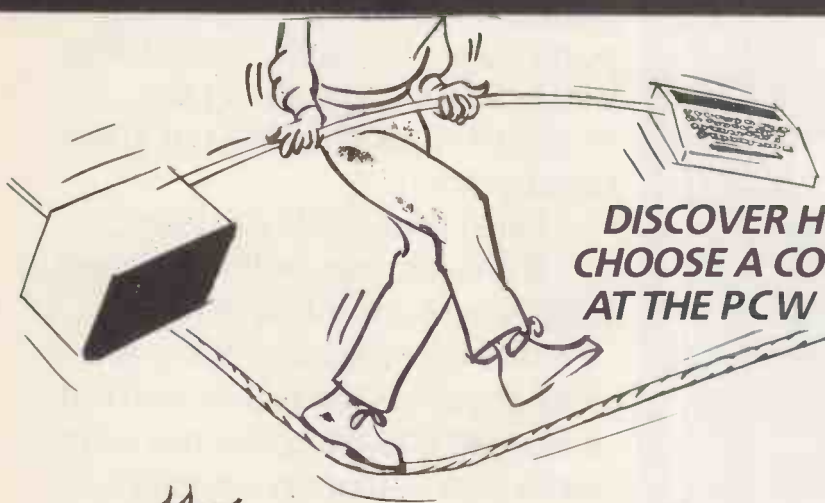
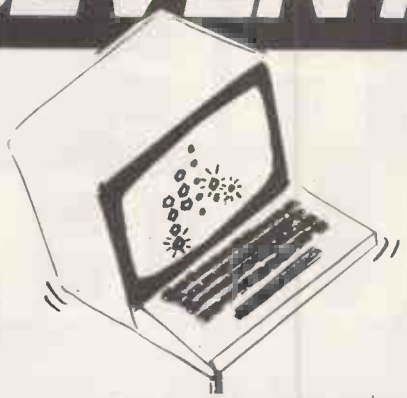
DON'T MISS THE MAGNIFICENT SEVENTH



DISCOVER HOW TO CHOOSE A COMPUTER AT THE PCW SHOW



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Catalogue. Assembler listing.

```
            Find address of next Line

38C5 LDA 7902  ;1st Line address high-byte
38C8 STA UH    ;and store in U-reg
38C9 LDA 7903  ;then low-byte
38CC STA UL    ;and store in U-reg
38CD LDA 7904  ;load the link
38D0 ADR U     ;and add it to U-reg

            Reached end of BASIC?

38D2 LDA 7867  ;last Line address high-byte
38D5 CPA UH    ;compare high-byte, and
38D6 BCR+ 08   ;if higher, forward 8 (to 38E0)
38D8 BZR+ 0C   ;else, if lower, forward 12 (to 38E6)
38DA LDA 7868  ;      else, if same, load low-byte
38DD CPA UL    ;compare, and
38DE BCS+ 06   ;if lower, forward 6 (to 38E6), else
38E0 LDI A 00  ;load 0,
38E2 STA 7904  ;store in 7904, and
38E5 RTN       ;return to BASIC.

            Merge point?

38E6 LDI A FF  ;load FF (merge token)
38E8 CPA (U)   ;compare with contents of next line address
38E9 BZR+ 01   ;if not same, forward 1 (to 38EC),else
38EB INC U     ;on to the next address

            Store present line address

38EC LDA UH    ;load it, and
38ED STA 7902  ;store it, ...
38F0 LDA UL    ;... both ...
38F1 STA 7903  ;bytes

            Find next Line link

38F4 INC U     ;move past Line Number
38F5 INC U     ;to link
38F6 LDA (U)   ;load link, and
38F7 INC A     ;increment it to point
38F8 INC A     ;past the e-o-l marker
38F9 INC A     ;to the next Line,
38FA STA 7904  ;and store it.

            Examine Line for Quotes

38FD INC U     ;move past link
38FE LDI A 22  ;ASCII for Quotes
3900 CPA (U)   ;and compare with address contents
3901 BZR- 3E   ;if not, backwards 62 (to 38C5)
3903 LDI YL 01 ;else, set Y-reg to 1

            Find label length

3905 LDX U     ;copy present address to X-reg
3907 INC X     ;move to next address,
3908 INC Y     ;and increment Y
3909 CPA (X)   ;second Quotes?
390A BZS+ 04   ;if yes, forward 4 (to 3910)
390C CPI YL 1A ;else, is Y 26 (a screenful)?
390E BZR- 09   ;      and if not, backward 9 to
               ;      loopstart (3907), else
3910 LDA YL    ;load label length, and

            Print it!

3911 JMP ED00  ;jump to ROM Display routine.
```

(continued from page 169)

and Def characters in quotes at the beginning of Basic lines. The labels are displayed one by one every time you press Enter.

The working part of the program is short enough to be kept permanently in Memory. It boils down, in effect, to five lines of Basic and 79 bytes of machine code.

Before you enter the program, RAM space must be reserved for the machine code. In program mode enter New0 to reset the system. The value of Status2 – 1 should be then be 14,533 if your machine has the 8K memory expansion module, and 16,581 if it hasn't.

Now enter

NEW STATUS2 + 78

and then key in the program using either 14533 or 16581 for S in Line 10. Save it on tape before running it — just in case! Finally run the program. If all is well, lines 5 and 11 to 19 may be deleted.

The assembler mnemonics, together with the comments, explain what happens. Line 10 of the Basic program takes the address of the first line from &7865 and &7866 and puts it into &7902 and &7903; &7904 is used to store the link to the next line.

Line 40 calls the machine-code routine, and the &ED00 system routine displays N accumulator characters, starting from the address held in the U-register. The time for which each label is displayed is controlled from Basic by lines 30 to 40.

This program reveals an interesting facet of the 1500 not disclosed in the user manual, though it does get a mention in the Technical Reference Manual. Other Sharp computers use a command like Limit to reserve a block of memory safe from the Basic interpreter. In general, this block is at the top of available memory.

There is, apparently, no comparable capability on the PC-1500, but there is the rather odd command New0. What this does is to instruct the interpreter to reset the entire system, with the first line available to any Basic program starting at memory location 0 — or, rather, at the first available RAM location.

Similarly,

NEW < number or expression >

instructs the machine after a reset to start the area usable by a Basic program at the specified memory location — provided it is after the interpreter and reserve areas.

So on an unexpanded machine, or one with the 4K expansion module, the command

NEW STATUS2 + 78

entered after New0 tells the machine to start any Basic program at the 16,582 + 78th byte after the interpreter reserve. In this way an area of memory between the top of reserve and the bottom of your Basic program can be set aside, inviolate to Basic, for any purpose you choose.

There's one big difference between the IBM PC and the computer below, and it's only fair that you should know about it.

Advance 86b specification. Intel 8086 CPU. MS DOS operating system. Twin-disk drives. 128K RAM expandable to 640K. Interfaces for light pen, printer/plotter, joystick, monitor and RS232C. Capacity for 4 expansion boards, plus a further 2 true 16 bit slots. Graphics - 16 colours. 80/40 columns x 25 row text. 640 x 200 pixels. Package illustrated **Kaga KP810 Printer** (with NLQ) £345.00 inc. VAT and **Novex 12" Monitor** (amber) £89.95 inc. VAT.

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The Ferranti Advance 86b costs only £1,499 (inc. VAT). The IBM PC equivalent will cost you a lot more than that.

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What's more, it comes with four free software programs – spreadsheet, wordchecker, word processor and database.

The package shown includes a monitor and printer and at £1933.95 (inc. VAT) still costs less than the equivalent IBM PC package.

And because the Advance 86b is available at all 33 W. H. Smith computer shops listed below, why not come in and see one.

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Stepping into the breach

Atari owners who want to get the most from their machines need more than the official documentation. Jack Schofield assesses what is available.

IT SEEMS Atari has reduced the quality of its documentation from the good old days, and this provides lots of openings for books. Authors have not been slow to fill the gaps.

The Easy Guide to Your Atari 600XL/800XL by Thomas Blackadar, is typically American in the best senses. It is thorough, goes through material slowly, and has an index. The book is certainly useful for anyone who has not met a computer before.

Your First Atari Program by Rodnay Zaks is well written, well illustrated — mostly with cartoons of dragons — and well laid out but it has almost nothing to do with Atari Basic, as distinct from any other variety. Some of the statements about it are just plain wrong: yes Rodnay, in Atari Basic you *can* use reserved words as variable names, except Not.

Getting started on your Atari is a cheaper British production by Tim Hartnell and Paul Bunn, the latter presumably supplying the Atari expertise. Again this is from a series of "Getting Started on" books, but at least all the coding is Atari-specific. Though it does not go into great depth, *Getting Started* does what it claims. It also provides a few games to type in at the end. At £2.95 it is acceptable value, notwithstanding the four pages given over to a printout of the times tables.

Paul Bunn's own book is *Making the Most of your Atari*. It is short on explanations but long on games programs to type in. The proof-reading could have been better and the listings clearer, but on the whole this is a useful book for those who already know a little Basic.

An Introduction to Programming the Atari 600/800XL is a really cheap effort, both in production quality and price. Like several earlier books it comes from a series which includes other micros like the Oric and Spectrum. However, it is even more Atari-specific and, unusually for a Basic book, is very detailed on specific registers. The Penfolds' book is rather better than it looks.

Get more from the Atari is from the indefatigable Ian Sinclair, and it has been cleanly produced with clear listings. It covers everything from setting up the machine to sound and graphics programming. The explanations are longer and clearer than in most similar books, and Sinclair is particularly good on strings.

Easy Programming for the Atari Micros is the largest, most comprehensive and most useful beginners' guide yet to appear from a U.K. author. Though still not as good as *Your Atari Computer*, published by McGraw-Hill, it presents a lot of information very methodically. It also contains numerous photographs, diagrams, flow charts and sound top-down programming advice.

The reason you might not like this book is that it is written in chat, and author Eric Deeson simply cannot resist a pun. Puns are alright . . . but "Hip hip array" and "Yellow subroutine"? This is a good book, if you can stand it. I enjoyed it.

Atari Basic Programs in Minutes is another from a series, and not particularly Atari-specific. It does not teach programming, but provides lots of short listings to type in. They are fairly well explained, and build up into reasonable programs. The emphasis is on serious and small business applications such as financial and maths calculations, record keeping, real estate and data analysis.

Atari Basic Faster and Better is by regular *Antic* contributor Carl M Evans. It is far more advanced than the usual beginners' books. The information is very well organised and presented. And notwithstanding the title, this substantial book includes a lot of machine code. Much of it comprises useful utilities such as block memory move, substring search, clock, Shell sort and DOS functions from Basic. In the U.S. the programs are available on a set of four discs.

Among the appendices is an excellent 11-page guide to Atari error codes. Although it might be hard to track down, and probably expensive, Evans' book is well worth the search.

Many Atari owners will want to write games, and there are quite a few books to help. A readable starter volume is *Writing Strategy Games on your Atari Computer* by John White, who is a contributor to *Popular Computing Weekly*. This is a particularly interesting book for the chess player, and has enough theory to be interesting even to the non-Atari owner. However, it also shows a good understanding of Atari Basic, which will help the reader even outside the games-writing field. Recommended.

Atari Adventures is from another stalwart of *Popular Computing Weekly*, Tony Bridge. It is split into two parts. The first

(continued on next page)

(continued from previous page)
provides a general overview of the whole field of adventures and "arcventures" — horrible word! The second half goes step by step through the writing of an adventure, and the book ends with a 22-page listing of a full game by Gary Radburn. If you are interested in writing adventures I know of no other Atari book on the subject.

Dr C Wacko's Miracle Guide to Designing and Programming your own Atari Computer Arcade Games is American — you guessed! — and a much slicker production than the British books. It has lots of neat cartoons and typeset program listings. However, it is so slangily written it is virtually unreadable by English-speaking people of taste and discernment.

Those who just want program listings to type in have a choice of at least three books, of which the best is *Software for the Atari XL*, in the "Best of PCW" series. Now you might think these were simply Atari games and utilities sent in by readers and published in the back of *Personal Computer World* magazine. In fact most have been converted from other machines, while Atari listings genuinely published in *PCW* have been missed out. However, the conversions have been done well. The listings are very legible, and someone took the trouble to get a printer which could handle inverse video and graphics characters.

The Atari Book of Games is, by contrast, a great disappointment: "21 sensational games" is the claim, but surely noughts and crosses and Pong hardly qualify today. The coding is tedious in the extreme. It is as though someone has converted old TRS-80 listings.

A rival is *Awesome Games for your Atari Computer*. It seems to have originated from the Netherlands, and again it is one of a series. "Awesome" is not quite the word for 31 shortish Basic games, but most of them seem OK. There is even a version of that old friend, Black Box.

Computer Tutor: Atari is something completely different. Basically it provides listings of 25 programs for educational use in homes or schools. There are two listings of each program, both Atari Basic and Atari Microsoft Basic being supplied. However, the programming does not stretch to sound and graphics displays. Themes range from Spelling Quiz through Math Teacher and Ballistics to Stock Market. Whatever the programs may be like, the listings are not very interesting.

For reference, *Mapping the Atari* by Ian Chadwick is a comprehensive and thorough memory map from Compute! books. Each important location is explained, and there are even a few short illustrative programs. As a source it is unrivalled and is definitely the book to get, if you can find a copy.

The original Atari manual has all the right information, but if you find it too terse, or if you have not got one, then the *User's Handbook to the Atari 400/800 Computers* offers a very good substitute. It does not cover the few things that are specific to the XL range. However, it does cover all the Basic keywords, disc, tape and Atari printer operations. Most definitions include short example programs, and there are also several useful appendices.

Atari Software 1983 is a 348-page book of reviews, mostly of software, such as games, business, education and utility programs. Each item is rated in a number of categories — 12 for games — including an overall rating. The reviews are very good, and the ratings from A to F seem to me to be very fair in general terms. It is only when plusses and minuses are added that the system breaks down. Surely no one really believes Pacman, rated A, is as good as Star Raiders, rated A, or that Choplifter, rated A+, is better.

Notwithstanding such pickiness, *Atari Software* is a valuable and useful guide, and deserves an updated 1984 edition. Considering the high prices of the American software it reviews, it should save you money in the long run.

An Introduction to Programming the Atari 600/800XL by R A and J W Penfold. Published by Bernard Babani, 116 pages, £1.95. ISBN 0 85934 118 6

Atari Adventures by Tony Bridge. Published by Sunshine, 146 pages, £5.95. ISBN 0 946408 18 1

Atari Basic by Richard Haskell. Published by Prentice-Hall International, 175 pages, £11.85. ISBN 0 13 049791 6

Atari Basic Faster and Better by Carl M Evans. Published by IJG Inc., 1953 W11th Street, Upland, Ca 91786, 299 pages. ISBN 0 936200 29 4

Atari Basic Programs in Minutes by Stanley R Trost. Published by Sybex, 171 pages, £8.95. ISBN 0 89588 143 8

Atari Software 1983 by Jeffrey Stanton, Robert P Wells and Sandra Rochowansky. Published by Addison-Wesley, 347 pages, £13.95. ISBN 0 201 10286 2

Awesome Games for your Atari Computer by Hal Renko and Sam Edwards. Published by Addison-Wesley, 154 pages, £3.95. ISBN 0 201 14670 3

Computer Tutor: Atari by Gary W Orwig and William S Hodges. Published by Little, Brown and Company, 345 pages, £10.95. ISBN 0 316 66502 9

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The Easy Guide to your Atari 600XL/800XL by Thomas Blackadar. Published by Sybex Computer Books, 198 pages, £6.95. ISBN 0 89588 125 X

User's Handbook to the Atari 400/800 Computers by Jeffrey R Weber and Stephen J Szczecinski. Published by Weber Systems Inc., 319 pages, U.S.$13.95. ISBN 0 938862 15 4

Writing Strategy Games on your Atari Computer by John White. Published by Sunshine, 131 pages, £5.95. ISBN 0 946408 22 X

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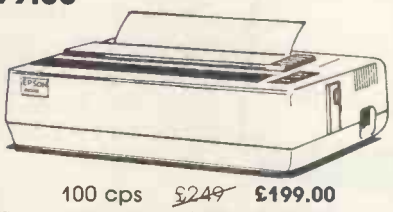

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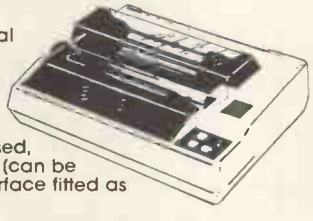

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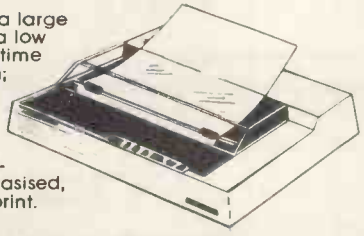

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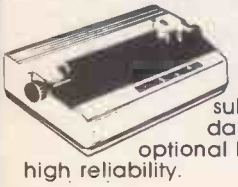

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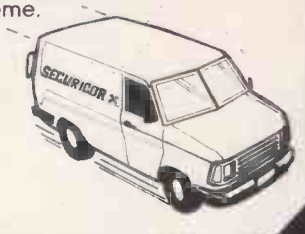

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The good old days

John Billingsley finds little time for nostalgia as he struggles to program some of the latest micros.

IN THE GOOD OLD DAYS you could recognise motorists by their leather caps and goggles. They had to know how to swing a starting handle, advance the spark and tickle the carburettor. Today's drivers expect to turn a key and go. Similarly today's microcomputer programmer is pampered by the system's friendliness, and needs little of the low cunning required to coax a working program suite out of the old mainframes and minicomputers; at least that is what I thought until recently.

Some years ago I developed a system for use in hospitals to analyse the patients' menu choices. It then used the old 2001 Pet, one of the pioneers among personals, and was designed to be used by office staff who had never seen a computer before. The software had to be friendly to the point of embarrassment, avoiding any possibility of baffling the user. When floppy-disc units became available, checks were made at every stage that the right data disc had been inserted, and polite messages cajoled the operator into correcting any error without fear of a crash. The 8000 succeeded the 4000 machine, and the system grew in scope and versatility to match them. Then came the stampede of the 16-bit machines and the cause of my present grumbles.

Time machine

With Commodore's business image tarnished by its massive advertising campaign for the down-market Commodore 64, we were asked to provide versions of software to run on the new generation of 16-bit business systems. The machine-code segments are well defined, and the linking Basic need only be transferred from one Microsoft version to another, so how could there be any difficulty? As I settled down with a DEC Rainbow I found out: it was like a trip back in a time machine to the monsters of my computing childhood.

My first warning was the incompatibility between the operating system and the Basic environments. If you want to look at the directory you type Dir at system level, but Files from Basic. Get them mixed and you will be told "Syntax error", or a graunching sound from the disc will be followed by the message Files? To find how much disc space is free you run the program Stat to find out — and it's goodbye to your Basic program. To get rid of a file from system level you Erase it, but from Basic you Kill it. To escape from Basic the grapevine tells me correctly that you type System, but I have yet to find it in the manual.

Old-style craft

Editing a program is an experience in itself. None of the namby-pamby business of driving a cursor around the screen, overtyping the listing and muttering WYSIWYG — what you see is what you get. Take pride in your traditional craft by memorising that you must type

```
EDIT1000
```

whoops!

```
EDIT 1000
```

then type spaces to see each character magically revealed. Savour your skill in remembering X to extend the line, C to change a character, 5D to delete the next five, I to insert some more text — now what on earth was the delimiter? When you type a new line in, the Delete key has a wonderful psychedelic effect as you correct your error. You may realise that Control-H will nibble characters from the end in the boring easy way, but to have real fun mix these and Deletes and try to guess the result.

After a while it dawns on you that the Rainbow's Red text editor might be an easier way of doing business. You save your program in text form by typing

```
save "prog", a
```

followed by System and

```
red prog. bas
```

It is dishearening to discover that Red cannot find your program. A directory search reveals it in lower case. Rename it? Ren cannot find it either. The only recourse is to return to Basic, and rename it in upper case from there.

A few minutes in Red will convince you that Rainbow software will not dazzle you with its speed. Red is a general text editor; it does not recognise Basic line numbers as such, and so you must locate the appropriate number. To find a line near the end of a reasonably substantial program takes 24 seconds. To go back to the top of the program then takes 12 seconds, and a similar time is needed to wipe the text from memory. To a user of Toolkit on the Pet and word processors such as Superscript these times are unbearably slow; the Pet can locate every occurrence of a chosen expression in under a second. Even before you get this far you will be taught a lesson in patience. It takes 40 seconds from switching on for the machine to load the operating system, which stretches to a minute or so before you arrive in Basic.

Plodding

In your plodding journeys between Red and MBasic you may find a few other surprises. In Basic, Shift-3 gave the expected #. In Red it gave a £ sign, which was transformed into Tron on loading the program back into Basic. The solution was obvious: select the U.S. rather then the English keyboard setting. Success, except that the * now typed as ", the " typed as #, and * was at last found masquerading as (. Back to the drawing board. It took a phone call to the rescue squad to reveal that not only can you select U.K. or U.S. keyboard and U.K. or U.S. display, yet another selection lurks for the unwary between Correspondence and DP modes.

I gritted my teeth and set to on the the software. Now how to implement that friendly file check? Open the file and trap the error if the file is not found. But if a random file is not there the system will create one. The Pet refused to do such a thing unless told the length of the record. Once written, the file contained this vital information which could be checked to flag a mismatch.

Not so the Rainbow. It must be told the

(continued on next page)

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length each time the file is opened; if not, the length defaults to 128 with potentially disastrous consequences. To be fair, this is probably true of all systems which use CP/M. If there is no disc in the drive, when perhaps a new data disc is called for, then any attempt to open a file causes a cryptic CP/M message to appear on the screen. Press the wrong key, and the user is dumped out of Basic with the loss of program, data and all.

Now for all the friendly screen prompts. The first need is to clear the screen but not just by rolling it upwards. In the *Owner's Manual* you will find a chapter of ANSI escape sequences. Believe it or not, the equivalent of a single Clr keystroke requires

```
Escape-[2J Escape-[H
```

The manual gives numerical equivalents of the character codes in octal.

Teletype

CP/M was originally designed for a system with a Teletype and paper tape punch and reader, and it shunts streams of characters to and fro in channels which can be assigned to any such device. It's hard to Clear Screen on a Teletype, and there is little joy in driving a cursor around to read characters from the paper's memory. So screen memory is regarded as inaccessible except for writing. The stream approach seems to fit in with DEC's philosophy, and it has made no effort to cheat as some other manufacturers have done. Even the keyboard cursor keys send back ANSI codes in groups of three characters, adding to the nightmare of writing interactive software.

My blood pressure started to rise when I tried to interface a printer to the system. The communications port cable had Transmitted Data and Received Data in the wrong order to suit the printer's interface connector. So, having two suitable plugs handy, I got out my soldering iron. Pin connections for the printer port are given on page 58 of the *Owner's Manual*. Signal ground was joined through pin 7, and Received Data from computer to printer was carried on pin 2. How about the handshake? Pin 20, Data Terminal Ready fitted the bill. The manual said, "If printer turns off DTR, the Rainbow stops sending characters to the printer. When the printer turns on DTR, the Rainbow sends characters to the printer.".

I made the connections, fiddled with baud rates, pressed Control, and the printer burst into action. I commanded the machines to Type my program, and text streamed on to the screen at a great rate. The printer struggled to keep up, but only caught one line in three. Why wouldn't the computer hang around for it? The printer clearly was not giving the right Masonic handshake.

I wasted time exploring port addresses to find out if DTR was being read.

```
PRINT INP(67)
```

showed an input bit bobbing up and down as On Line was pressed on the printer. A meter confirmed that this was the vital pin 20 handshake. A phone call solved the mystery: "Oh, it's not as it says in the manual. The Rainbow uses XOn/XOff. You'll probably need a different printer interface." All I needed was an extra wire, and the patience of Job.

The first program is starting to come together now — only another dozen or so to go. Another pleasant surprise was that Microsoft has improved its handling of For-Next loops. The Basic I had learned to love was elegant in its simplicity. Commands were performed as they were encountered, and loops could be as convoluted as I wished. There were none of the territorial squabbles indulged in by Fortran, and provided any unfinished loops were tidied up by a later

```
I = N:NEXT
```

all was well.

A particular use for multiple Nexts was when listing all names in an array beginning with say, B. A program structure with a particular turn of speed was

```
10 A = ASC ("B")
20 FOR I = 1 TO N:IF ASC(NA$(I))< >A
   THEN NEXT: GOTO 40
30 PRINT NA$(I): NEXT
40 . . .
```

In MBasic it gives a "Next without For" error. Even the simple

```
10 FOR I = 1 TO 10: PRINT I
20 GOTO 100
30 NEXT J
100 NEXT
```

gives the error. The updating programmer has gone to enormous trouble to clear up the pothole of the untidied For by scanning every line for Nexts during a Goto, only to create an elephant trap which further defeats portability. More important, the modification makes understanding of the innards less clear.

Zapped

I am not swiping just at CP/M and Rainbows. MS-DOS and Apricots are just as capable of inducing extreme exasperation. Whoever dreamed up the idea of the Apricot's ladder being user-friendly has a warped sense of humour. Between one phase and the next a lumbering great program must be loaded, all to substitute the use of cursor and numeric keys for a civilised menu selection. Short circuit the process and you are in trouble. Try calling Serial from the system prompt. Change the settings, select Accept, and all seems well when the A> prompt reappears. But now enter MBasic, and load a program. Your every instruction will be greeted with "line buffer overflow". Press the Reset button and reboot, enter MBasic again and the story is the same. The machine is so thoroughly zapped that it must be turned off and on again to recover.

If you really want to sample the joys of masochism, try getting a Rainbow and an Apricot to talk to each other. If you have a large file to be transferred to the Rainbow's disc you may find that vital byte or two disappearing between the cracks. The protocol seems to indulge in more handhakes than a French family reunion, and time after time ends up in deadly embrace. You start to realise why the Async package on the Apricot is twice as big as MBasic.

Large memories are perverting the system writers into the bad old habits of the mainframes — never use a byte of machine code when you can call a 20K package. And when packages call packages which call packages, the user clearly should buy another megabyte of memory. I suppose it's good for trade.

Too flashy

The trouble with operating systems is that they try to be flashy. An operating system is like your liver. You cannot function without it, but if it makes you aware of its presence then there is something decidely wrong with it. The authors of CP/M are ceaselessly amazed at the adoption of their system in such a widespread way. The arguments for portability are unquestionable, and the structure provides a ready recipe for system designers to add a BIOS for their new machine. But has nobody the imagination to expand the system to be upwards compatible with all the interactive facilities offered by a machine with screen-mapped memory?

Apart from disc files CP/M addresses itself to just four: CON, AXI, AXO and LST. The old Pet allows a dozen devices to be addressed on its IEEE-488 bus, or up to 3,000 or so when secondary addresses are called into use. Few if any of the 16-bit manufacturers provide a user port which is useful for sensing and activating gadgets such as mice for menu choice. So how can we get the best of all three worlds of friendliness, hardware versatility and software portability?

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For a while some manufacturers will get away with it. But when users see their children's toys outperforming systems costing five times as much, the bubble must surely burst. In the meantime, I have a worrying feeling that I am getting used to wearing the leather cap and goggles.

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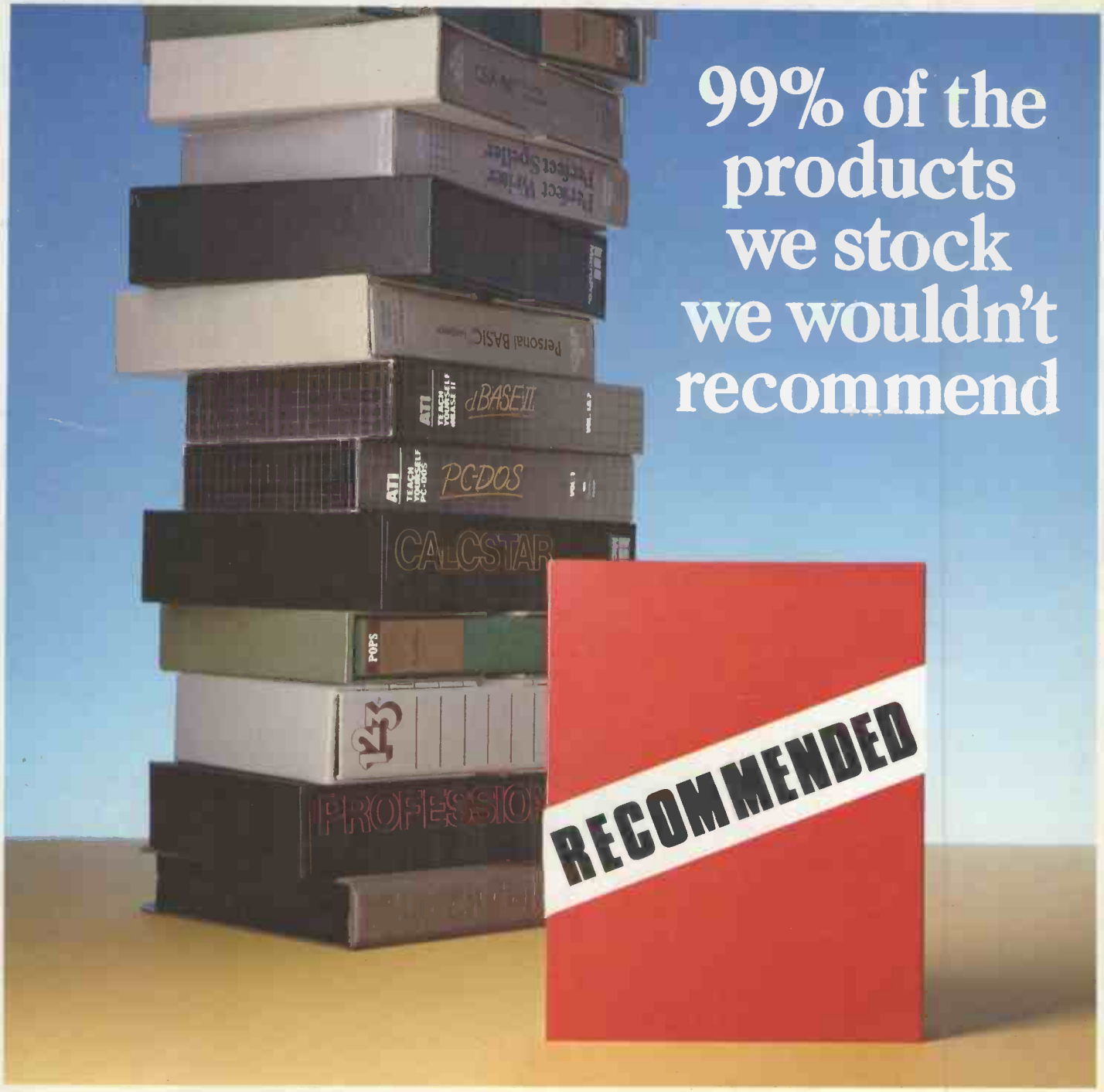

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