AUGUST 1985 • Volume 8 • Issue 8

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2

PRACTICAL COMPUTING

AUGUST 1985 **CONTENTS**

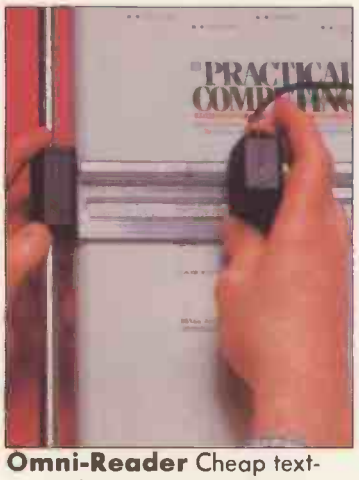
COVER FEATURE

PRINTERS

This month's special feature by *Ian Stobie* looks at printers in all their various incarnations. Starting on page 85 there is an introduction to the available technologies and current market trends. Then on page 88 *Jack Schofield* looks at what's happening among the dot-matrix printers: NLQ is becoming an almost standard feature to be found on, among many others, Epson's new LX-80. Finally, on page 92, we report on our hands-on experience with the hottest of hot technologies: lasers, in the form of Apple's new Laserwriter **85**

INSIDE

Vienna PC Outstanding screen display — page 66.



Omni-Reader Cheap text-input device — page 57.

TWO AT-ALIKES

The elegant, sophisticated Compaq Deskpro 286 and the workmanlike Kaypro 286i are leading contenders for the title of top PC/AT clone. *Jack Schofield* makes the comparison **47**

GEM DESKTOP

Is Digital Research's icon, mouse and window environment the ultimate front end? *Mike Lewis* assesses its chances of bringing Mac-alike applications to each and every micro **50**

OMNI-READER

Ian Stobie investigates a cheap text-scanning device which enables your micro to read typewritten copy **57**

CMS 6502 RACK SYSTEM

This crate machine lets you build up a totally open BBC emulator to meet your specialised requirements. *Roger Cullis* takes the lid off **58**

VIENNA PC

Glyn Moody looks at this MS-DOS machine from Northern Telecom, which has possibly the best white-phosphor VDU produced so far **66**

WORD PERFECT

Is Word Perfect really so good that you should throw-out WordStar and start again? *Susan Curran* believes it might be **68**

MAC MUSIC

Turn your Mac into a revolutionary music processor, or use it as a synthesiser. *Glyn Moody* with two new programs **70**

HOTLINES

Before you buy that micro *Joia Shillingford* gives 10 tips on what to ask the hotline services that go with them **74**

TOP 10 NON-IBMULATORS

You don't have to choose IBM. We give 10 good reasons why you could be better off with something completely different **77**

INTERVIEW – BILL GATES

Glyn Moody talks to the ever-youthful boss of Microsoft, who gives his views on the Mac and the IBM PC **81**

NEWS

HARDWARE NEWS
Commodore's C-900 and Amiga machines **15**

Flight Simulator on the AT.

IBM NEWS
Price cuts **19**

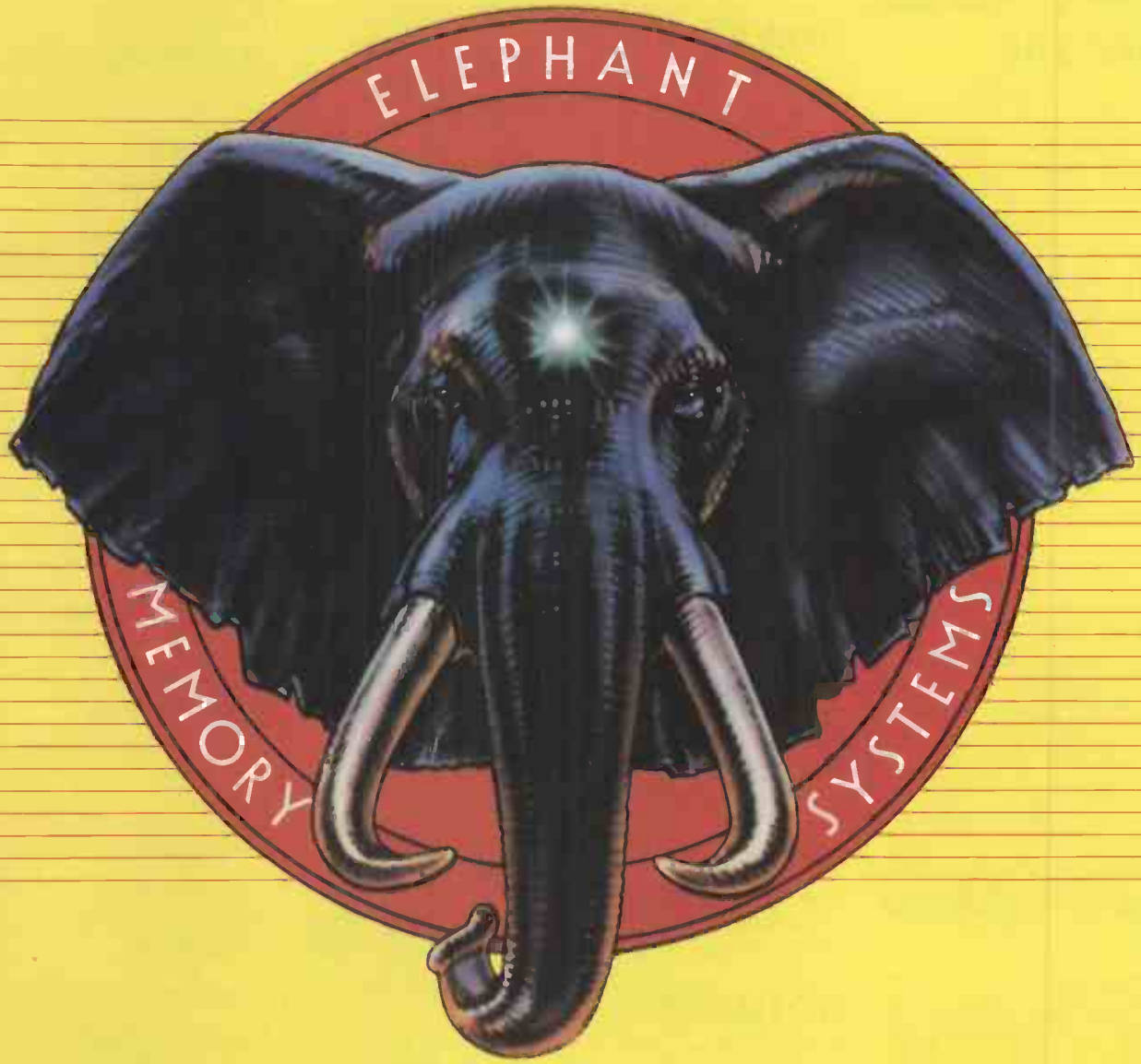
SOFTWARE NEWS
How to match up incompatible files **21**

GENERAL NEWS
BTG's £100,000 academic enterprise competition **23**

OPEN FILE

REGULARS

MORE ELEPHANTS TO TRUST



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4

THE BRITISH WHAT?

Whatever happened to the British micro? A couple of years ago, we seemed to be dominating at least the home micro business through Sinclair, Acorn, Dragon, Oric and Lynx, with the Jupiter Ace and Grundy Newbrain adding to the list. Since then five of these seven firms have gone into receivership, Acorn has had to be bailed out by the Italians, and Sinclair Research by a subsidiary of the Maxwell empire.

British micros never had quite the same dominance of the business market, but the story is little different there. The arrival of the IBM PC and its host of clones cut a swathe through the ranks of British manufacturers, and the number of bankruptcies doesn't even bear thinking about. There are still many small firms successfully making high-quality micros, but the only major manufacturer still flourishing seems to be ACT.

What are the prospects for the survivors? Sinclair Research, sad to say, needs new products. The Spectrum is a micro of little merit, which sold on good marketing, patriotism and price. Now that it is being undercut by superior machines only the existing software base supports it. Every Spectrum program converted to another machine is another nail in its coffin.

As for the QL, this was spoiled by being released in a botched form. Again, a new version is desperately needed, with a built-in 3.5in. disc and full Motorola 68000 instead of the cut-down 68008. Otherwise it looks likely to lose out in the battle between the Amstrad CPC-664 and the Atari 520ST.

Acorn's product line also looks weak, with the inept Electron and ridiculously overpriced BBC B+ having limited appeal. The immediate hope is that Olivetti can flog them in the underdeveloped education markets overseas before an industry-standard operating system catches on.

For the future, however, Acorn badly needs a BBC C. The only obvious option is to redesign the B to incorporate the existing National Semiconductor 32016 add-on. This would provide BBC B compatibility with an extension of remarkable power and educational appeal.

ACT is in no desperate need of new products, which is all the more reason why it ought to launch some soon. The requirement is an 80286-based machine to compete with the IBM PC/AT, allowing ACT to slide imperceptibly into proper IBM compatibility. The only worry is that ACT will neglect its U.K. and European user base while trying to crack the American market. Look what happened to Acorn . . . .

There are two other major micro manufacturers active in the U.K.: IBM and Commodore. IBM is continuing to expand its operations in Greenock, Scotland, where it makes vast quantities of IBM PCs, almost all for export. No one thinks sales of IBM's micros are going to stop.

Commodore, however, offers more cause for concern. It is not the fault of the British workforce that Commodore's product planning appears to be a shambles, and that the company's declining sales look like putting it into the red this year. However, the Corby factory appears to be churning out Commodore 64s in great quantities for Europe and Australasia. And when Commodore sorts out its product line, it should find itself selling all the main industry-standard operating systems: PC-DOS on its IBM PC clone, the Unix-like Coherent on the 900 and good old CP/M on the 128. The other products can presumably be junked. If it works, Commodore might do quite well.

The continuing success of IBM and ACT, and the possible revival of Commodore's fortunes, show that it is possible to manufacture successful micros in the U.K. and to sell them overseas. The real problems are getting both the design and marketing right, and Amstrad has shown we can do that too. If the CPC-464 was actually made in the U.K., that would be a success worth bragging about.

5 YEARS AGO...

Here at last — the 64K RAM chip is finally being shipped to European dealers and developers and is now available for the general market. Manufactured by Motorola, it has, for some incomprehensible reason, been called the MCM6665L25.

It is a 65,536-bit high-speed — 250 nanosecond access — dynamic RAM requiring eight address lines. Complete address decoding is done on-chip with address latches incorporated. Operating from a single 5V power supply the chip dissipates less than 300mW. The only reservation about this great advance in chip development is the price. A quick calculation on our 16K RAM micro shows that the price per byte of a 16K RAM is 0.3p whereas that of the 64K RAM works out more like 2p per byte. No doubt the price will eventually fall.

Cover feature: page 85.
Photo: Tony Hutchings.

EDITORIAL 01-661 3609
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PUBLISHED by Electrical-Electronic Press, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. Tel: 01-661 3500. Telex/grams 892084 BISPRS G.
DISTRIBUTED by Business Press International Ltd. Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.
SUBSCRIPTIONS: U.K. £15.50 per annum; overseas £30 per annum annum; selling price in Eire subject to currency exchange fluctuations and VAT; airmail rates available on application to Subscriptions Manager, Business Press International Ltd. Oakfield House, Perrymount Road, Haywards Heath, Sussex RH16 3DH. Tel: (0444) 459188.

Printed in Great Britain for the proprietors Business Press International Ltd by Greenaway Harrison Web Offset Division, Southend-on-Sea. Typeset by Lithotype Design, London EC1.

ISSN 0141-5433

Would-be authors are welcome to send articles to the Editor but *PC* cannot undertake to return them. Payment is at £35 per published page. Submissions should be typed or computer-printed and should include a tape or disc of any program.
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.

Line Counter

I REFER to the program Line Counter in the Commodore section of Open File on page 138 of the May 1985 issue of *Practical Computing*.

May I first point out an error in the published program, said to be for the Commodore 64. In that machine, the address of the ROM subroutine which converts an integer in AX to a decimal string and prints the string is $BDCD, so the data in line 21 should be 205, 189.

I devised my own program for the same purpose to help me split up Basic programs into handy sections for printing. My version is shorter and more elegant. Instead of plodding through the business part of each line and counting the zeros which mark the end of the lines, it jumps straight from one line to the next using the next line address placed at the beginning of each line in Basic RAM, and counts the jumps. To convert the published program to be equivalent to mine, the following amendments are required:

13 substitute 1 for 0 or, perhaps better, 164; 43 for 160, 0.
14 DATA 72,200,208, 2,230, 89, 177, 88
15 DATA 240, 12,133, 89,104, 168, 230, 35
16 DATA 208, 2,230, 36, 208, 232, 104, 165
17 DATA 36, 166, 35, 32
delete 18 & 19
21 DATA 205, 189 (see above)

Consequentials are

7 891 instead of 905
23 118 instead of 132

For my own purposes I have added a routine which returns the number of the nth line, where n is first Poked into locations 251,252. For brevity and convenience, the first 14 bytes of the line counter routine are placed in a subroutine, which also opens the nth line routine. Then n is decremented by 1. The same technique is used, combined with a countdown, to find the address pointed to at the beginning of the (n – 1)th line. Then 2 is added to obtain the address of the line number bytes of the nth line, and the integer is printed as before.

HAROLD H BROWNE,
Maidstone,
Kent.

THE EDITOR REPLIES: You are quite correct. We left the wrong line 21 in place when making the listing. It should read

21 DATA 205,189

as you point out.

FEEDBACK

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. Write to

Feedback, Practical Computing,
Quadrant House, The Quadrant,
Sutton, Surrey SM2 5AS

WANTED. . .

I HAVE BEEN waiting expectantly for some years, cash in hand, for a device which I really need to appear on the market. Because it seems so extraordinary that I have not come across anything of the kind, I appeal to your readership for a solution, which I feel very certain will be of widespread interest.

What I seek is:

- A standard QWERTY keyboard computer preferably CP/M, having both a word processor, preferably WordStar, and a Basic, preferably Microsoft, in on-board ROMs or ROM cartridges.
- A composite video interface for use with a monochrome monitor.
- Bubble memory or battery powered with CMOS circuitry.

Sufficient free memory to hold a few pages of text, say, 5/10K. As third choice a built-in cassette system might be acceptable.

- A serial interface and facilities to dump text or a Basic program direct from memory to another micro having conventional discs.

The purpose? To enable me to draft at home the odd letter, brief report or small segment of program. Then to carry only a single small unit to the office next day, where either letter or program can be transferred to the office micro for further editing and/or printing. I feel certain that I cannot be the only person to whom such equipment would be of the tremendous value.

PETER GOODE,
Hayes,
Middlesex.

THE EDITOR REPLIES: The Epson PX-8 and NEC-8401a both have WordStar in ROM and would seem nearest to filling the bill. The Epson is widely available, but the new NEC portable has only been launched in the U.S. Unless, of course you know different.

Matrices and complex numbers

IN YOUR March issue, page 59, there appeared a letter enquiring about matrix and complex-number handling. May I bring to your attention the Matrom, a sideways ROM for the BBC Micro, which adds matrix handling to BBC Basic? It has been used in teaching since October 1984, and can be bought for £25 from Matrom, c/o Mathematics Laboratory, School of Mathematical and Physical Sciences, University of Sussex.

I have often been puzzled by the short-sightedness of designers of programming languages who build a fixed number system into their languages. Perhaps it is because they have failed to distinguish between the syntax and the semantics of arithmetic. The rules of algebra concerning +, −, *, but not /, are the same whether they refer to integers, complexes, elements of an algebraic number ring, or finite field, etc. All these number systems are useful.

The proper approach would be to restrict the programming language specification to questions of syntax, and to leave details of implementation to a library module. The module, selectable by the user and perhaps held in ROM or on disc, would deal with how numbers are to be represented in memory, how they are to be input, how displayed on the screen, and how the primitive arithmetic operations are to be executed. Integers and/or floating-point numbers could form a default module.

Such a system is quite possible with Forth, where any word can be redefined. In Pascal you could get by if you are prepared to put up with clumsy prefix notations like plus (x,y) instead of x + y.

It is not necessary for a programming language to specify a number system, any more than it should specify the computer it runs on. It is even conceivable that one could lay down appropriate calling conventions for each processor to enable standard suites of machines-code programs to be used with any high-level language that has been designed to take advantage of them.

G C WRAITH,
Reader in Mathematics,
University of Sussex,
Falmer,
East Sussex BN1 9QH.

Finding out the hard way

AS AN avid reader of your excellent publication I have always been disappointed by the lack of in-depth review — or any review — of the various programming languages and associated compilers and development tools available. Perhaps you feel that this is too esoteric for most readers who seem to be content with Basic. As someone who specialises in instrument interfacing via IBM PCs to networks/mainframes, I had more or less despaired of being able to do such work in anything other than Basic assembler.

IBM's Basica is so incredibly powerful for interfacing and communications work that this, coupled with its interactive nature, makes development work simple. However, with complex programs of, say, 48K and over, the lack of global variables and associated subroutines makes less elegant coding than I would prefer. The failure of IBM to provide a version 2.00 compatible compiler in the U.K. is a further serious disadvantage; Basica is painfully slow. The major problem, as I see it, is that no other development systems on the IBM, such as Pascal, Fortran and C, have intrinsic communications/graphics/screen-handling support and one is at the mercy of third-party suppliers for these items. To my cost I have

discovered that the quality of such offerings is rarely acceptable. Even when they are available, the endless compile/debug, run/debug cycle is painfully slow.

The latest version of Borland's Turbo Pascal seems to change all that, even more so with the about-to-be-released Graphics Toolbox. It is superb on all aspects of screen-handling/graphics/file-handling and I have just discoverd that an Asynch Manager is now available. This package essentially replicates the communications power available in Basic. All this, coupled with the almost unbelievable speed of the one-pass compiler, and the numerous handles thoughtfully proved into the BDOS/BIOS means that the full features of the IBM PC are available without need to recourse to assembly language.

The low start-up cost of Borland's package puts it within the reach of most programmers; its specification must be one of the most comprehensive available. For programs of medium complexity, where speed of development, and indeed of execution — use the 8087 version for maths-based packages — is vital, I doubt if it could be rivalled.

The point, however, is this: despite reading a whole host of computing/IBM-related magazines I still had to find out most of this the hard way. Indeed I only discovered the Asynch package because I had more or less decided to invest in a complete C development system and the Borland version was mentioned in small print at the end of a flysheet. The resultant saving in time/effort/money was considerable. Publications, such as yours, which cater for the serious user, should perhaps think a little more along these lines and less along the games/business package approach. After all, there are only so many ways of watching a business rise/fall, or solving the Towers of Hanoi problem, vital though it is that we understand these things. There are a whole host of areas where micros are not making any impact simply because the right questions are not being asked. Even if the correct tools are being provided for the job, who knows about them?

DR BARRY CLARK,
Glasgow.

THE EDITOR REPLIES: Turbo Pascal looks outstanding, especially for the low price, but we are still waiting for our reviewer to produce his report.

Using Pip instead of Typewrit

I WAS surprised to see the routine Typewrit.Com to turn a micro into a typewriter published in the May edition of *Practical Computing*. Has it been forgotten that this facility exists under Pip? Load a disc containing Pip, and on the A> prompt type

PIP LST:=CON:

press Return, and the job is done.

Different printers react in different ways. The Microline 82 only prints a line when Return is pressed. This is very helpful because it is possible to correct a line before printing. However, you must use the space bar to space across the paper as you would do in envelope addressing. The Tab key will not work. The Smith-Corona TP-I prints each letter as it is typed. In fact it behaves as described by the Lees.

A BILBROUGH,
Callow End,
Worcestershire.

JOHN AND TIMOTHY LEE REPLY: If you redefine the devices with

PIP LST:=CON:

then the first line that you type appears on the screen. But when you press Return, the cursor moves to the beginning of the same line, so the second line you type overwrites the first, and so on.

Using two different daisywheel printers set up correctly for normal working with Basic or WordStar, we found that the lines overprinted one another as they did on the screen. This could be cured by changing the switch settings on the printer to Local Linefeed. An alternative is to type Control-J after every Return. This makes the printer advance a line without requiring switch changes.

The program Typewrit has the advantages that each line is shown on the screen, with no overwriting, the switch settings on the printer do not require changing, and no control characters need be typed.

Using Pip you have to use the space bar to move across the paper to the starting point for each line, which is a nuisance if you are doing several envelopes or a set of sticky labels. Typewrit remembers how far across the page you tabbed the first time. It is also a nuisance remembering that Ctrl-Z is needed to return to CP/M, rather than the usual Ctrl-C. Lastly, if you want tabs expanded under Pip, type

PIP PRN:=CON:

Comm +

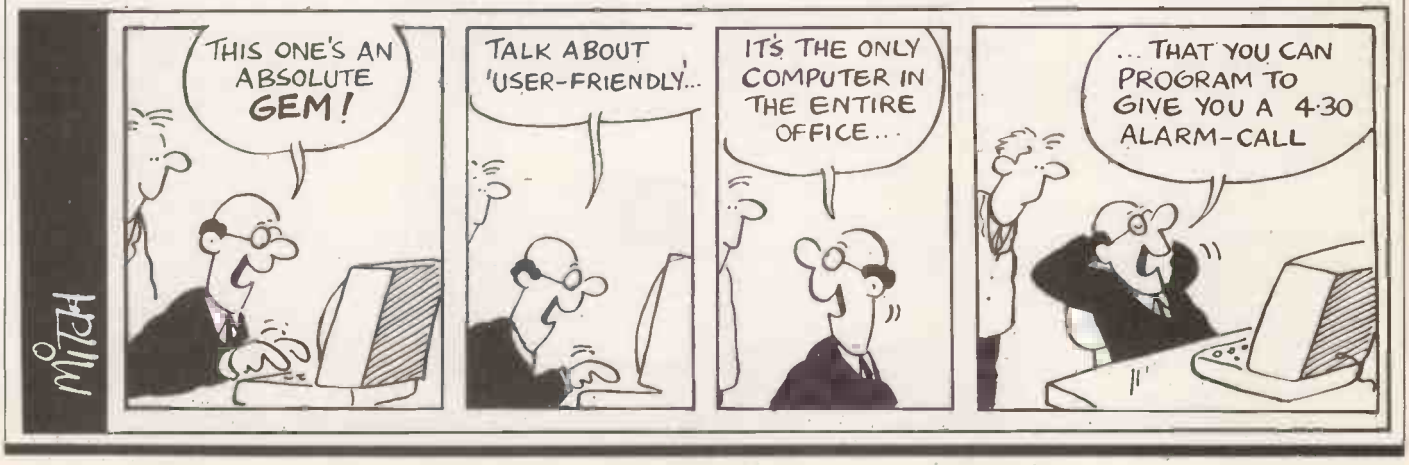
WE READ with interest your piece "Soft Options", page 105, in June's *Practical Computing*, regarding IBM PC software. Your list of British packages included only Unicom Rap and the Braid Mail Manager. You are clearly unaware of Lion Micro System's Comm + package.

Comm + offers facilities for uploading and downloading files from systems such as Telecom Gold; Viewdata access at 1;200/75 baud; error-checking file transfer, which is better than Bstam in so far as we can transfer all eight bits of a file over seven-bit datalines as well as offering XModem compatibility, and five other terminal emulations including ANSI. As far as we know, Comm + is the only package to include as standard an integral programming language of its own which isn't merely a script file processor, but is a genuine language written for communications. It does for communications what dBase II did for databases and offers bespoke performance at a fraction of the time and cost of writing from scratch. We also include integral text editing and formatting, including a telex formatter, as standard.

Comm + is available for 79 different CP/M-80, CP/M-86, MS-DOS, PC-DOS, MP/M and CCP/M systems, which is a range unrivalled at present.

Lastly, we'd like to point out that though Rap does error checking on Gold, our own algorithms for doing this are far more efficient — we've been asking Robin Oliphant to make them available since the end of 1982 with no luck. If Telecom Gold let users have access to the language facilities that U.S. Dialcom users have as standard, such as the Prime Assemblers, Fortran and Basic compilers and so on, we could do it ourselves. So Rap being able to do error checking with Gold isn't a technical innovation but a marketing coup . . . we could do it better if they'd let us. And Comm + is a better package than Rap in all other respects — it's available on a far wider range of machines, and if Gold are genuinely interested in extending facilities for users, they really ought to let us put the other end of our error checker on their system.

ANDREW MARGOLIS,
Lion Micro Systems,
London WC1E.



Q I use a CP/M machine for word processing with WordStar, and running Microsoft Basic programs. Please can you tell me if it is possible to use WordStar as a screen editor to edit programs as I do on a mainframe. Some Basic programs stored on disc do not seem to be the letters and numbers I would expect, so I can't edit these. Those programs that are stored correctly appear to edit OK with WordStar, but after such editing Microsoft Basic loads correctly but gives an error Direct Statement in File when I try to run the program.

MARTIN JOHNS

A WordStar is primarily used as a word-processing program, but it may also be used as a sophisticated full-screen editor for writing and editing programs in Basic, Fortran, Pascal, machine code or any other language. Using an editor is much better than altering a program under Basic, since only the part of a line that is wrong needs to be changed. it is also possible to move a line from one place to another, change the line number, make global changes throughout the program, and so on.

Basic programs are stored as a series of ASCII characters. The Basic interpreter compacts the lines you type, by converting keywords such as Input, Print, Goto, and so on into a single character. Numbers are converted into binary. When you have finished typing the program, you generally save it on disc, and with Microsoft disc Basic the command is

```
SAVE "FILENAME.BAS"
```

This command writes the compacted form of the program on to disc, and it is very difficult to use an editor to alter such a file, since the lines of program do not look like the text you typed in. It is possible to save the program on disc using ASCII characters rather than the compacted form with the command

```
SAVE "FILENAME.BAS",A
```

The file produced in this way looks just the same as the lines of program you typed in, so it is easy to edit the file using WordStar or any other text editor. If you would like to use the editor on a file you have stored in compacted form on disc you just first load the compacted file into memory under Basic and then save it on the disc in ASCII form before using the editor. To run WordStar you type the command WS, and after the sign-on message has been displayed the No-File menu appears on the screen. If you want to edit a program you must enter the command N to edit a non-document file. You can enter text, move the cursor, add, delete, alter and so on.

Programs are made up of lines of code which comprise letters and numbers, which are part of the ASCII set of characters which require only seven bits, so the eighth bit is never set. Thus the Microsoft Basic interpreter expects to find a program where only seven bits have been set. If you edit a program in Document mode, you may accidentally set the eighth bit to some character in the program file. When MBasic finds the character with the eighth bit set it thinks that there is a mistake, and gives the error message Direct Statement In File.

If you have always edited the program in Non Document mode this can never happen and there is a very simple way to put the problem right should you make this mistake. Simply copy the file using the CP/M utility program Pip, and write it back on the disc with the same file name, using the Z option to zero the eighth bit. For example:

```
PIP FILENAME.BAS=FILENAME.
    BAS[Z]
```

The file is now identical to the original except that any eighth bits that were accidentally set have now been unset, and you can run MBasic without any problems.

SORTING METHODS

Q I have a problem sorting numbers into order on a computer. I am using a bubble sort written in Basic and, while it works correctly, the computer is unbelievably slow. I have been told that there are much better ways of sorting a large number of values. Please can you suggest reference books which describe these, and explain how they work. Is there anywhere I can get these better programs, either on disc or as listings which I can type in?

D OLDERSHAW

A There are quite a lot of different sorting methods available, and the bubble sort is the slowest. For general purposes, the Shell sort is among the best, and always works. Hoare's Quickersort is often even better, but you may by chance get pathological data — that is, data arranged in an unfortunate order — which makes this very slow. If you have a special case such as dealing with integer numbers which have a limited range, then an address sort is the best choice.

Two articles on sorting appeared in *Practical Computing*, the first in the March 1983 issue, pages 120 to 122, and the second the following month, pages 136 to 138. Mike Lewis also wrote about sorts in the February 1985 issue, page 53. The standard reference to sorting methods is the book *The Art of Computer Programming — volume 3 sorting and searching* by D E Knuth, published by Addison-Wesley. The Shell algorithm is described in an article "A high speed sorting procedure" by D L Shell in the *Communications of the Association for Computing Machinery*, July 1959. The last two references are technical, and an easier explanation is given in our own book, *Statistics and Computer Methods in Basic* published by Van Nostrand Reinhold. It has a 17-page chapter on sorting techniques, together with tried and tested Basic programs for five methods.

Alternatively you can buy sorting programs on disc for £75 plus VAT, or listings for £25 from Micro Logic Consultants Ltd of Horsham, Sussex. Telephone: (0403) 731818.

Finally, remember that whichever method you use it will work much faster if you use a Basic compiler, rather than an interpreter.

? • ! • ? • ! • ? • ! • ? • ! • ? • ! • ? • ! • ? • ! • ? • !

Q Has there been an article in *Practical Computing* on the maintenance and repair of disc drives? I would like to know, for instance, whether there are any internal parts which need cleaning and/or lubricating. What disasters would be likely to ensue if I took the cover off to explore the working parts. Are there such things as maintenance kits, as there are for cassette recorders?

M J HOSKEN

A There has not been an article on this subject in *Practical Computing*, and we do not know of one anywhere else. We have not heard of maintenance kits for disc drives, though they are common enough for tape and cassette recorders.

We usually go to a reputable dealer to get disc drives fixed. There are programs sold for Apple, CP/M systems and the IBM PC that test a variety of things to do with your discs. They may test the speed of the drives, the pressure the discs, the alignment of the read/write head, and so on. We can see little point in buying these programs, since we lack the expertise and the specialist equipment required to fix the fault.

However, there are some things we will do. A number of suppliers sell special discs to clean the read/write head. In time, the head may become dirty because of the build-up of dust or from oxide which wears off the surface of the disc. The special discs are similar to a floppy disc, but are abrasive. Usually you put a special disc-cleaning fluid on the disc and run it in the drive. It is worth doing this periodically as routine maintenance or when you suspect trouble.

The disc cleaning fluid may be expensive, and you could save money by going to your local chemist and buying some isopropyl alcohol, otherwise known as isopropanol; it is the same as the cleaning fluid. I know of people who soak cotton buds, intended for cleaning children's ears and noses, in isopropyl alcohol and poke them into the drive to clean the read/write head. Be very careful if you do this, lest you disturb the alignment of the head. On no account should you poke round inside with anything rigid, like a screwdriver or a pencil.

If you have disc-drive trouble, it is worth checking the connections where the ribbon cable is plugged in. The plug slides off the printed-circuit board and reveals a set of gold-plated contacts. If these look the slightest bit black, oily, dirty, or even dull, clean them using a hard rubber. It is safest to rub along the length of the gold contact, rather than across them.

We once had a drive that squeaked when it spun. After checking that it was not just one particular floppy disc causing the problem, we unscrewed the printer-circuit board from the drive and used a pin to put a single drop of very thin sewing-machine oil on the ball race at the centre. Too much oil would be disastrous. If any gets on the read/write head, it will not read or write, and if any gets on a disc that too will stop working — permanently. Routine oiling is not required, and in general you will do more harm trying to oil it than leaving it alone. PC

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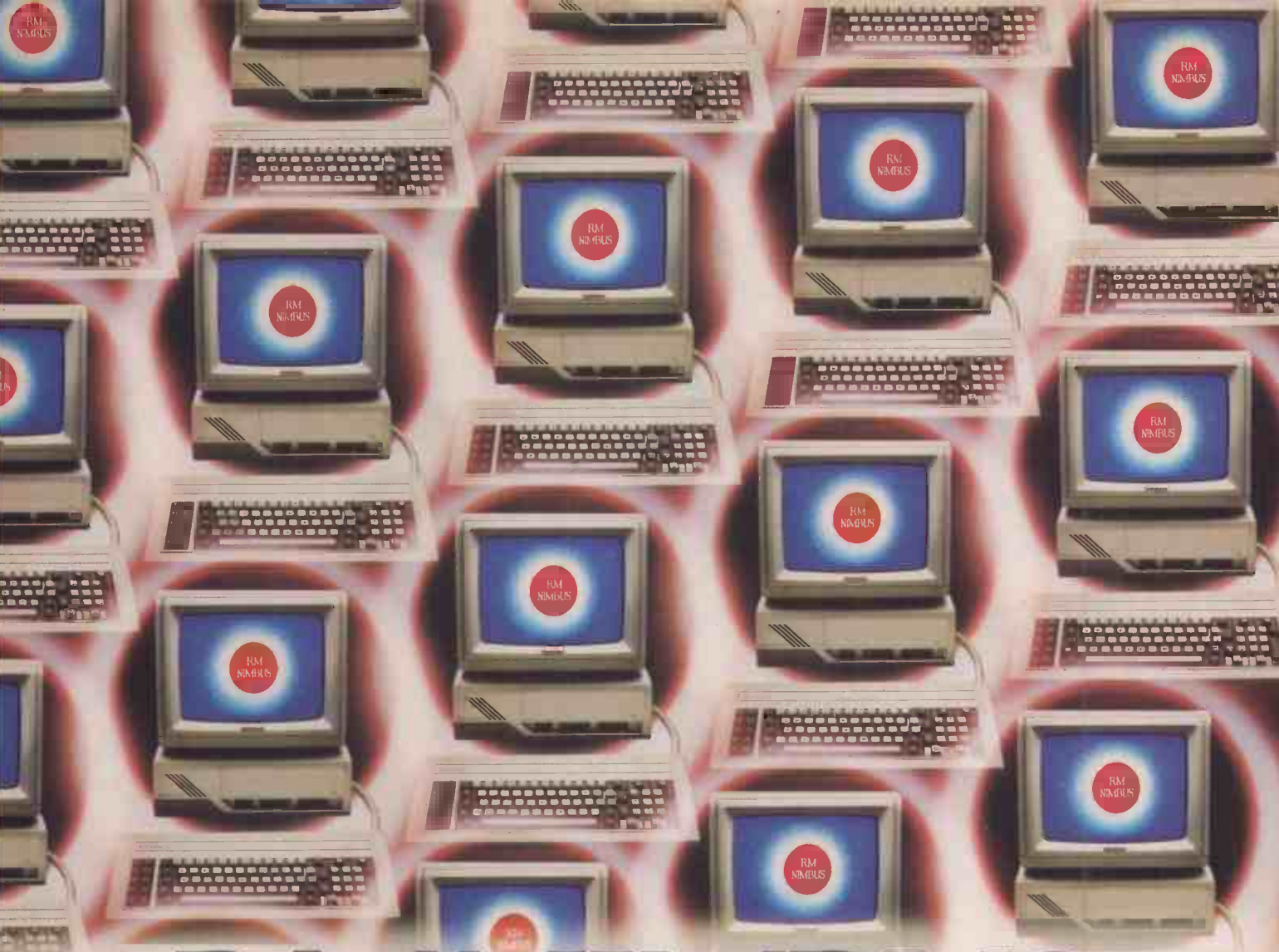

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*Microsoft Networks and MS-DOS are trade marks of Microsoft Corporation.
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To: Caroline Rawle, Research Machines Limited, Mill Street, Oxford OX2 0BW.

Please send me details of RM Nimbus network ☐

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RESEARCH MACHINES MICROCOMPUTER SYSTEMS PC 8

NEXT MONTH

SPECIAL SECTION

GRAPHICS

Business graphics is a fast-growing field, to judge by the number of packages that incorporate or add graphics features. But how useful, and how cost-effective, are they? We look at the market, from simple pie charts to special presentation programs.

HARDWARE

ZENITH

Five new machines are due from Zenith, including a trendy transportable — a new implementation of the Morrow Pivot — an improved IBM PC compatible 150, and an AT-alike. We hope to preview the most interesting of the bunch, the Z-200, to see whether Zenith can follow up its achievements in the U.S. market with success in the U.K.

SOFTWARE

ALL THAT JAZZ

Lotus has finally delivered Jazz, its much-hyped do-everything business package for the Apple Macintosh. Was it worth the wait, or are programs of this size just dinosaurs on the Mac?

TOP 10 SURVEY

TRANSPORTABLES

IBM has just slashed £500 off the Portable PC to compete with the rival Compaq and Olivetti M-21 transportables, while Osborne and Kaypro are also making an impact with both CP/M and IBM-compatible machines. We check out the offerings in this exciting market.

Don't miss the September issue of

PRACTICAL COMPUTING

On sale at W H Smith and all good newsagents after August 14.

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

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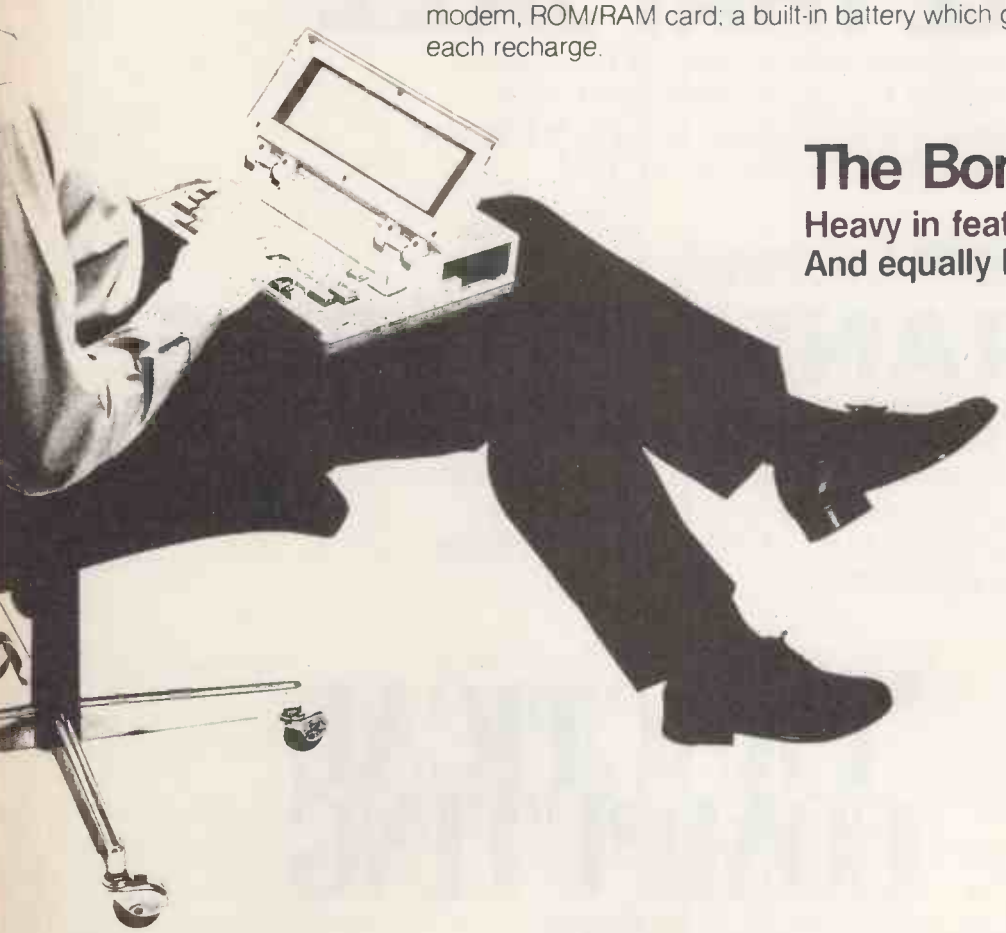

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CBM'S Z-8000 AND AMIGA ANNOUNCED

COMMODORE has announced some details of its unusual Zilog Z-8000 based machine, the Commodore 900. When it becomes available in the autumn, it will have 512K RAM as standard, upgradeable to 2Mbyte, and a 1.1Mbyte floppy; a second floppy will be optional. Ports include four RS-232s and a Centronics. The operating system will be Coherent, which is apparently a close relative of Unix. It has been acquired by Commodore from an outside firm.

There will be two main versions; the single-user as described, and the multi-user which has a 20Mbyte, 40Mbyte or 67Mbyte Winchester. Up to eight users can be supported. A notable feature will be its extremely high-resolution graphics: 1,024 by 800 pixels and 16 colours. This suggests the machine will be targeted at CAD/CAM, scientific and business-graphics applications.

The first rumours about the Amiga, Commodore's answer to Atari's ST, suggest that it too will have high-resolution colour graphics of the sme order as the 900. Indications are that it will have a 68000 CPU and a 3.5in. floppy. The U.S. launch is scheduled for the middle of July; it is unlikely to appear over here before next year. There have been conflicting reports on the pricing, but it seems likely to be over £1,500.

Meanwhile, a novel scheme has been announced to boost sales of Commodore's old stalwart, the 64. Every Commodore 64 pack, which costs £199, will entitle the purchaser to three nights' free accommodation for two people at one of over 300 hotels. These range from four star to guest houses, and are located in France and Belgium as well as the U.K. At the time of purchase you are provided with vouchers and a list of hotels. It will be interesting to see how the opposition responds.

Details on all Commodore products from local dealers.

Macenhancer

MICROSOFT has launched a hardware expansion device that allows Mac applications to use a wide range of IBM-compatible printers. The Macenhancer provides four additional ports, giving access to a total of five different peripheral devices such as printers, modems and general RS-232 equipment. In particular, it allows the Epson range of printers to be used.

Software is also provided that enables the Mac to emulate VT-52 and VT-100 terminals, allowing it to be hooked up to mainframes. The Macenhancer is accessed through the Mac's menus; active devices can be changed without dismantling equipment or exiting from an application.

The price is £250 plus VAT. More details on (07535) 59951.

NEC APC III

THE JAPANESE electronics giant NEC has launched what it believes to be a major new onslaught on European business-micro markets with its APC III. Rather unadventurously this is just an MS-DOS machine with 128K RAM, 640K floppies and a variety of hard-disc options. It does at least use the faster 8086-2.

There are RS-232 and Centronics ports and four expansion slots. A colour board is available. The high-resolution mode offers 640 by 400 pixels in up to eight colours, or in monochrome if you prefer.

More interesting is the bundled software, rejoicing in the name of the NEC Foundation Package. This has been commissioned and written in the U.K., and as well as the standard generic packages like word processing, spreadsheets and electronic mail, it also offers a Gem-like front end called, appropriately enough, Front End. A mouse is available.

The dual-floppy model costs £1,735 plus VAT, monitor included; the top-of-the-range colour version with a 10Mbyte Winchester costs £3,058. For more details telephone 01-267 7000.

The APC III: the Japanese threat?

More Midases

SIRTON has added two new systems to its Midas range of micros. The Midas 286 has, unsurprisingly, an 80286 at its heart. Like the Jarogate Sprite, it uses Concurrent CP/M with PC-DOS emulation. Other operating systems include Xenix and CP/M Plus. It is claimed that up to 18 users can run off the one processor. The one-chip version of Ethernet also comes as standard.

Options include an IBM PC compatible graphics board, and an eight-port I/O board. Prices for the Midas 286 start around £6,000.

The similarly priced Midas 68/XE is based on the 68000 processor. It runs Xenix, Unix, Idris and a CP/M emulating operating system. Unlike the Midas 286, which is aimed at business users, the 68/XE is geared more to the scientific community.

Details on both systems can be obtained on 01-640 6931.

(More news on next page)

HARDWARE SHORTS

- The Magnum portable from down under is to be distributed in this country by PM Professional Micros. Telephone: (0954) 81991.
- In the U.S. Amstrad is launching the CPC-6128, a 128K version of the CPC-664. Price is in the range $600 to $700; and all sales will be through the U.S. distributor Indescomp. A U.K. launch is unlikely this year.
- The Q+4 from CST is a multi-way expansion module. the price is £150. More on (0223) 323302.
- A miniature line driver from Picotech allows RS-232 equipment to be connected over distances of several kilometres. Prices are from £59. Details on 01-502 0728.
- An Amstrad light-pen is available from Dk'tronics for £24.95 including VAT. More information on (0799) 26350.
- U-Microcomputers has launched hard-disc versions of its U-Man series 1000 micros with 10Mbyte, 21Mbyte or 42Mbyte Winchesters. Prices start at £3,800. More on (0925) 54117.
- Husky Hunters can now be charged from vehicle batteries. The necessary power unit costs £95. More information on (0203) 668181.

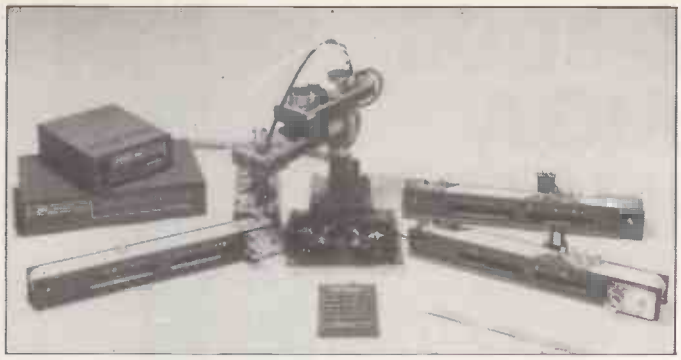
Honeywell HCX-0940

THE unmemorably named HCX-0940 from Honeywell is a 40Mbyte 8086 machine running under Concurrent DOS. It sits at the top of Honeywell's business-micro range.

Prices in this series begin at a rather steep £3,245 plus VAT for a twin 640K floppy version, and the latest addition is £6,900. Subsequent releases are likely to include Gem software. Details on (0442) 212781.

Gold Octopus

LSI COMPUTERS of Woking has launched a top-end model to its Octopus range. The Octopus Gold comes with 768K RAM as standard, as well as the dual processors of the earlier machine. Winchester drives of 10Mbyte, 20Mbyte or 40Mbyte are available. The entry-level Gold system starts at £5,300 plus VAT. New expansion boards include an IBM PC emulator boards for £220. Details on (04862) 23411.



Ivax the Scara robot

IVAX is a selective compliance assembly robot arm — Scara for short — from Powertran Cybernetics. It is designed for educational and training purposes. In industry, Scara precision-assembly robots are becoming the norm. Ivax aims to teach the principles behind the work cells approach, with its attendant high speed and accuracy.

The basic robot arm costs £980; the Z-80 based controller costs £801.50 and the power supply unit £136.50. Alternatively, it is possible to use a BBC Micro or Apple for control purposes. More information on (0264) 64455.

BBC B + Z-80 = ?

USERS who have connected up an Acorn Z-80 second processor unit to their shiny new BBC B+ may have experienced difficulties with CP/M software. This is due to a minor incompatibility between the 1770 DFS and the CP/M BIOS. If it is any comfort, Acorn has two solutions to the problem.

The first is a revised Disc 1 which forms part of the bundled Z-80 software; the other is a modified DFS EPROM which is currently being developed. Availability and upgrade policies will be announced shortly.

Megabyte Apple card

RAMWORKS is a memory expansion card for the Apple IIe which allows a desk top of up to 736K to be set up within the Appleworks program. It includes an 80-column display facility, and larger sizes of Ramworks will also simultaneously act as RAM discs for Appleworks. Prices range from £299 plus VAT for the 128K Ramworks card, giving a desk top of 101K, to £1,199 for the 1Mbyte card, which allows a 736K desk top. More information from Bidmuthin Technologies on 01-628 0898.

BBC's Good Companion

THE GOOD COMPANION for the BBC Micro from Bevan Technology adds a 100K 3.5in. floppy and the ability to link up to a videotape or videodisc machine. There are also extensive digital-to-analogue facilities which allow motorised units to be controlled via a Logo-like language. The cost is £347 plus VAT, and more information can be obtained on (0902) 23546. PC

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IBM SLASHES PRICES

IBM has improved the attractiveness of its Portable Personal Computer, the PPC, by slashing £470 off the price. A single-disc PPC with built-in screen now costs only £1,419 plus VAT. The market for IBM-compatible transportables is very competitive, with rival models from Compaq, Olivetti and Kaypro putting IBM under pressure.

Several other IBM products have had hundreds of pounds knocked off their prices. The 10Mbyte expansion unit for a PC is down from £1,954 to £1,275, and the one for the XT down from £1,582 to £1,071.

A new product is the fixed disc adaptor, which enables a PC to be upgraded by adding a hard disc. It costs £298. The 10Mbyte hard discs themselves now cost £782.

The prices quoted are for IBM's own retail outlets and exclude VAT. Local dealers may offer different prices.

Flight Simulator 2

THOSE unfortunate enough to have bought an IBM PC/AT or compatible will have discovered the major drawback — it doesn't run the Microsoft Flight Simulator. Microsoft has now launched version 2, which runs on the AT and also the PCjr.

The only major difference is that the RPM readout has been changed from dial to digital, though the single manual now seems more accessible. Flight is the same, so if you've learned how to land you won't need to go back to flying school.

Olivetti

OLITALK is a new communications program for the M-21 and M-24 IBM-compatible computers. It allows them to emulate almost any asynchronous terminal, with DEC VT-100, IBM 3101 and TTY included as standard. It costs £99.

The M-21 transportable is now available with a built-in self-locking 10Mbyte hard disc for £2,995 — which is claimed to be substantially below the price of competing products. The M-21 has an 8MHz Intel 8086 and can be configured with 640K of RAM.

Contact British Olivetti Ltd, PO Box 89, 86/88 Upper Richmond Road, London SW15 2UR. Telephone: 01-785 6666.

Plus 5 has launched versions of its hard-disc range in a case to match the Olivetti M-24. Capacities range from 5Mbyte to 110Mbyte, and prices from £1,195 to £6,350.

Contact Plus 5, Crowborough Hill, Crowborough, East Sussex TN6 2EG. Telephone: (08926) 63211.

Three-speed PC printer

IBM LOOKS SET to make an impact in the dot-matrix printer market with the Proprinter, which offers several facilities that make it particularly attractive to users.

The Proprinter offers three operating speeds: 40cps for correspondence-quality work, 100cps for memos and reports, and 200cps for drafts and high-volume work. The printer also has a neat dual paper-handling facility, which means it has a slot through which you can slide single sheets of paper and envelopes for printing, without having to remove the normal continuous fan-fold paper.

The Proprinter has a buffer built in, and it can also print graphics. It is being made by IBM in Amsterdam. Priced at a fairly competitive £499 plus VAT, it may even pick up sales from users of non-IBM equipment too.

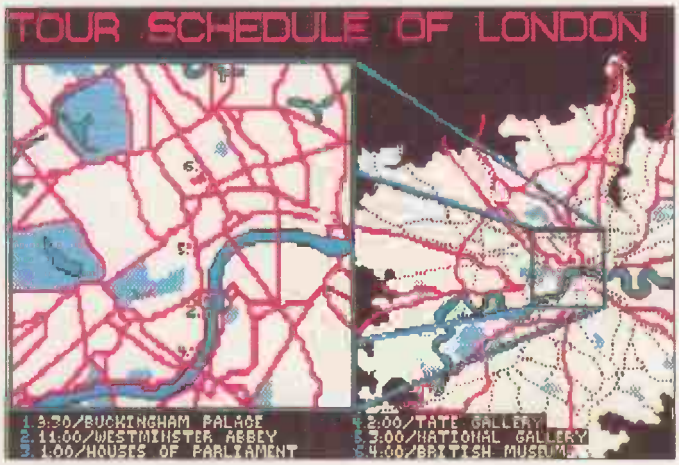
Micro Five's AT-alike

MICRO FIVE of California has launched a low-priced Series 5000 IBM PC/AT compatible micro with a specification very similar to the Compaq Deskpro 286 reviewed on page 47 of this issue.

The main features are an Intel 80286 chip which can be run at 6MHz or 8MHz, and a built-in hard disc with tape streamer backup. Micro Five offers a range of hard discs from 27Mbyte to 116Mbyte. The tape-streamer capacity is 60Mbyte, compared to the Compaq's 10Mbyte.

Micro Five's name is not well known because it operates as a supplier to OEMs and value-added resellers (VARs) who put their own names on the machines before selling on to end-users.

Contact Micro Five in Costa Mesa, California on (U.S. area code 714) 957-1517.



PC graphics

THE Personal Presentation System, PPS, is a British graphics package offering icons and symbols which can be recalled from memory. Frames can be grabbed from other packages such as Lotus 1-2-3. Now a series of library discs is being introduced to extend the range of symbols and icons available, including maps and flags.

Contact The London Software Studio on 01-935 3033.

VCN Execuvision currently offers the largest library of graphics images for the IBM PC. New subjects include maps (illustrated above), energy and utilities, and The Sports Collection.

Contact Visual Communications Network Inc., Greyhound House, 23-24 George Street, Richmond, Surrey TW9 1JY. Telephone: 01-948 8601.

File transfer

M-MASTER is a disc-to-disc file-transfer utility that allows a PC to read, write and format discs in over 70 different CP/M and MS-DOS formats. This enables files to be transferred from other machines without modems and cables.

M-Master runs in 128K RAM and a PC or compatible with two disc drives. The price is £65, including VAT and postage.

Contact C+G Consultant Services, PO Box 100-A, Surbiton, Surrey KT5 8HY. Telephone: 01-399 8530.

PC2PC

NCR has launched a local area network called PC2PC. It connects up to 64 PCs together for £449 per connection. The net is a version of the Corvus Omninet, and one PC must be designated as file server.

The NCR package comprises interface boards, software, tap box, cable, and everything else you need, right down to wirestrippers. It is claimed a network can be installed in less than two hours.

Contact NCR Ltd, 206 Marylebone Road, London NW1 6LY. Telephone: 01-725 8337.

IBM SHORTS

- Prospero's Pro Pascal compiler has now been validated Class A for the IBM PC and compatibles. Phone: 01-741 8531.
- Cipher's 5210 25Mbyte quarter-inch floppy tape backup plugs straight into an XT and costs only £995 plus VAT. Phone: (0276) 682912.
- Quantec Executive Desktop, QED+, is now available in a multi-user version. Phone: 01-228 7507.
- Practicorp has launched an IBM version of Practibase. It is claimed to read and convert dBase II files and run dBase II programs. It costs only £99.95, including VAT. Phone: (0473) 462721.
- Bonnie Blue is a £99.95 plus VAT word-processing program from Paperlogic. It offers advanced facilities, including mail merge, macros and multiple windows. Phone: 01-935 0480.
- Golden Common Lisp for the IBM PC supports more than 400 primitives and is described as an ideal Lisp-learning/AI tool for novices. It costs £545 plus VAT. Phone: (0923) 47707. PC

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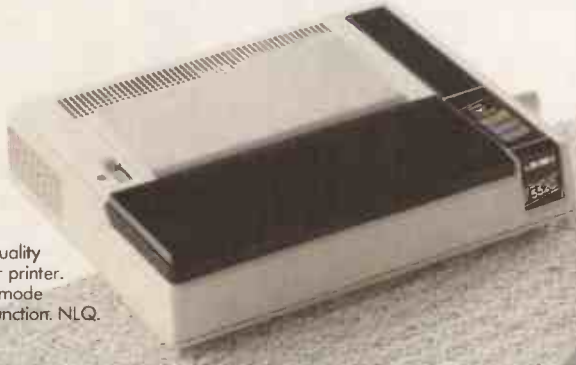
*IBM is a trade-mark of IBM Corporation.

JUKI 6100: one of the best-selling letter quality daisywheel printers in the UK. Graphic mode and full word processing support.

JUKI 2200: fully portable daisywheel printer with 2k buffer memory and full word processing support. Ideal for use at home.

JUKI 6300: high speed (40 cps) daisywheel printer with 3k buffer memory and full word processing support.

JUKI 6000: letter quality daisywheel printer designed specifically for home use.



JUKI 5520: low-cost, high quality dot matrix personal computer printer. High speed (180cps), graphic mode and optional 4-colour print function. NLQ.

JUKI 6100-I: brand-new, IBM*-compatible version of the best-selling 6100. Graphic mode and full word processing support.

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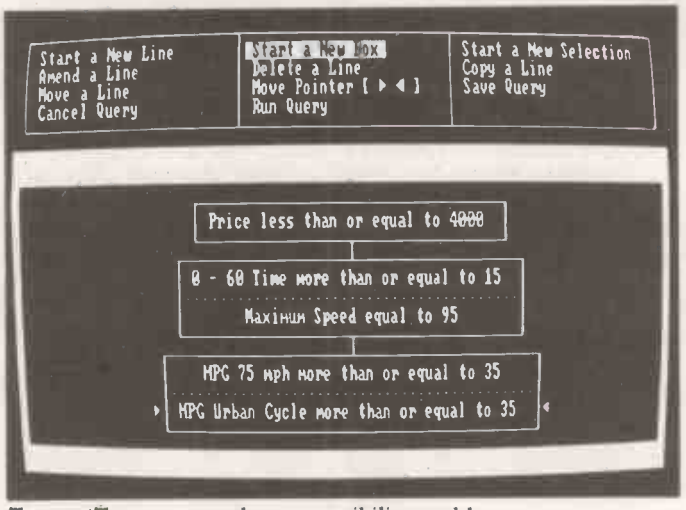
DATA INTEGRATOR

TWENTY/TWENTY is designed to retrieve data from incompatible programs like Multiplan, Lotus and dBase II. You can then query the data on-screen or construct printed reports with it.

Available for the IBM PC, with an Apricot version on the way, Twenty-Twenty addresses the problem that much business information is locked up in completely incompatible files. Much of its value is therefore lost, as it is not at all easy to spot how different pieces of information relate together.

Twenty-Twenty consists of a file integrator, a report generator and a menu-driven query system, and it also has facilities for setting up regular jobs as simple-to-run tasks. It can read data from a long list of well-known programs, including Delta, Framework, VisiCalc and Supercalc, as well as files in the common DIF and Sylk interchange formats. It does not allow you to alter the data stored with any source program.



Twenty/Twenty can solve compatibility problems.

Twenty-Twenty costs £345 plus VAT and was developed by Interactive Software Products Ltd in St. Albans. It should not be confused with the similarly named 20/20 from Access Technology Inc. in the U.S. which is a very powerful spreadsheet program also running on the IBM PC. More details on Twenty/Twenty from ISPL, 1-4 Lloyds Bank Chambers, The Maltings, St. Albans, Hertfordshire. Telephone: (0727) 36341.

SOFTWARE SHORTS

● Spellcheck II is an updated version of Beebugsoft's spelling checker for the BBC computer. Supplied on ROM it comes with a 6,000-word dictionary and works with both Wordwise and View. Price is £31 including VAT. Contact Beebugsoft on (0727) 60263.

● Tasman has released a disc-based version of its excellent Tasword word-processing program for the Amstrad. Called Tasword 464D, the new program costs £24.95 including VAT and runs on the 664 as well as the 464 Amstrad machine. Contact Tasman Software on (0532) 438301.

● Statcalc runs on both the IBM PC and Apple II and provides a set of powerful tools for statistical analysis, including regression. The Apple version costs £85 while the program is £150 on the IBM PC. Contact Dr Alan Lee, Department of Maths and Statistics, University of Auckland, Private Bag, Auckland, New Zealand.

Easy database

CLASMA RECALL is a record-handling and mailing package aimed at the first-time business user. It lets you design your own record layouts, and incorporates a diary which you can link to your database. The program runs on the Apricot and IBM PC and costs £395. Details from Clasma Systems Ltd, 10 Barley Mow Passage, London W4 4PH. Telephone: 01-994 4394.

Sage redesigns range

SAGESOFT has redesigned its entire range of accounting software for 16-bit machines. The new range starts with Bookkeeper, £295, a package aimed primarily at the cash trader operating under the Retailers Special VAT Scheme.

Next up is Sage Accountant, £495, which is the replacement for the existing top-selling Sage Accounts program. Sage Accountant Plus, £695, is the same program but with the addition of automatic invoicing and stock control.

Top of the range is Financial Controller, £995, designed for companies with up to 10,000 accounts and requiring a hard disc. The programs run on most MS-DOS machines including Apricot, Sanyo and IBM PC, the first three are available now, while Financial Controller is due towards the end of the year.

Contact Sagesoft plc, NEI House, Regent Centre, Gosforth, Newcastle-upon-Tyne NE3 3DS. Telephone: 091-284 7077.

Mac colour plots

MACPLOT enables you to get high-quality plotted output, in colour, from plotters connected to the Macintosh. Version 1.5 costs £99 and works with 15 different types of plotter. You transfer pictures to be plotted from programs such as Macdraw, Mac Chart or Jazz via the Mac's clipboard. More details from Microspot, 9 High Street, Lenham, Maidstone, Kent ME17 2QD. Telephone: (0622) 858753.

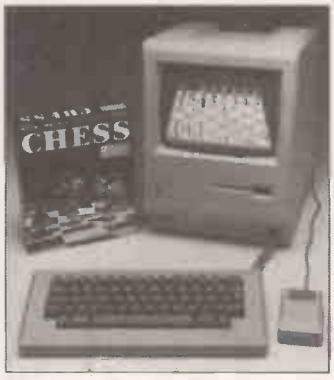
Macintosh roundup

Animation Toolkit lets you create continuous moving pictures on the Macintosh. The program costs £48.20 plus VAT and will run on the single-drive 128K Mac. Contact P&P Micro Distributors Ltd, New Hall Hey Road, Rossendale, Lancashire BB4 6JG. Telephone: (0706) 217744.

Maclion is a very powerful database package designed for creating complete business applications. It can handle multiple files and produce customised reports, and it helps you transfer data to it from other Mac applications. Maclion requires at least 128K and two disc drives, and costs £379 plus VAT from P&P.

Mactype is a typing tutor which will teach you either the conventional QWERTY keyboard or the alternative Dvorak layout. Proponents claim that the Dvorak layout encourages faster typing, and the Mac's completely soft keyboard can be redefined to work Dvorak-style with most applications. Mactype costs £49 plus VAT from P&P.

Maclink and Mactransfer are two communications programs for the Mac. Maclink lets you move IBM PC files to the Mac, and consists of a set of converter programs to translate between specific packages such as Lotus and Multiplan and WordStar and Macwrite. Mactransfer is a similar program for the Apple II; it lets you move most Apple word-processing files, DIF format files and also Applesoft source code across to the Mac. Maclink costs £119 plus VAT, Mactransfer £45 plus VAT. Cabling is extra. Contact P&P.



Psion 3D chess

PSION CHESS for the Mac offers you a choice of 2D or 3D display and has 28 levels of play. Price is £49.95 including VAT. Contact Psion Ltd on 01-723 9408.

Free software

THE Free Software Handbook describes 70 of the best American public-domain programs for Z-80 based CP/M systems. The book costs £17.95. For another £10 you can get the programs too, though you have to send your own discs in — enough to take 1.2Mbyte. Most formats are supported, including Apple and BBC CP/M.

Contact Davis Rubin Associates Ltd, 1 Canonbourne, Weston sub Edge, Chipping Campden, Gloucestershire GL55 6QH. Telephone: (0386) 841181. PC

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Cheques payable to: West One Galaxy Business Systems Ltd.

£100K COMPETITION

THE British Technology Group has announced its 1985 Academic Enterprise Competition with total prize money of £100,000. There are two classes of entry: the first is for academic researchers who have set up, or intend to set up, a new business as a means of commercialising their results. The other is for all other methods of transferring technology from academic institutions to industry. The closing date for entries is 30 August 1985.

The competition is open to members of staff of U.K. universities and polytechnics, and postgraduate students or post-doctoral workers. It is also eligible to anyone who has left any of these since 1 January 1980. Entries must relate to commercial exploitation of work carried out in such institutions, and is designed to encourage such transfers. Hardware and software products are eligible. First prizes in each class are £25,000, with £10,000 and £5,000 for runners-up.

Details from 01-403 6666.

On-line GAS

A WORLDWIDE consultancy and information publishing service is being launched purely as an on-line service on Telecom Gold. Global Analysis Systems (GAS) offers a three-tier service providing economic consequences of political and strategic events in 100 countries throughout the world. Systematic analysis of significant daily events is provided at 12.45p.m. every day, drawing on consultants in London, Paris, Bonn and New York.

Such services do not come cheap: the world is divided up into four regions, and the annual fee for information on each varies from £2,000 to £3,000. The daily analysis service costs £3,000. As a small consolation prize you are given a Telecom Gold mailbox free. Details on 01-606 7060.

Second-hand micros

COMPUTERLINES is a new Prestel service from Interlex which allows used micros to be bought and sold. Starting on Prestel page 36,019, there are pages devoted to machines available or wanted. Anyone can access them. The cost for one of these pages is £10 per fortnight. There is also a charge of £15 for setting up the page. This is carried out by Interlex, which also advises on suitable asking prices. It is also possible to access a list of used micros for sale via electronic mail. More details on 01-943 4366.

A more conventional alternative for selling your old and unwanted micro is provided by a new section in *Exchange & Mart*. Called Micro Mart, it covers sales of hardware, software, peripherals, books and magazines. This is in addition to a computer category within the business section. More information on both services from (0202) 670011.

Golden oldies

THE FRENCH firm Eureka has bought Oric from its receivers, including all stocks and parts and the right to the company name and its trade names. Eureka Informatique is a Paris-based distributor of Sinclair, Amstrad and Enterprise micros. It also manufactures monitors. Although warranties have expired following receivership, existing owners will be able to apply for assistance to the French company. More from Eureka Informatique, 39 Rue Victor Masse, 75009 Paris. Telephone: Paris (010 331) 281 2002.

On the other hand, the Superbrain is now officially dead. The last batch has been bought by Professional Micros from Intertec in the U.S. Professional Micros will continue to support existing users for up to five years. Details on (0954) 81991.

Micro maintenance

GRANADA has launched a national micro maintenance service under the name of Microcare. Designed for companies who require 24 hours a day, seven days a week technical support with hotline facilities for emergencies, the service is costed on an individual basis.

There is a network of service centres around the country and a team of mobile technicians. More information can be obtained from (0296) 84321.

Microsoft education discounts

MICROSOFT has joined the battle for the minds of the U.K.'s youth with a 30 percent educational discount on a range of products. The categories of end-user that will qualify for discounts include primary and secondary schools, further education institutions, polytechnics and universities. Details on the range of hardware, software and books covered by the scheme can be obtained on (07535) 59951.

Booming BMMG

THE CREDIBILITY of the British Microcomputer Manufacturers' Group's claim to be the voice of the British micro industry has been strengthened by the recent addition of ICL, Sinclair Research, Future Technology Systems and HM Systems to the group. This brings the membership to about 50 percent of all British micro manufacturers. The most glaring omission is ACT. Details on the BMMG from (0763) 71209.

Typesetting from micros

THREE new services offer micro users the possibility of converting computer files into typeset documents. Type Club offers a do-it-yourself mail order service: it claims that no special software is required. Micros for which the service is available include the IBM PC, Apple and many others. Details from PO Box 186, Poole, Dorset BH13 6DL.

Typeshare provides a photo-typsetting service from financial documents. More on 01-485 9515.

The service offered by Textech allows you to send text files produced on IBM, Apricot and Apple computers to a typesetting machine. This can be done by telephone, by floppy disc or by a portable capture device. More information on (0580) 880421.

Applecard

NOT ANOTHER expansion board for the IIe, but a credit card which is claimed to have one of the highest instant credit limits. Up to £2,500 can be obtained on the spot after fulfilling "certain criteria", allowing you to walk away with a Macintosh if you so desire. Details on (0442) 60244.

NCC directories on disc

THE NATIONAL COMPUTING CENTRE is issuing its present paper-based directories of hardware, software and training courses, on discs. Each directory comes in the form of a pair of floppy discs, with menu-driven file-searching programs. Updates are similarly issued on disc.

Formats available include the IBM PC, Apricot and ICL PC. The cost is £75 for single copies, and £450 for annual subscriptions comprising 10 copies. More on 01-353 0011. PC

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Z80 CP/M Card for II+	£ 39.95
Z80 PLUS Card with Manual for II+	£ 49.95
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(Note: All INTEC drives are UK built and backed – Prices include controller card, cables, power supply, utility and diagnostic software for DOS, PASCAL & CP/M, together with 24 month service warranty.)

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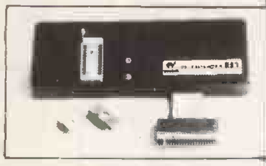

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```
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         RAM START ADDR —4000
         EPROM ST. ADDR — 0000
         JOB LENGTH     — 4000
         TASK           — CHECK

WHICH TASK DO YOU WISH TO DO
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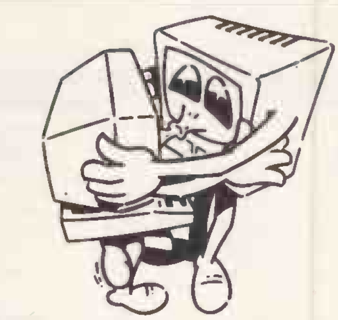

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• Circle No. 155

BY RAY COLES

MEMORY REFRESH

Developments in RAM, ROM and related devices are just as significant as new microprocessor technology.

During the past few months I have devoted rather too much space to interesting new microprocessors and their complex peripheral circuits, with the result that memory components have unfortunately been rather neglected.

This has not been due to a deliberate policy of victimisation on my part. Each month, when limbering up in preparation for setting pen to paper, I sort through a four-week hotchpotch of press releases, data sheets and news items. There are usually a number of glamour items which catch my eye, and I choose the one which appears to have sufficient depth and interest for me to then concoct a distilled brew for this column.

Every month there are numerous items which by themselves are not adequate column fodder, even though they may be interesting in a somewhat limited way. Now the pangs of guilt presumably experienced by all wielders of the censor's blue pencil have got to me, and as a penance I offer this month a bumper compendium of some of the smaller items which were passed over.

MEMORY DEVICES

The theme — for there has to be one — is memory devices, because in recent months there have been quite a number of interesting developments. Memories last got star treatment when I covered the status of 256K dynamic RAMs. At that juncture I predicted, I believe, that before too long the price per bit would drop below that of the 64K devices. That happy event has now occurred, and as a result very few designers will be bothering with 64K RAM chips any more, despite the fact that for some considerable period many more 64K chips than 256K chips will be sold for existing designs.

Surprisingly, some second-generation 256K chips with improved features are now becoming available. One such chip is the Intel 51C256H, which offers ripple mode fast addressing of a random or sequential selection of up to 512 bits within a row to give cycle times of less than 65 nanoseconds. It is fabricated using an advanced low-power CMOS process.

For some designers however, even 256Kbits per package are insufficient, and as a result memory suppliers have developed some interesting ways of producing tomorrow's memory size today, although unfortunately at a premium price. Electronic Designs Europe, for example, is selling 1Mbit dynamic RAM devices which are actually assembled from four conventional 256K chips in leadless packages mounted on a 22-pin single in-line ceramic substrate along with appropriate decoupling capacitors. Two organisations are available, 256K by 4 and 1M by 1, which cater for most types of memory architecture.

SQUEEZED CHIPS

Another way to get a bigger device is to use one of the Micron Technology Inc. DRAM arrays which actually utilise older, but safer, unpackaged 64K chips squeezed into a single 1in. square 68-contact flat leadless chip carrier package. The MT-8064 is organised as 64K by 8, the MT-1512 as 512K by 1, and the MT-9064 as 64K by 9. In each case 10 64K chips are used to provide a redundancy factor. The 64K chips are squeezed together so tightly that it seems a shame that they all had to be sawn from their parent wafer in the first place. Perhaps this demonstrates that eventually the logic of wafer-scale integration will become inescapable.

All the devices mentioned so far are, of course, dynamic in operation. This means that they have to be refreshed continuously, or else they lose their data. The advantage of dynamic RAMs is that they provide the highest memory density of all, so the penalty of having to provide special refresh circuitry is usually acceptable.

But not always: the Hitachi HM-65256AP is a dynamic RAM device with on-chip refresh logic, making it a so-called pseudo-static memory array organised as 32K by 8. For some small systems a single 28-pin HM-65256AP package is all the RAM needed, and there is therefore an important niche for these designs. Better still would be a truly static 256K chip, and Mitsubishi has just announced that it will have a CMOS device available soon with this specification.

Not all new RAM devices are aimed at main-memory applications however. The CY-7C401/2/3/4 series from Cypress Semiconductor are designed to act as buffers between processors and peripheral functions operating at different speeds, and are therefore organised as CMOS first-in-first-out (FIFO) memories with completely asynchronous read and write logic. The very high speed requirements and the need for on-chip address logic means that memories of this type are small, typically organised as 64 by 4 bits.

Giant strides have also been made in the other variety of main memory, namely read-only memory or ROM. Of course, ROM has generally been used to hold fixed system software such as a disc operating system and a Basic interpreter, but today it is also being increasingly used to hold applications packages such as spreadsheet, word processor and database programs.

The current state of the art seems to be about 1Mbit of masked program ROM in a 28-pin dual in-line package, fabricated in either NMOS or CMOS technology. The MSM-531000P NMOS device from Mitsubishi, organised as 128K by 8, is typical. It offers an access time of 250 nanoseconds and is ideal for the mass production of identical software — more correctly called firmware — for applications in personal computers and the like. It is not well suited for much else, however, because it is necessary to order many thousands of these devices all containing the same code.

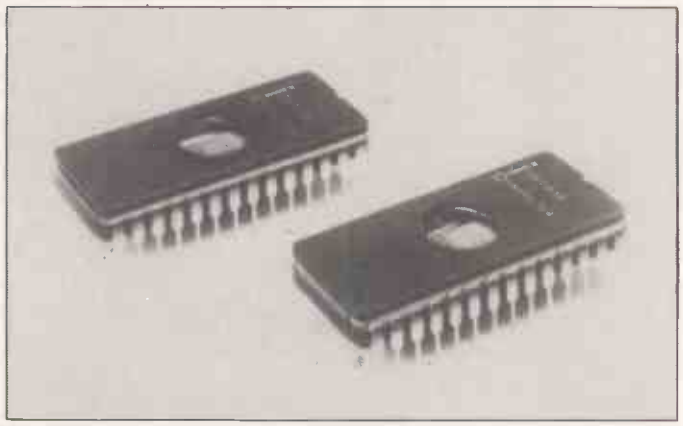
ULTRAVIOLET LIGHT

During development or field trials it is often necessary to revise ROM-based code. This is an impossibility with masked devices, so for this stage of design erasable, programmable read-only memories or EPROMs are used. In the EPROM field, developments have been spectacular in recent months, and examples of the latest state of the art are the Intel 27512 and 27513 64K by 8 devices. They are both fabricated using an advanced NMOS process, and are erasable using short-wave ultraviolet light.

The 27513 is particularly interesting because it is organised as four 16K by 8 pages, only one of which occupies space in the microprocessor memory map at any one time. If the system software can be organised to suit, the 27513 can quadruple available code space because the pages are not selected by direct addressing, but are instead selected by the generation of a special page address sequence on the control and data buses. It is ideal for memory-limited eight-bit systems.

Also from Intel, the world leader in EPROM technology, comes the 27916 KEPROM — an unfamiliar acronym which stands for keyed-access EPROM. This 16K by 8 device is designed to discourage hackers. It foils all attempts to obtain improper access by requiring the use of an encrypted authentication handshake sequence before the stored data can be read or used as executable code. All KEPROMS contain encryption circuitry to implement a proprietary logic combination of a random number together with a confidential user-defined 64-bit key, which is programmed into a special location on the chip.

In the future there will no doubt be many more developments. Already I have seen press releases detailing soon-to-be-available 1Mbit DRAMS; they are Japanese, of course. And perhaps before long we shall even see the incredible Sinclair/Catt wafer-scale mass-storage devices. Stranger things have happened.



The Intel 27916 KEPROM: hacker-proof code at last?

BY MIKE LEWIS

THE BASIC RULES OF STYLE

There is nothing wrong with programming in Basic, as long as you observe some simple ground rules.

Basic might be the world's best-known programming language but it has an awfully bad public image. How many times have we heard it described as unstructured and spaghetti-like, with some critics even claiming that Basic has the same effect on your thinking ability as poorly fitted spectacles have on your eyesight.

True, Basic has many faults, but to call it unstructured is surely to blame the tool for the shortcomings of the product. It is in the finished programs where you must look for structure; the language is merely a means to that end. To criticise Basic for the mess that some programmers make of their coding is like blaming English for the trashy novels that some writers churn out. In fact, Basic programs can be as well-structured as any, provided you are prepared to follow a few simple rules.

By far the most important of these is to avoid the Goto statement like the plague. This is easier than you might think. Assuming that you are using one of the many implementations of the ever-popular Microsoft Basic, you will always be able to get by with three control-flow constructs: If-Then-Else, For-Next and While-Wend.

Over the last few years, I must have written nearly a quarter of a million lines of Basic. If you looked through all these programs, you would find scarcely half a dozen Gotos in the lot. If you do not believe me, just remember that Pascal and C also support the Goto statement, yet how many users of these languages even know it is there, much less rely on it?

It is a different story, however, with the Goto's cousin, the Gosub. The essence of modular programming is to split large chunks of code into small pieces, so subroutines are pretty vital. The problem with Gosub is that it works with line numbers, and these have no logical connection with the job that the subroutine is doing. If your Basic supports alpha labels, be thankful and use them. Better still, take advantage of user-defined functions whenever possible.

Make each Gosub routine a distinct piece of code. Give it a name, if only in a Rem; surround it by blank lines to make it stand out, and be sure that it follows the elementary rules of modular programming. Each routine should have just one entry and exit point, a well-defined interface with the calling program, and no side effects elsewhere.

Incidentally, putting a blank line around subroutines is not always possible, because standard

```
1000 '  Program: COUNTER

        Counts the words in a text file.

        Written by M.Lewis, July 1985. Version 1.0.
1010 '
        The program displays the number of words in a specified file. The
        file is assumed to be ASCII, with lines delimited either by
        carriage-return/linefeed or just line-feed.
1020 '  For compatibility with WordStar, high-order bits are cleared and
        dot commands are ignored.
        A word is defined as a string of letters delimited by non-letters.
1030 '
        Variables used:
                INFILE$                 Input file name
                STARTLINE%              Start-of-line flag
                INWORD%                 Flag to say if current char is in a word
1035 '          FOUND%                  Flag to say new word has been found
                CHAR$                   The current character
1040 '  Constants used:
1050            DOT$="."                'Introduces a WordStar dot command
1060            LINEFEED$=CHR$(10)      'ASCII line-feed
1070            TRUE%=-1: FALSE%=NOT TRUE%
2000 '
        ------------------------
        Main path of program
2010
        GOSUB 4000                      'Initialisation; open files

2020    WHILE NOT EOF(1):
                GOSUB 5000              'Get next word

2030            WORDS%=WORDS%+          'Count it
2040    WEND

2050    GOSUB 6000                      'Display count and closedown
2060    END
4000 '
        ------------------------
        Initialisation routine.
                Gets file name from user and opens file; initialises flags.
4010
        LINE INPUT "Please enter file name ", INFILE$
4020    OPEN "I",1,INFILE$
4030    PRINT: PRINT "Counting in progress"
4040    STARTLINE%=TRUE%: INWORD%=FALSE%
4050    RETURN
5000 '
        ------------------------
        Get next word.
                Reads one char. at a time until complete word processed;
                takes care of high-order bits and dot commands
5010
        FOUND%=FALSE%:

        WHILE NOT FOUND% AND NOT EOF(1):
                CHAR$=INPUT$(1,#1)      'Get next character
5020            CHAR$=CHR$(ASC(CHAR$) AND &H7F)
                                        'Mask high-order bit
5030            IF STARTLINE% AND CHAR$=DOT$ THEN
                        WHILE CHAR$<>LINEFEED$ AND NOT EOF(1):
                                CHAR$=INPUT$(1,#1):
                        WEND            'Skip dot command
5040            IF CHAR$=LINEFEED$ THEN
                        STARTLINE%=TRUE%
                ELSE
                        STARTLINE%=FALSE%
5050            IF CHAR$("A" OR (CHAR$)"Z" AND CHAR$("a") OR CHAR$)"z" THEN
                        INWORD%=FALSE%
                ELSE
                        IF INWORD%=FALSE% THEN
                                INWORD%=TRUE%: FOUND%=TRUE%
5060    WEND
5070    RETURN

6000 '
        ------------------------
        Display results and close down
6010
        PRINT: PRINT "No. of words:", WORDS%
6020    CLOSE
6030    RETURN
```

Listing 1. A short Basic program, written according to the rules of style described in this article. The modular structure is emphasised by the broken lines separating the various subroutines.

Basic does not support such an obvious requirement. In Microsoft Basic, you can fake it by placing a Line feed character immediately after the line number. This generates a physical line break without ending the numbered program line. If your keyboard has no Line feed key, use Control-J — or Control-Enter on the IBM PC. Alternatively, press the Tab key until the cursor wraps to the next line.

In fact, when it comes to program style, the Tab and Line feed keys are pretty well indispensable. By style, I mean the way a program looks to a human reader rather than the computer. A well-styled program is one that is easy to understand, and therefore easy to debug and modify. Using indentations and physical line breaks to emphasise the program's structure is the first principle of good programming style.

This is most commonly done in the block statements like For-Next and While-Wend. Listing 1, a simple word-counting program, has several examples. If-Then-Else constructs are handled similarly, with the If-Then and the Else each given a physical line to itself. This arrangement can of course be nested, as line 5030 shows.

Personally, I like to go one further by placing a Tab immediately after the line number. Given that these numbers have nothing to do with the logic of the program, they ought to keep their distance from the actual code, and hitting the Tab key is the easiest way to bring this about. I also make liberal use of tabs for lining up comments. Another example of the use of this handy key is in Data statements.

Comments, of course, are *de rigeur*, even in the smallest programs. Just as a good book has an introduction, so every program should start with a comment block which prepares the reader for what is to follow. As a minimum, this should contain the program name, date written, version number, programmer's name, and a short description of the program's function.

Some programmers also like to list all the variables in the introductory comment, and even the names of files, arrays, user functions and the like. This might sound like a lot of typing, but it could save you, or someone else, a good deal of time when you need to alter the program in years to come.

The next rule is to choose variable names with great care. They should be readable as well as meaningful. A good test of a program's style is to see if you can understand it when it is read aloud, so avoid unpronounceable abbreviations. Virtually all mod-

(continued on next page)

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ern Basics offer more than the two-character variables of the original standard, so take advantage of them. Also, avoid using like-sounding names for different items: Total.Amount and Totl.Amnt, for example.

It is a good idea to make constants into variables. After all, a variable does not have to vary. Your program might test for a page break with a statement like

```
IF LINE.COUNT% = 66 THEN
    (new-page routine)
```

But it would be better to hold the magic value of 66 in a variable, and to do the test as

```
IF LINE.COUNT% =
    PAGE.LENGTH% THEN
    (new-page routine)
```

Apart from making the workings of the program that tiny bit clearer, this approach would help you out if you ever decided to switch to 72-line paper.

This rule should be followed even if the constant is truly constant. Rather than sprinkling 3.14159 around your program, set up a variable called Pi and use that instead. Nobody expects this particular value to fluctuate, but coding it this way will lower the risk of a hard-to-spot typing error.

Another good practice is to initialise variables and constants close to where they are used. If your program does all its printing in just one module, it would be better to set the line count to zero and the page length to 66 at the start of that routine, rather than at the very beginning of the program. This will help the reader to see what the initial values are, and also simplify the job of using the same module in another program.

Always type at least one space between each word in a statement. It's true that some interpreters allow keywords and variable names to run together, but the human eye is less tolerant. Many Basics also permit the same variable name to be used for different data types. Thus Count$ and Count% are completely different objects. But again this might be confusing to a human reader and is best avoided.

Using constants for flag settings is something you might like to consider. In listing 1, the values True% and False% are used in this way, these being much more obvious than their numeric values of −1 and 0.

As another example, suppose your program analyses a customer's payment record in order to set up a credit rating. You might have a field called Status% which contains, say, 1 for bad risk, 2 for unknown, 3 for OK, and so on. Instead of assigning and testing these numbers directly, try re storing them in fields called Bad.Risk%, Ok%, etc. You could then use constructions like

```
IF STATUS% = BAD.RISK% THEN
    (credit refusal routine)
```

which should be clear enough to anyone. A similar technique can be used for an index into an array, the effect being a bit like Pascal's user-declared scalars.

Incidentally, if all the variables in your program are integers, it is worth putting

```
DEFINT A-Z
```

at the head of the program to avoid the need for those irritating percent signs after every data name.

Flag settings, of course, do not have to be integers. Some programmers prefer to use character strings. So the credit status field in this example would be Status$, and it would hold actual words like "Unknown" and "Possible". This could give rise to

```
WHILE STATUS$ = "Unknown"
    (perform status check)
```

This will serve just as well even if the strings are not intended to be seen by the program's users.

One final tip: always use parentheses in complicated arithmetic and relational expressions, even where the interpreter does not itself require them. I never feel completely at home with the ranking of operators, and I work on the assumption that anyone reading my coding might be equally uncertain. Brackets are a good way of breaking a complicated expression into simpler units.

By now you might be wondering what effect all these Rems, long variable names, character strings, parentheses, etc., will have on your program's running time. Good style is indeed the enemy of program efficiency. If your Basic is interpreted rather than compiled, most of the principles set out here will result in bulkier source files and slower programs; eliminating the Goto, on the other hand, will tend to speed things up.

If you are developing a highly competitive mass-market package, this could be a problem. But nobody would use interpreted Basic for a product that is to rival Lotus 1-2-3. In most cases, the additional running time of a well-styled program will be tiny, especially when compared to the savings in your own debugging and maintenance time that these principles will help you to achieve. PC

ATARI ST

520ST

POWER WITHOUT THE PRICE

THE NEW ATARI 520ST

Under the new leadership of Jack Tramiel (former boss and founder of Commodore Business Machines), Atari Corporation have marked their entry into the world of business/personal computers with a machine which leaves the competition standing. Tramiel's slogan 'Power Without the Price' has been implemented in the manufacture of the new 512K Atari 520ST colour computer which offers the user amazingly high performance at an incredibly low price. Launched as a work-station, this new system incorporates seven software packages as well as the 520ST computer with 512K RAM, mouse controller, high resolution monochrome monitor (640x400), 95 key keyboard (with 18 key numeric keypad), MIDI interface, GEM and a 500K 3½ inch disk drive, all for the package price of only £651.30 (+VAT = £749). Dubbed the 'Mac beater' and the 'Jackintosh' (after Atari's Chief, Jack Tramiel), Atari's new machine has been directly compared with the Apple Macintosh RRP £2595 (+VAT = £2985) which offers similar features and capabilities but at a much higher price. Favourably reviewed by the UK's highly critical specialist computer press, the 520ST is likely to make a great impact in this country as a sophisticated alternative to an IBM PC, APRICOT or APPLE MACINTOSH. Unlike its overpriced competitors, the Atari 520ST can be linked up to a colour monitor to unleash a choice of up to 512 colours. The addition of colour brings out the full potential of graphics packages such as GEM.

USER FRIENDLY GEM OPERATING SYSTEM

The power of the ST is harnessed and made user friendly by the new operating system 'GEM' from Digital Research. GEM stands for Graphics Environment Manager and allows a user friendly colour or B/W graphics interface which closely resembles that of the Macintosh. This similarity extends to the use of moveable resizeable windows, icons to represent objects such as disks and disk drives, and the use of pull down menus and a mouse. The advantage of all this is that the computer becomes extremely easy to use. GEM has now been implemented for the Acorn, ACT, Atari, IBM, ICL, and Olivetti. Software written for GEM on one computer should also run under GEM on another computer. This will enable the market to quickly produce a large library of standard interchangeable software.

FREE SOFTWARE AND FUTURE EXPANSION

The Atari 520ST comes supplied with seven free software packages as listed below. 1) TOS -Tramiel Operating System based on CPM 68K. 2) GEM Graphics Environment Manager by Digital Research (DR) giving a WIMP (Window, Icon, Mouse, Pull down menu) environment. 3) DR GEM Paint for creating graphics masterpieces. 4) DR GEM Write for word processing. 5) Logo learning language to enable you to write your own programs easily using turtle graphics. 6) DR Personal Basic a powerful user friendly version of the Basic programming language. 7) BOS operating system giving you access to dozens of business applications packages already available on the market. Designed with future expansion in mind, the ST also features a host of different interfaces to the outside world and an impressive list of accessories is planned. Atari will soon be releasing a 1000K (1MB) 3½ inch disk drive, and a 15MB hard disk storage system as well as a mass storage compact disk (CD) player capable of storing an entire 20 volume encyclopedia on one disk. A full range of inexpensive printers are planned including dot matrix, daisywheel and thermal colour printers. With its unbeatable graphics, speed and software at a price which is far below that of any comparable personal computer currently on the market, the ST is all set to do battle with the competition. To receive further details of the ST from Silica Shop, just fill in the coupon below with your name and address details and post it to us.

Silica Shop Price: £651.30 + £97.70 VAT = £749.00 This price includes:

- ★512K RAM
- ★B/W MONITOR
- ★MOUSE
- ★500K 3.5" DISK DRIVE
- ★GEM
- ★KEYBOARD (95 KEYS)

£749

ATARI 520ST SPECIFICATION

MEMORY
512K RAM (524,288 bytes)
16K ROM expandable to 320K
Port for addnl 128K plug-in ROM cartridges
200K TOS operating system

GRAPHICS
Individually addressable 32K bit-mapped screen with 3 screen graphics modes
320x200 pixels in 16 colours (low resolution)
640x200 pixels in 4 colours (med resolution)
640x400 pixels in monochrome (high res)
16 shades of grey in low res mode
512 colours available in low/medium res
8 levels of each in red, green and blue

ARCHITECTURE
4 custom designed chips:
GLUE Chip - MMU Memory Mngmnt Unit
DMA Controller - Graphics Processing Unit
16/32 bit Motorola 68000 processor at 8MHz
eight 32 bit data registers
eight 32 bit address registers
16 bit data bus/24 bit address bus
7 levels of interrupts/56 instructions
14 addressing modes/5 data types

DATA STORAGE
High speed hard disk interface
Direct memory access 1.33 Mbytes per second
CD (Compact Disc) interface
Built in cartridge access
Dedicated floppy disk controller

DISK DRIVE
500K (unformatted) s/sided 3½" floppy d/drive
349K (formatted) storage capacity

SOUND AND MUSIC
Sound Generator
Frequency control from 30Hz to above audible
3 voices (channels) in wave shaping sound in addition to a noise generator
Separate frequency and volume controls
Dynamic envelope controls
ADSR (Attack, Decay, Sustain, Release)
Noise generator
MIDI interface for external music synthesizers

KEYBOARD
Separate keyboard microprocessor
Standard QWERTY typewriter styling
Ergonomic angle and height
95 keys including 10 function keys
Numeric keypad — 18 keys including ENTER
One touch cursor control keypad

MONITOR
12" screen - high res monochrome monitor
640x400 monochrome resolution

VIDEO PORTS
Display - Low Resolution - 40 columns
Med/High Res - 40/80 plus cols
Medium res RGB (Red/Green/Blue) output
High resolution monochrome (Black & White)

COMMUNICATIONS
Bidirectional centronics parallel interface for printers, or modems capable of input/output
RS232C serial modem/printer interface
VT52 Terminal Emulation Software
Maximum Baud Rate up to 19,200
High speed hard disk interface
Floppy disk controller (Western Digital)
2 joystick ports (one for 2 button mouse)
MIDI interface for external music synthesizers

GEM WIMP ENVIRONMENT
WIMP - Window Icon Mouse Pop-down menus
Two button mouse controller
Icons/Pull down menus/Windows
GEM VDI - Virtual Device Interface
GEM AES - Application Environment Services
GEM BBT - Bit Block Transfer
Real time clock & calendar

SOFTWARE
GEM environment
with user friendly Macintosh style operation
'TOS' - Tramiel Operating System
Atari's own system based on CPM 68K with hierarchical directory & file structure plus a host of MS DOS & UNIX command structures
'BOS' - Business Operating System
to run any standard BOS business programs
GEM desktop
with GEM PAINT graphics mgmt system and GEM WRITE word processor
Personal BASIC and OR Logo
originally written by Digital Research (DR) Very much like those on other machines except for the extensive use of pull down menus, mouse control and windows

VARIOUS
Dimensions: 470mmx240mmx60mm
Replaceable external power supplies
Expansion: 3½" floppy disk drives 500K/1,000K (two drives can be connected)
3½" 15Mb hard disk
CD (compact laser disc)
Dot matrix & d/wheel prntrs (black)
Thermal dot matrix (colour)
RGB & monochrome monitors

LANGUAGES
BASIC & LOGO supplied
Many others will soon be available, including Assembler, BCPL, C, Cobol, Compiled Basic Lisp, Modular-2 and Pascal

Note: Some of the above specifications are pre-release and may therefore be subject to change

MACINTOSH v F1e v 520ST

"Imagine a Fat Mac - the 512K Apple Macintosh - but with a bigger screen, a far bigger keyboard with numeric keypad, cursor and function keys, and colour. That gives you some idea of what the Atari 520ST is like, except for two important things. First the Atari seems faster. Second the Atari system is about one third of the price."
June 1985 - Jack Schofield - PRACTICAL COMPUTING

FEATURES OF BASIC SYSTEM	APPLE MACINTOSH	APRICOT F1e	ATARI 520ST
Price Includes B/W Monitor	YES	NO - extra £200	YES
Keyboard size mm (LxDxH)	330x147x50	450x167x28	470x240x60
Keyboard size ins (LxDxH)	13x5¾x2	17½x6½x1	18½x9½x2½
3½" D/Drive (Unformatted)	500K	500K	500K
3½" D/Drive (Formatted)	399K	315K	349K
WIMP (Window, Icon, Mouse ...)	Apple	ACT - Activity	GEM
Real-time Clock	YES	YES	YES
Polyphonic Sound Generator	YES	NO	YES
RS232 Serial Port	YES	YES	YES
Centronics Parallel Printer Port	NO	YES	YES
Dedicated Floppy Disk Controller	NO	YES	YES
Hard Disk DMA Interface	NO	YES	YES
Full stroke keyboard	YES	YES	YES
Number of keys on keyboard	59	92	95
Numeric Keypad	NO	YES (16 Keys)	YES (18 keys)
Cursor Control Keypad	NO	YES	YES
Function keys	NO	10	10
16-bit processor	68000	Intel 8086	68000
Processor running speed	8MHz	4.77MHz	8MHz
RAM size	512K	256K	512K
Number of graphics modes	1	4	3
Number of colours	Monochrome	16	512
Max Screen Resolution (pixels)	512 x 342	640 x 256	640 x 400
Mouse Included	Single Button	NO - extra £95	Two Button
Replaceable External Power Pack	NO	NO	YES
Cartridge Socket	NO	NO	YES
Joystick Ports	NO	NO	YES (two)
MIDI Synthesiser Interface	NO	NO	YES
Monitor Size	9"	9" - extra £200	12"
RGB Video Output	NO	YES	YES

System Cost with: Mouse - Monochrome Monitor - 512K RAM - 500K Disk Drive

Price of basic system (exc VAT)	£2595+VAT	£595+VAT	£652+VAT
+ Mouse	Included	£95+VAT	Included
+ Monochrome Monitor	Included	£200+VAT	Included
+ Expansion to 512K RAM	Included	£295+VAT	Included
Price of complete system (exc VAT)	£2595+VAT	£1185+VAT	£852+VAT
PRICE rounded down including VAT	**£2,984**	**£1,362**	**£749**

PRESS COMMENT

"Atari's new corporate image as an aggressive low cost computer maker is likely to mirror that of Commodore where Mr. Tramiel established the maxim that 'Business is war'."
August 21st 1984 **FINANCIAL TIMES**

"This is the only personal computer I know of that comes with a Midi interface as standard."
Peter Bright March 1985 **PERSONAL COMPUTER WORLD**

"The (GEM) version running on the Atari 68000 machines will have the additional advantage of leaving the PC version standing."
April 6th 1985 **PERSONAL COMPUTER NEWS**

"It would seem that GEM offers the ideal operating system."
March 7th 1985 **POPULAR COMPUTING WEEKLY**

"I found it (GEM) extremely easy to use and was very impressed with the way in which it disguises the unfriendly hardware and operating systems lurking under the surface."
Peter Bright Feb 1985 **PERSONAL COMPUTER WORLD**

"The electronics in the machine are a work of art ... The heart of the 520ST is a Motorola 68000, one of the most powerful 16-bit processors around and in many respects it is close to being a 32-bit chip ... when the machine appears in the shops, I'll be at the front end of the queue to buy one."
Peter Bright June 1985 **PERSONAL COMPUTER WORLD**

"This machine is significantly more powerful than an IBM PC ... If it's possible to design a sure-fire winning machine, this is it."
May 11th 1985 **PERSONAL COMPUTER NEWS**

"... the use of GEM makes the new range of Atari computers so similar to the Macintosh (with the added attraction of colour), that they are already being called 'Jackintoshes'."
May 2nd 1985 **COMPUTING**

"The new Atari ST computers truly represent to the consumer what Jack Tramiel is saying — easy-to-use computing power without the price."
March 1985 **ANALOG COMPUTING**

"It (the ST) uses the most modern technology that is affordable, in a package that gives a professional impression."
May 23rd 1985 **POPULAR COMPUTING WEEKLY**

"The Atari ST is one of the most elegant designs I have seen ... Atari has used an original and elegant method of memory management which should make the ST faster than any other PC on the market - in any price bracket ... The 64K dollar question is would I go out and spend money for one? To which the only answer is 'Try and stop me!'"
John Lambert July 1985 **ELECTRONICS & COMPUTING**

"The 520ST is technically excellent ... The 520ST hardware is the new standard by which others will be judged."
July 1985 **YOUR COMPUTER**

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PLEASE SEND ME FREE LITERATURE
ON THE NEW ATARI 520ST COMPUTER

Mr/Mrs/Ms: Initials: Surname:

Address:

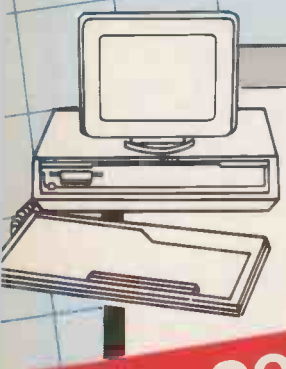
Postcode: 33

Do you already own a computer
If so, which one do you own?

● Circle No. 152

COMPUTER DISCOUNT STORE

VALUE AND SERVICE



SYSTEM · 1

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SYSTEM · 3

APRICOT F1

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SYSTEM · 5

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ALSO AVAILABLE
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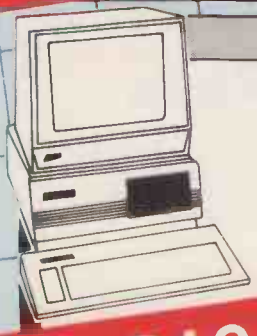

SYSTEM · 7

ZENITH Z150

(IBM Compatible) twin floppy
+ free accounts software
ALSO AVAILABLE
10 Megabyte
Hard Disk
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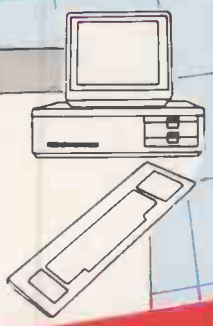
£1645 + VAT

● Circle No. 153



SYSTEM · 2

COMMODORE PC-10

(IBM Compatible)
256K ram
Free Accounting Suite
including payroll

£1395 + VAT

SYSTEM · 4

OLIVETTI M24

Twin Floppy
+ Free Accounts Software

ALSO AVAILABLE
10 Megabyte Hard Disk
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BY BEN KNOX

CELLULAR RADIO DROPS YOUR BITS

Thinking of hooking up your micro and acoustic coupler through the cellular radio phone network? Then think again: life is not that simple.

Cellular radio has been operating in this country for almost half a year. For those of you who have been on the moon, in a coma or staying at Her Majesty's pleasure I will give a quick rundown on what cellular radio is.

Many years ago someone had the bright idea of making the telephone into a compact, self-contained, portable unit. The only way for this to be done is, of course, by using radio waves instead of wires. The main problem about this method is that each telephone needs to use a different frequency to communicate. Otherwise, two telephones working on the same frequency would interfere with each other. Yet separate radio frequencies cannot be allocated to each and every telephone because there are not enough to go around.

SAME FREQUENCIES

The cellular radio system was devised to overcome this problem. By using low-power transmitters on the telephones and at the base stations where the radio system links to the normal telephone network, the same frequencies can be used several times over — so long as telephones which use the same frequencies remain outside the radio range of each other. The range covered by each low-power base station is called a cell. Each cell handles a set of frequencies; the number of frequencies defines how many people can be using telephones in that area at any one time. Adjacent cells handle different sets of frequencies.

Problems inevitably arise when a telephone moves from one cell to another while it is being used. If a telephone is being used in cell A at a frequency understood by that cell, when it moves to cell B it will be ignored because it is not using one of the frequencies used by cell B. This flaw is overcome by incorporating the appropriate electronics into the base stations and telephones in order to change the frequencies as the user moves from one cell to another. The changeover takes approximately 300 milliseconds.

While changeover — or hand-off, as it is called in technical circles — takes place, the line drops. This is imperceptible to the caller and the called person, as the gap produced is extremely small compared to the number and length of gaps in human speech. I once heard that well over 50 percent of human speech is actually made up of silence.

That then, is more or less how the cellular radio system works. The result is that an almost limitless number of people can have telephones which they can carry in their pocket or car.

Recently, while working on an item for Thames TV's *Database*, the director of the programme borrowed two Vodafones from Racal to review. Racal is one of the companies running a cellular radio network in Britain; the other is British Telecom/Securicor and their system is called Cellnet. Shortly before, I had placed an order for a rather nifty looking Cellnet pocket phone.

Anyway, the models we had from Racal were called Transportables. I have been slightly wary of the word "transportable" describing a piece of equipment, ever since the time I got on a train at Charing Cross station and almost left my arm on the platform attached to an Osborne 1 microcomputer. My fears were not wholly unfounded: after carrying the Vodafone around for two weeks I was absolutely positive my right shoulder was perceptibly lower than my left.

Each telephone came in a neat looking designer shoulder bag, with "Vodafone" emblazoned in nice, big red letters across the side. If you unzip the bag, you can remove the phone and see it in all its glory. Naked, the Vodafone is a pretty unimpressive sight. I suspect more design effort was put into the bag than the phone. It is made up of three parts: handset, aerial unit and battery. The aerial unit and battery are just slabs of black plastic which lock together. When linked, they are about the size of a full-height disc drive — and about 20 times as heavy. The handset is grey and has a mouthpiece and earpiece in the same positions as on a normal telephone handset. On the back is a matrix of 16 buttons, marked: 0-9, Snd, Sto, Rcl, End, * and £. Above the buttons is a two-line liquid crystal display. The handset is connected to the aerial unit by means of a short, curly cable.

CALL PROCEDURE

The Vodafone is fairly easy to use. To make a call, you type in the number you want to dial. Each digit is displayed on the LCD when you press it. To dial the number press the Snd button. If you are calling another Vodafone, you will be connected in a few seconds. It takes up to a minute to connect to numbers which are on the normal telephone network. When you have finished your call, press End and you are disconnected. There are 99 memories which can be utilised with the Sto and Rcl (Store and Recall) buttons.

Additional features are controlled at the Vodafone base station. These include outgoing call barring, call diversion, automatic alarm call, conference calls, and hold for enquiry. These functions are activated by sending a string of numbers, interspersed with * and £ symbols, to the exchange.

So much for the use of cellular radio for voice calls. The computer will be interested in the possibilities of data communications over the system. Sadly, cellular radio has a number of characteristics which make it an unsuitable medium for data transmission. There are four separate phenomena which may contribute for data corruption. Their effects are magnified many times when data transmission is attempted while actually on the move.

The first is known as Rayleigh fading, or sometimes as multi-path fading. The effect of this phenomenon is unpredictable variations in the signal strength when it is received. Rayleigh fading is caused by the simultaneous reception of signals which have travelled by different paths, having been reflected off either moving or stationary objects. If different parts of a signal are received at the antenna at the same time, the signal can cancel itself out. If you know about sine waves, think of a trough and a peak being received at the same time. While Raleigh fading is not particularly noticeable to voice users, modems are extremely sensitive to variations in signal strength.

HAND-OFF

Hand-off, the second problem, I have described already. The 300ms. break in transmission is detectable by a modem. The number of times that hand-off occurs during a call depends on whether the telephone is moving, how fast it is going and in which direction.

The third problem arises because it is sometimes necessary for the base station and cellular telephone to communicate with each other. In voice calls, this signalling takes place in the gaps in speech. When modems are communicating, there are no gaps. The number of times that this signalling will occur during a call cannot be predicted.

Finally, there is interference. All types of radio interference are covered under this heading, but the type which is come across most of all is co-channel interference. This occurs when different signals using the same radio frequencies interfere with each other. Remembering that with cellular radio, the same frequencies are reused as often as possible, you can see that under certain conditions this type of interference can be a major problem.

For data transmission to be possible over the cellular network a system of error detection and correction must be introduced. Racal data transmission division, Vodata, has come up with the Cellular Data Link Control (CDLC), which goes through a number of contortions to provide uncorrupted data.

To correct errors, CDLC uses a technique known as forward error correction. Simply, this means that data is sent twice and the receiving equipment selects parts of each of the two pieces to reconstruct the original data. If necessary, another system called block retransmission can be invoked. The receiving equipment can request that a block of data be retransmitted if too many errors were detected in the first transmission.

Other features of the CDLC include resistance to hand-off and blanking, asynchronous working, 1,200 baud data transfer rate, full duplex, and RS-232 compatibility. All in all, the CDLC system does seem to have solved the problems of transferring data over the cellular radio system. All that needs to happen now is for someone to convince British Telecom to use CDLC on Cellnet, instead of developing its own, incompatible system. PC

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BY DAVID LEVY

TWIXT

A peg-board game for two players.

Twixt is another delightful game invented by Alex Randolph, whose brick-dropping game Pferdeäppel appeared in *PC* in March. The game is marketed in the U.S. by Avalon Hill, and it sells so well in Germany that there are even Twixt tournaments for the really serious players and Twixt experts sometimes give simultaneous exhibitions against a number of weaker players. But for some reason the game cannot be found in shops in the U.K., which is a great pity because Twixt is great fun and intellectually challenging.

The game is played on a 24- by 24-peg board. The two players, Red and Black, take turns to put a peg into one of the vacant holes. If a player's peg which has just been played is then a knight's move away from one or more existing pegs of the same colour, that player joins the adjacent pegs with a horizontal bridge, provided that this bridge does not cross an existing bridge belonging to either player.

Figure 1 represents the lower left-hand corner of the board. Red has created a bridge for d4 to e2, since these two holes are a knight's move apart. Black could form a bridge between c3 and d1, but it would be illegal to make a bridge by playing in e4 because the line from c3 to e4 crosses Red's bridge from d4 to e2. A player is allowed to remove any number of his own bridges as part of a move, but this rule can be ignored when programming the game to avoid making the task unnecessarily complex.

LINE OF BRIDGES

The object of the game is to create an unbroken line of your own bridges twixt opposite edges of the board. For example, Red might be playing from north to south, in which case Black will be trying to create a bridge from east to west. Once a section of bridge is in place it may never be moved by the opponent, and a player may not place a bridge so that it intersects with any bridge already placed by his opponent.

Since the Twixt board is even larger than a Go board, the number of legal moves at any stage will be enormous in comparison with board games such as chess, draughts and Othello. Twixt is a good example of the problems of searching large game trees. Just how do you deal with a game in which the branching factor is so large that a full-width tree-search would be impossible to any substantial depth?

Consider the very first move of the game. You might think that playing a peg in one of the four central holes is a very strong move, and in fact this is true. But to take care of this situation one player places the first peg and the opponent then decides to which player that peg belongs. According to the inventor, a good first move in Twixt is m6 because it is not so fantastic that the opponent will certainly take it, but it is good enough so that if the opponent does not take it the peg on m6 will play an important part in the game.

RAPID BRANCHING

When programming games which have a very large branching factor, that is, number of legal moves, a sensible philosophy to adopt is to be highly selective in the analysis. In a chess program, where the average branching factor is around 37, some strong programs written for microprocessors can analyse the full-width tree to a depth of seven-ply or more. A Twixt program analysing a full-width tree to the same depth, would encounter around 50,000 times as many terminal nodes. It might be possible to write a Twixt program to search fully to a depth of three- or four-ply when playing at the rate of three minutes per move, but I do not believe that player would be happy waiting so long for a response and I am suspicious as to the resulting strength of the program.

By being selective in the search process, a game-playing program can discard many of the obviously bad moves, thereby reducing the branching factor substantially. At each ply in the tree the program says to itself: "Which moves look worthwhile and which ones should I ignore?". If its selectivity criteria are accurate it will be able to discard a large proportion of the legal moves without any detriment to the final result. You could also adopt this approach in chess or any other two-person game, for example, by not allowing the program to examine moves which give away pieces for nothing. What you gain is the ability to search the game tree to a more useful depth. However, there will be occasions when a superficially useless or bad move actually turns out to be the right thing to do but the program ignores it.

One way to select the moves which are to be examined further is to apply the terminal evaluation function to positions at every stage of the tree search. First the program generates all the legal moves from a position, and then it evaluates these moves with the same evaluation function that it applies to terminal positions. The moves are then sorted, which has the beneficial side effect of speeding up the alpha-beta search. An arbitrary cut off is applied so that the program discards all but the best n moves, or all moves whose evaluation is more than a certain amount below that of the seemingly best move.

This approach was employed in one of the earliest chess programs, written in the late 1950s for the IBM 704 mainframe. The program selected the seven best moves in the root position, then the seven best replies to each of these moves, and so on, to a depth of four-ply. Its search process, with 2401 terminal nodes on the tree, took around three minutes, in which time today's leading microcomputer chess programs can examine trees with around one million terminal evaluations.

QUICKER EVALUATION

Another method of selectivity is to apply a different evaluation function, usually one which is more sophisticated than that used for evaluating terminal positions. The reason for this approach is that there are many more evaluations carried out at the terminal positions. Consequently the terminal evaluator should be quicker and less sophisticated than the evaluation function used to select which moves are to be analysed further.

A third approach to the problem of selectivity, and one which is best used for Twixt, is to use very simple heuristics to select those moves which, without the benefit of evaluative heuristics, look as though they might be worthy of further analysis. This makes the selectivity process much quicker.

One simple heuristic which often serves this purpose is to look at moves which appeared to be quite good two-ply earlier in the tree. If the program applies its full evaluation function to each of the moves in the root position and then produces a sorted list, the moves which feature in, say, the top 10 places in the list will, in many games, have a high correlation with the top 10 list two-ply further on into the game. For most strategy games approximately half of the moves on the most likely to succeed list normally reappear on the list two-ply later.

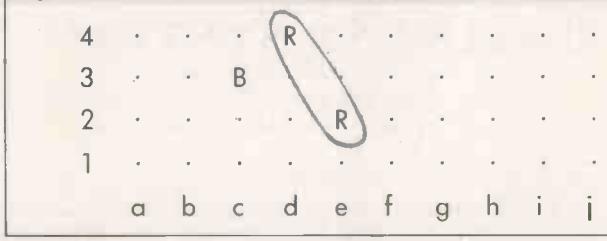
Another heuristic useful in Twixt is to look at all moves which create bridges immediately. A less obvious concept is to examine forking moves. If in figure 2 Red were to place a peg in g3, he would be creating a two-pronged attack — hence the term fork — on the holes at e2 and e4. Placing a subsequent peg in either of those holes would immediately create two bridges, from c3 to the new peg and from the new peg to g3. Black would have no way to stop both possibilities.

Another heuristic which seems to work quite well is to look at moves which are within a certain distance of your opponent's previous move. This distance might be two rows and columns either side of the previously occupied hole, in which case there would be a maximum of 24 legal moves to examine as a result of this particular heuristic. Extending the distance to three rows or columns on either side would increase this maximum from 24 to 48, which is already making the tree too bushy.

Having created the basis for a selective search program, you must consider how to evaluate positions on

(continued on next page)

Figure 1.



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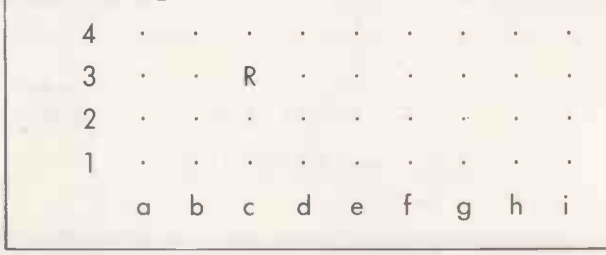

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the game tree. The evaluation function can be used in two different ways: it should be applied to all positions at one-ply so that the root moves may be sorted, thereby speeding up the search process because of the substantial number of cut offs created by the alpha-beta algorithm, and the evaluation function is also applied to all terminal positions. It might be worthwhile to use it to sort the moves selected at ply 1, but experience from chess suggests that this is only useful for the replies to that root move which is sorted to the top of the list.

It is worth using four features in the evaluation function. An important aspect of playing Twixt well is that wherever possible, moves should not only help to make progress towards your own goal but should also impede the progress of your opponent.

This is not accounted for in the evaluation function itself, but will be a by-product of the look-ahead search. As a result, on level 1, — that is, a one-ply search — the program may play aggressively but it will overlook attacking possibilities by the user.

The features in the evaluation function are as follows:

Bridges. The number of bridges already in place on the board; own bridges minus opponent's bridges.

Potential Bridges. The number of different moves available which will create one or more bridges for the player whose turn it is to move next. Count one extra move for each bridge in excess of one that can be created by a move.

Forks. The number of vacant holes on the board that are a knight's move away from two or more of a player's existing pegs, with no intervening bridge: score own forks minus opponent's forks.

Attack Strength. Some sort of measure is needed for the extent to which a player's bridges are working towards the ultimate goal, that of creating an unbroken line between the appropriate opposite edges of the board. If the individual bridges are well connected to each other there will be a relatively small number of lazy pegs — that is, ones which are attached to fewer than two bridges. But this concept in itself is insufficient because a ring of bridges would have no lazy pegs but would be of no real use to the player. Another aspect of attacking strength is the extent to which bridges are forward looking, say, from b1 to c3 for the player moving north to south, rather than sideways looking from, say, b1 to d2.

A count of the number of forward-looking bridges might also be a useful measure to be included in the Attack Strength feature. Score one point for a forward-looking bridge, provided that the row which it crosses has not already been crossed by another forward-looking bridge of the same colour. Score 0.5 for a forward-looking bridge if the row that it crosses has already been crossed once by a forward-looking bridge of its own colour. Score $1/(n-1)$ if the row crossed by a forward-looking bridge has already been crossed by n forward-looking bridges of the same colour. This evaluation will encourage the creation of all forward-looking bridges, but will put greater emphasis on moves that extend over rows that have not yet been crossed.

COMBINATION

You could combine the two aspects of Attack Strength into one feature: for example, forward-looking score divided by number of lazy pegs, but it is simpler to treat each of these two aspects as separate features, in which case the evaluation function will have five features altogether.

The program will then perform the tree search. It generates, evaluates and sorts all the moves in the root position. It then selects the best n of these moves — you should choose n to be in the range 20 to 30 — and discards the rest. Your level 1 search should now play the move at the top of the list. For a higher level of skill, the program should perform a search to the appropriate ply depth, selecting which moves to examine further on the basis of the criteria already described. In the terminal positions the program applies the evaluation function, in which the weightings for each feature have been arrived at largely by experimentation.

LOOK FOR A WIN

One thing about the evaluation function seems obvious: a fork should be valued at something between one bridge and two bridges. For searches of five-ply and deeper, apply the evaluation function at four-ply, and extend the search only to determine whether or not there exists a simple forced win. The same selection criteria are used to determine which moves should be examined beyond four-ply, but the terminal evaluation should consist only of Win, Loss and Neither values. This approach should ensure that the program plays sensible strategic moves, while leaving sufficient computation time to detect straightforward races towards the edges of the board. PC

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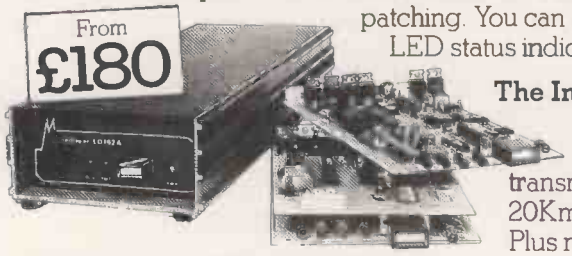

The Interdriver LD192 Mains Powered Base-Band Modem
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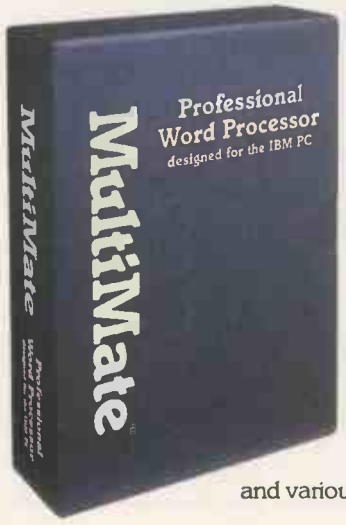

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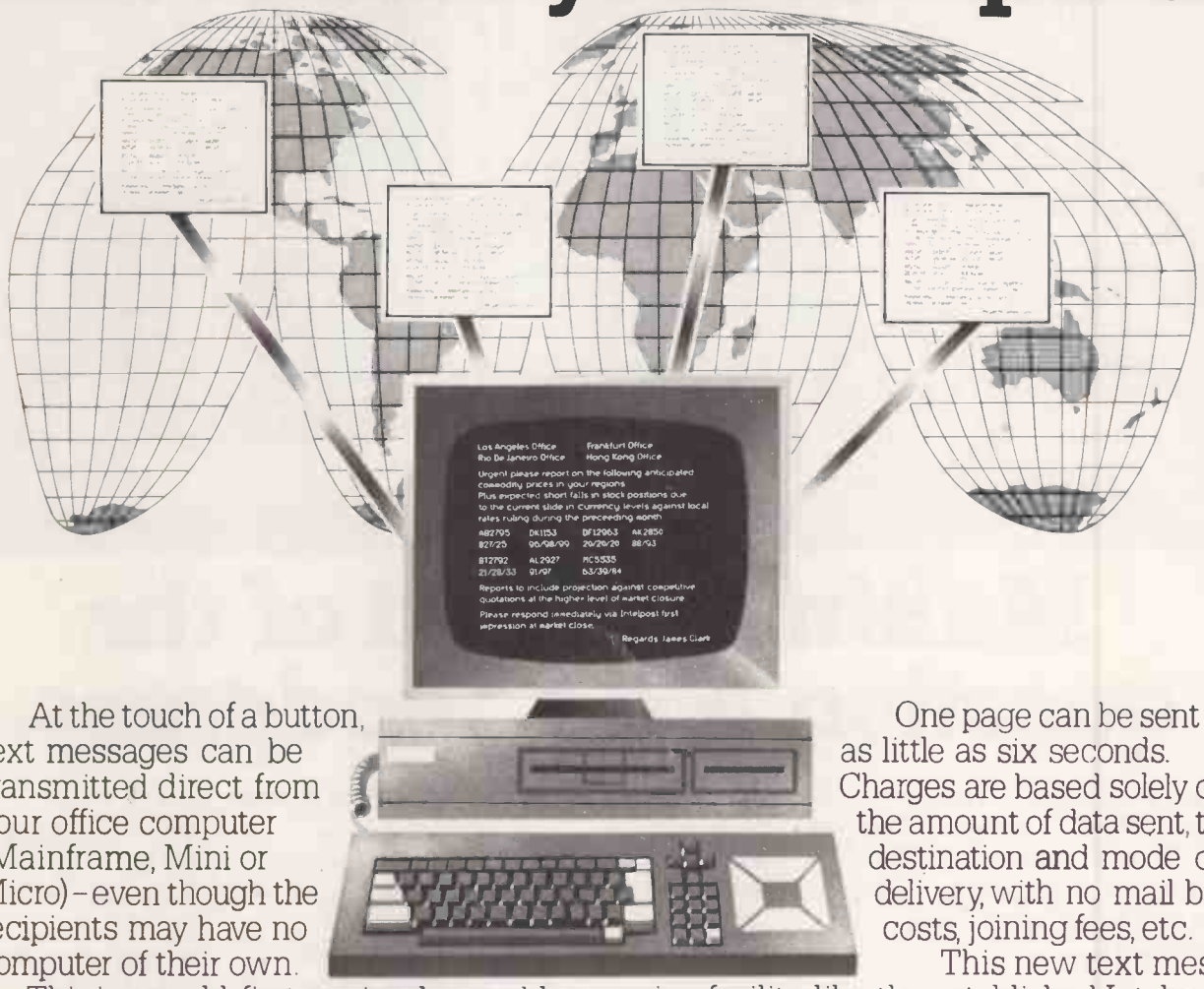

At the touch of a button, text messages can be transmitted direct from your office computer (Mainframe, Mini or Micro) – even though the recipients may have no computer of their own.

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All that is required is a modem and your own or a commercially available software package.

One page can be sent in as little as six seconds. Charges are based solely on the amount of data sent, the destination and mode of delivery, with no mail box costs, joining fees, etc.

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COMPAQ DESKPRO 286
KAYPRO 286i
AT-EMULATORS: LUXURY v. UTILITY

By Jack Schofield

IBM's 80286-based PC/AT has set a new standard for personal computers. Two new arrivals both subscribe to it, but are radically different in other ways.

BASIC BENCHMARKS

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Av.
Deskpro 286 — 80286	0.3	1.2	2.8	2.9	3.2	5.7	9.1	9.2	4.3
Kaypro 286i — 80286	0.4	1.7	3.8	4.0	4.3	7.9	12.3	12.5	5.9
IBM PC/AT — 80286	0.5	1.9	4.6	4.7	5.2	9.1	14.6	13.5	6.8
Olivetti M-24 — 8086	0.5	2.0	4.6	4.7	5.2	9.4	14.8	16.1	7.2
Headstart ATS — 80286	0.6	2.5	5.5	5.7	6.2	11.2	17.6	18.2	8.4

The announcement last August of the IBM PC/AT threw all the major IBM-compatible manufacturers into a frenzy of activity. A dozen of them have since announced new machines which emulate the PC/AT, and samples are now starting to come through. The first to arrive was the Intertec Headstart ATS, which offered very small size and network capabilities, plus a low prices. The two latest releases from Kaypro and Compaq, are reviewed separately on the following pages. In terms of raw performance, however, both micros are very similar to the IBM PC/AT.

The standard eight Basic Benchmarks were run on all the available AT-alikes, plus the Olivetti M-24. On this basis, the Compaq Deskpro 286 emerged as a clear winner, being significantly faster than the IBM PC/AT. The Kaypro and Olivetti micros ran at roughly the same speed as the IBM, with the Intertec Headstart slightly slower.

The Compaq's advantage is that it runs the 80286 chip at a slightly faster clock speed of 8MHz, compared with the 6MHz of the PC/AT. It can also be run at 6MHz if this is necessary to ensure software compatibility.

The Compaq is the only one of the 286-based machines to offer significantly better performance than the 8086-based Olivetti M-24. This is because the 80286 actually runs the PC-DOS operating system in a compatible mode where the chip emulates

(continued on next page)

BAGSHAW BENCHMARKS

	BM0	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	BM9	BM10	BM11	BM12	BM13	Total
Deskpro 286 — floppy	10.5	4	4	12.5	15	16.4	5	17.5	5.3	8	13.4	75	45.5	18.2	250.3
Deskpro 286 — 30Mbyte hard	6.2	1.8	2.5	2.3	2.8	3.6	1.2	3.8	1.1	0.8	1.6	11	5.9	3.2	47.8
Deskpro 286 — RAM disc	6	1.5	2	1.5	1	1	0.7	1	0.7	0.3	1	9	5.5	0.7	31.9
Kaypro— floppy	12	12	11	23	11	24	4	26	14	8	16	89	57	21	328
Headstart ATS— floppy	16	11	10	14	14	38	12	65	18	8	17	70	48	52	393
Apricot XI— 10Mbyte hard	16	6	7	11	7	26	1	27	2	4	9	50	20	6	192

(continued from previous page)

an 8086. The enhanced Protect mode, where the full power of the 286's architecture is unleashed, is not currently accessible from PC-DOS.

The second major advance offered by the PC/AT standard, compared with the PC standard, is much faster disc operation. In most businesses, the extra disc speed is far more useful than the extra processing power.

The standard Disc Benchmarks devised by Eric Bagshaw of the National Computing Centre — see *Practical Computing*, July 1984 page 99 — were run on the Compaq, Kaypro and Headstart models. Unfortunately, samples of the IBM PC/AT and Olivetti M-24 were not to hand for these Benchmarks to be run. Again, however, the Compaq Deskpro emerged as a clear winner.

One of the problems with PC-DOS and, of course, the highly similar MS-DOS, is that it cannot address more than 640K of RAM. This is now seen as a major limitation for three reasons. First, the 8086 and 80286 can address 1Mbyte of RAM, and the 80286 can address 16Mbyte in Protect mode. Second, memory prices have dropped so rapidly that large amounts of memory — over 1Mbyte — are now affordable. Third, many software houses now seem to be incapable of writing programs that are smaller than about 400K.

The Compaq Deskpro 286 supplied for review actually had 2.2Mbyte of RAM installed, which is 1,536K more than could be accessed via PC-DOS. PC-DOS version 3.0 has a useful way of handling this. The VDisk command in DOS 3 enables virtual discs — also called RAM discs or silicon discs — to be set up very easily. The Compaq's extra memory could therefore be used to provide the maximum 640K of RAM to DOS, plus the 512K RAM discs addressed as D:, E: and F:. As an experiment, both of IBM's PC-DOS discs, including the supplementary programs, were copied into the virtual disc D:. This comprises 50 files and a total of 450.5K of code. Copying all this from D: to E: using *.* took all of four seconds. With DOS or other large programs run entirely from RAM, the performance of a micro is electrifying. For anyone with a suitable micro and DOS 3, and who can afford it, this must look like an attractive way to go.

Future versions of PC-DOS will inevitably be obliged to expand their memory address capability above 640K, and eventually provide proper multitasking facilities using the Protect mode of the 80286. Whether these enhancements will arrive later this year with DOS 4, or next year with DOS 5, is open to speculation and doubt. Until they do, in our view the Olivetti M-24 still offers the best price/performance ratio in the IBM-alike universe. However, 80286-based machines are clearly where most of the business-micro market is headed, and the progress being made is exciting.

COMPAQ DESKPRO 286-2

Compaq has made a fortune out of making IBM-compatible micros better than IBM. The Deskpro 286 model 2 is the latest in what is now an extensive line-up and, true to form, it beats the IBM PC/AT in almost every department. And as with the Compaq portable, the Deskpro offers better IBM compatibility than IBM's own micro.

Microsoft's Flight Simulator was one of the first guides to IBM compatibility, because of the direct use it makes of the IBM PC ROM. Nowadays all true IBM compatibles are capable of running it. However, in launching the PC/AT, IBM changed the standard somewhat, and the Flight Simulator, FS-1, would not run. Therefore Microsoft has produced version 2, or FS-2, to run on PC/ATs and on the PCjr.

The clever thing about the Deskpro 286 is that while it obviously runs FS-2, as an AT-alike should, it also runs FS-1, like a real PC-compatible micro. This is something that the Kaypro 286i, Headstart ATS and the PC/AT itself cannot do.

In other departments, too, the Deskpro 286 offers more and better facilities than the PC/AT. One problem with IBM's micros is that the monochrome and graphics displays

SPECIFICATION

CPU: Intel 80286 running at 8MHz
RAM: 512K, expandable to 8.2Mbyte
Storage: 1.2Mbyte floppy disc, 30Mbyte hard disc, 10Mbyte tape streamer; optional 70Mbyte hard disc and 360K floppy discs
Display: 12in. dual-mode amber monitor showing 80 characters by 25 lines and IBM-compatible graphics
Ports: parallel printer port, RS-232C serial port, RGB and composite-video ports
Availability: autumn 1985
Price: not known
Supplier: Compaq Computer Ltd, Ambassador House, Paradise Road, Richmond, Surrey TW9 1SQ. Telephone: 01-940 8860

● The Deskpro 286 model 1 is similar but comes without the hard disc and tape backup. Transportable versions will also be available.

KAYPRO 286i

Those who have used Andrew Kay's transportable micros will find the new 286i, a desk-top IBM PC/AT-alike, very familiar. Like other Kaypros it appears to be made of industrial-grade sheet metal. The finish is black and utilitarian, with moulded rubber edgings and cork discs to protect the desk top.

The system box is huge: it takes up about 360sq.in. of desk top. This machine would look perfect on a factory floor. Anyone who wants a svelte, luxury micro like the IBM PC/AT, or the almost equally stylish Compaq Deskpro, should look elsewhere. However, the Kaypro 286i does its job, which is to emulate the IBM PC/AT. It delivers a great deal of computing power, including an excellent bundle of software, at a quite attractive price.

Where the Compaq 286 and Olivetti M-24 micros compete by offering significantly better performance than the equivalent IBM micros, the Kaypro is simply a clone. The board design is very similar to that of the PC/AT, and the ROM BIOS, supplied by Phoenix Software, emulates IBM's. The colour graphics appears to be driven by a Hercules Color Card, and this leaves five of the eight expansion slots free.

In sum, the hardware is all pretty standard stuff. As with the Kaypro transportables, the "unique selling proposition" of the 286i is a bundle of Micropro software: WordStar and Mailmerge, Calcstar, Infostar and Starburst. The one important piece of software that you have to buy is a copy of IBM's own PC-

SPECIFICATION

CPU: Intel 80286 running at 6MHz
RAM: 512K, expandable to 15Mbyte
Storage: 286i B with two 1.2Mbyte 5.25in. floppy discs, 286i A with one floppy disc only
Display: 13in. RGB colour monitor showing 80 characters by 25 lines and IBM-compatible graphics
Ports: parallel printer port, RS-232C serial port, RGB port: no ports supplied with 286i A model
Availability: now
Price: model B, £4,136 plus VAT; model A, £2,674
Supplier: Kaypro (U.K.) Ltd. Telephone: (06286) 67547

COMPAQ DESKPRO 286

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	☐	■
Ease of use	☐	☐	☐	■
Documentation	☐	■	☐	☐
Value for money	☐	☐	☐	☐

☐ Far superior to anything else in its class. If reasonably priced, this machine should be a huge success.

are provided as separate systems, using separate cards as drivers and separate screens. Either you have the excellent monochrome character set and no graphics, or the colour-graphics facilities and low-resolution text. Like other Compaqs, the Deskpro 286 combines them so you get both.

The Deskpro 286 also runs much faster than the IBM PC/AT, thanks to its 8MHz 80286, where the IBM uses a 6MHz version. The Compaq chip will run at 6MHz, if the software requires 6MHz for compatibility. The Deskpro 286 runs the standard Basic Benchmark routines in an average of 4.3 seconds, compared with the 6.8 seconds of the PC/AT.

The Deskpro 286 is also a snappy performer of the Bagshaw Benchmarks, which measure the speed of disc operations. The Deskpro 286's floppy disc ran the 14 routines in a total time of 250 seconds — faster than the IBM PC/XT's hard disc, which takes 254 seconds. When the same routines were run from Deskpro 286's built-in hard disc, the time of 47.8 seconds was nearly twice as fast as any other machine we have tested, with the runners-up being the Jarogate Sprite at 91 seconds, and the Wyse PC at 178 seconds.

In terms of raw specification, the Deskpro 286 supplied for review offered considerably more than a PC/AT. Where the PC/AT has a built-in 20Mbyte hard disc, the Deskpro 286-2 offers a 30Mbyte model; 20Mbyte and 70Mbyte options are also available. Where IBM offers no means of backing-up important data — except on to a mass of floppy discs — the Deskpro 286 has a built-in tape streamer with a capacity of 10Mbyte per tape.

On test the Deskpro 286's performance was sparkling. The legibility of the amber dual-mode screen was outstanding, all operations were very fast, and the machine ran virtually all software thrown at it. It did not run the IBM diagnostics disc, but that is only to be expected. There were no problems reading 360K discs written by or for other IBM-compatible machines.

The keyboard has the same layout as the PC/AT, including the unimplemented Sys Req key, but with LED indicators actually built into the tops of keys like Caps Lock, etc. The PC/AT layout is superior to that of the standard IBM PC, though it takes some getting used to.

Two drawbacks to the Deskpro 286 emerge when you try to move it about. Like the PC/AT itself, the Deskpro 286 is very heavy. But a 2.2Mbyte micro with a 30Mbyte hard disc, built-in tape streamer and massive power supply could hardly be expected to be light. Also, before you lift the machine you have to release three screws and slide the lid off, to lever a locking prong for a hard disc into the Park position.

Another drawback may turn out to be the price, which had not been divulged at the time of writing. Compaq is not known for being noticeably cheaper than IBM. However, you do tend to get more for your money, and frankly the Deskpro 286 is worth a premium over the IBM PC/AT. Unless you have a ridiculous attachment to the three little letters I, B and M, the Deskpro 286 is a far better machine to buy.

CONCLUSIONS

■ The Deskpro 286 offers a high level of compatibility with the IBM PC and PC/AT micros, to the extent that it could even be more IBM compatible than IBM's own machines. This enables it to utilse the large PC and PC/AT software base.

■ The extra convenience of the dual-mode screen display, built-in tape backup and greater expandability make the Deskpro 286 model 2 clearly preferable to the IBM PC/AT.

■ For single-user desk-top computing, the Deskpro 286 is, in terms of specification, facilities, speed and performance, the best micro ever reviewed by *Practical Computing*. For applications where the power is required, it should sell like hot cakes, almost regardless of price.

KAYPRO 286i

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	■	☐
Ease of use	☐	■	☐	☐
Documentation	■	☐	☐	☐
Value for money	☐	☐	■	☐

☐ Little more than an IBM PC/AT clone. Its bundled software may not quite compensate for its lack of finesse and finish.

DOS version 3. Unlike Compaq and Olivetti, Kaypro does not supply its own version of DOS.

The system supplied for review had an Intel 80286 chip running at 6MHz, 512K of RAM and two 1.2Mbyte half-height 5.25in. floppy-disc drives. There is a battery-backed clock/calendar, and space for an 80287 maths co-processor. RAM can be expanded to 640K on the main board using 18 64Kbit RAM chips and, it is claimed, to 15Mbyte using expansion cards. The review sample was set up to include an optional hard disc, which can be added as an upgrade. There is also a single-floppy version with no colour board and no ports. In fact, on power-up the hard dics's red access light winked and we thought one might be inside, but this was not the case.

The system was run using the 13in. RGB colour monitor supplied. This required a separate mains lead, unlike the Compaq monitor which plugs into the back of the Deskpro. The Kaypro also lacks a composite video port. While it was nice to have colour, as many of the newest IBM PC packages use it extensively, the IBM's sharp, high-resolution monochrome character set was sadly missed.

On test, the Kaypro performed impeccably. For reasons unknown it ran the eight standard Basic Benchmark routines slightly faster than the IBM PC/AT: the Kaypro's average was 5.9 seconds, compared to the PC/AT's 6.8 seconds. As the chip and DOS are identical, this presumably means that Microsoft's GWBasic is just slightly faster than its Basica.

The Bagshaw Benchmarks, which measure the speed of disc operations, produced curious results, in that times varied a great deal between tests. The total time of 314 seconds seems reasonable, though both faster and slower results were obtained, which could have something to do with the buffering.

Another feature of the drives was that they made embarrassingly loud scrunching noises when the first few tracks of a 360K disc were read, before they settled down into quiet operation. The drives themselves were efficient and reliable, and there were no problems reading 360K IBM PC discs.

The Kaypro's keyboard is laid out like the PC/AT, and feels quite good for typing. It does have the same metallic construction as the rest of the machine and, indeed, the rest of the Kaypro range. You get serviceability with little cosmetic finish and no finesse at all. Not everyone will like it.

No problems were experienced with standard software packages, though the 286i would not run the IBM PC diagnostics disc nor Microsoft's original Flight Simulator. It did, however, happily run the new version 2, designed for the PC/AT. In these respects the Kaypro performed like the Intertec Headstart, reviewed last month. Also like the Headstart, the Kaypro is badly documented, with only preliminary notes supplied.

There is little else to say about the 286i. It does perform as an IBM PC/AT clone, it has useful free software. At a lower price than the PC/AT, the 286i should also appeal to those whose needs are for utility rather than glamour.

CONCLUSIONS

■ The Kaypro 286i is an IBM PC/AT clone, and imitates its rival about as closely as is legally advisable. This makes it a machine of huge raw power.

■ The Kaypro differs from the PC/AT in also having a huge raw appearance. That it is utilitarian is about the nicest thing one can say about a micro that is prettier than only the Advance 86B.

■ The bundled Micropro software is of known quality and is an attractive extra.

■ If the price is aggressive it should appeal to those who value functionality over glamour. The quoted price is around 10 percent less than the PC/AT. Even with the free software, this may not be quite competitive enough.

GEM DESKTOP
WIMPS FOR ALL

By Mike Lewis

Digital Research's Gem brings a uniform Mac-style graphics interface to a wide range of personal computers, including the IBM PC.

The arrival of Gem marks the most realistic attempt yet to bring the marvels of overlapping windows, pull-down menus and multiple founts to a wide range of personal computers. It is a strategically important product, for both programmers and end-users. If it succeeds it will do for graphical interfaces what CP/M did for operating systems.

The comparison is an apt one because, above all, Gem is to do with portability. Just as CP/M allowed software houses to write a program for one computer in the expectations that it would run on many others, so Gem gives them the world of Wimps — windows, icons, mice and pointers — without having to worry about the details of widely differing graphics hardware.

Gem is not itself an operating system, but rather a layer of software that lives between the OS and an application program. The hardware-dependent parts are provided by Gem's licensees — that is computer manufacturers and OEMs — while writers of application software gain access by means of a programmer's toolkit.

SOFTWARE YET TO COME

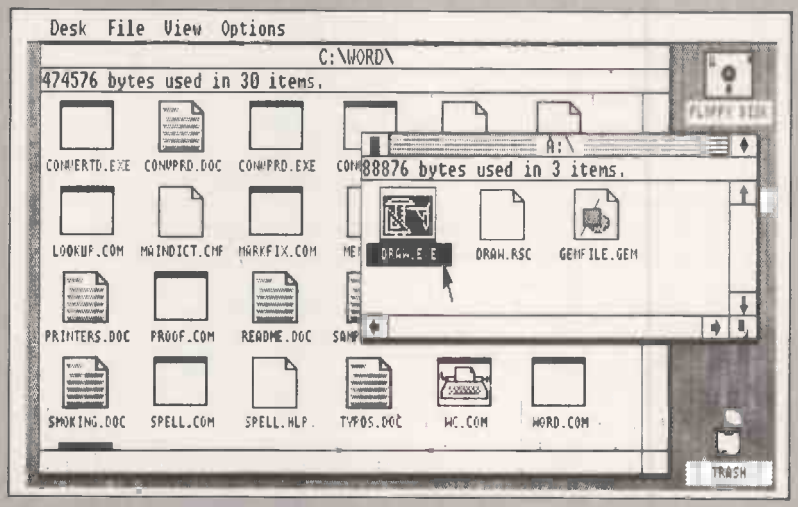
What Gem will do for the end-user depends on the extent to which developers of databases, spreadsheets, accounting packages, etc. make use of the goodies that it offers. So far, Gem-based packages have come in a trickle rather than a flood, but it's early days yet.

In fact, the only Gem offerings to date have originated, not surprisingly, from Digital Research. These include Gem Draw, Gem Paint, Gem Graph and Gem Wordchart, all of which should be available by the time you read this. At the moment, the only established product is Gem Desktop, which is in many ways the hub of the system.

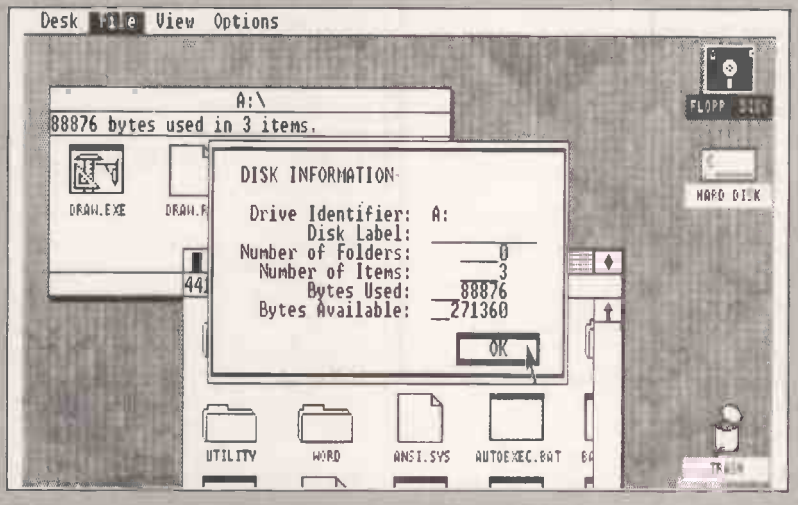
To run Gem, you will need 256K of RAM and a graphics display. A hard disc is advisable, but not vital. The version we tried was for the IBM PC, but it ran quite happily on the closely compatible Compaq Deskpro and Olivetti M-24. Versions for other systems will be supplied by the hardware manufacturers — they already exist for the Atari ST series and the entire Apricot range — but the IBM version is sold by Digital Research itself.

Of course you will also need a mouse. In fact, Gem can be made to work with various pointing devices, such as joysticks and touch-screens, provided the manufacturer supplies the necessary drivers. We used the two-button Microsoft mouse, only the left-hand button being operative in Gem. In the IBM version you can get by with the cursor keys instead of a mouse, but it is a slow and clumsy alternative.

Installing Gem is simple, the whole operation being carried out by a batch file called GemPrep. If you are using floppies, you end up with two discs: a startup disc and the disc containing the Desktop program.

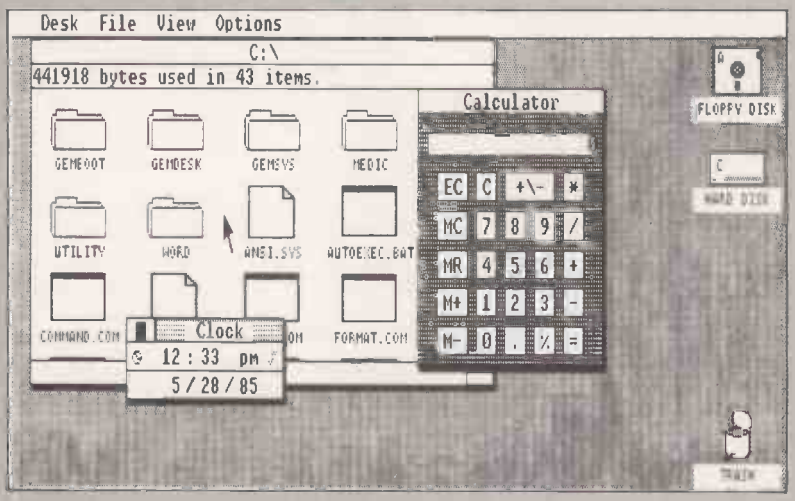


Desktop provides a separate scrollable window for each sub-directory. Each icon in the window represents either a file or another sub-directory. The user is able to move windows to anywhere on the screen, change their size and make them overlap.



The Get Info option in the File menu brings up an information box for the currently selected object, which may be a disc, folder, application or document. In this case, it is the floppy disc in drive A which is selected, as indicated by the reversed disc icon.

Digital Research's version of Gem runs on the IBM PC and compatibles. Versions for other systems will be supplied by hardware manufacturers.



Desk accessories may be invoked from Desktop or within a Gem application. The clock and the calculator are supplied with the package. Programmers who have the Gem Toolkit may add their own accessory programs.

SPECIFICATION

Description: Gem is an operating system extension that lets programmers use overlapping windows, icons, mouse support, pull-down menus and multiple founts; Desktop uses Gem to perform the common DOS utility functions
Hardware required: IBM PC family or compatibles, Atari ST or Apricot, other versions available soon; bit-mapped graphics display, 256K RAM, mouse or other pointing device
Publisher: Digital Research, Oxford House, Oxford Street, Newbury, Berkshire. Telephone: (0635) 35304
Price: Desktop costs £49.95 plus VAT
Available: now

To start Gem itself, you place the startup disc in Drive A and type GemRun. You are then prompted to swap discs, after which Desktop takes over the screen. Drive B remains free for other programs and data. You can also start Gem from a hard disc.

The aim of Desktop, in a nutshell, is to replace the DOS command line. It does not replace DOS itself or even Command.Com, but it does provide an easy way of carrying out basic housekeeping tasks without having to remember unfamiliar commands. Experienced users might prefer the old-fashioned A> prompt, but a newcomer should find Desktop less intimidating and easier to learn.

The initial Desktop screen shows an icon for each floppy or hard disc and a trash can. There is also a menu bar with four choices: Desk, File, View and Options. To do anything useful, you have to select a disc by moving the mouse pointer to the icon and clicking the button. This switches the icon to a dark picture on a light background, Gem's standard way of highlighting a selected object.

To see what's on the disc you open the drive, either by double-clicking the icon or by selecting Open from the File menu. Gem responds by displaying the disc's root directory in a window, with an icon for each file. These so-called directory icons come in three varieties: folders, which are DOS sub-directories; applications — Bat, Com and Exe files; and documents, which are meant to cover text and data files, but are in fact anything that is not a folder or an application.

BRANCHING

Since a folder is a sub-directory, it can itself be opened to display a further window of icons. Folders may contain other folders, reflecting DOS's tree-like structure. There is a New Folder option in the File menu which serves the same purpose as the DOS MkDir command, and you can copy files between folders, root directories and other discs.

Copying a file is simply a matter of selecting the icon, then dragging it with the mouse button held down to where you want it to go. Gem warns you if the file already exists at the destination, and also gives you a chance to rename the copy. You can copy entire discs in this way, just by dragging one disc icon on to another. If you drag an icon to the trash can, it is deleted after a suitable warning message.

The most important operation that you normally carry out at the DOS command line is to invoke an application program. In Gem, this is done simply by opening the application's icon. Before handing over to the program, Desktop invites you to enter a parameter, the name given to a command-line tail, for passing to the program. Although the application takes complete control of the screen, when it finishes the Desktop reappears exactly as you left it.

The other type of icon which you can open is a document. The aim here is merely to see what is in it, via the DOS Type command. Bear in mind that a Gem document is not necessarily text, so trying to

(continued on next page)

(continued from previous page)
open a binary file will result in a screenful of rubbish.

Opening a document in this way reveals one of the main weaknesses of Desktop, something which is also evident when you wish to format a floppy or carry out a disc-to-disc copy. In each case, Desktop steps aside and allows the equivalent DOS command — Type, Format or DiskCopy — to take over, exposing the user to precisely the sort of cryptic dialogue that Desktop is designed to avoid.

Having opened a document, it is a trifle disconcerting to see your attractive Desktop display disappear, albeit temporarily, to be replaced by a monochrome text screen, with the contents of the file flashing past and only the Control-S key to stop the scrolling. Would it have been so difficult for Digital Research to have displayed the file in a Gem-style window and to have given the user a little more control over the scrolling? As it is, relinquishing control to DOS in this way gives Desktop a decidedly unpolished appearance.

Fortunately, these are the only occasions on which Desktop's dealings with the user are open to criticism. In general, you are never left wondering what is going on and most of the system's messages are polite, clear and to the point. When you start an operation that might be either time-consuming or destructive, such as copying or deleting a file, Desktop issues an unambiguous warning and gives you a chance to back out. More confident users can switch off this feature.

A particularly interesting aspect of Desktop is the way in which documents with the same file type can be linked to a specific application. Once this is done, opening a document of the relevant type will have the same effect as invoking the application, with the document's name as a parameter.

For example, you could assign all documents of type Txt to WordStar. Then when you double click on a file named Report.Txt, Desktop will load WordStar which will in turn open Report.Txt ready for editing. To help you remember which documents work with which programs, you can superimpose special icons on the normal application and document icons. Thus there is a typewriter icon which would be suitable for a WP program, and one resembling a sheet of paper for word-processed text.

RESUME LATER

Normally, this link-up between applications and documents survives only for the current Gem session. The same is true of the various toggles and switches which you can set to disable the warning message before file deletions, for instance. However, if you use the Save Desktop function in the Options menu, all these settings are written to disc. The next time you invoke Desktop, the system will be just as you left it.

In any discussion of Gem, there is a strong temptation to make comparisons with the systems that has most furthered the Wimp cause: the Macintosh. Certainly, Gem has a great deal in common with the Mac, at least from the user's viewpoint. This is no bad thing, because once you have learned how to operate one of these, you will know the other too.

Windows have a near identical anatomy in both systems. By manipulating the various controls around the edge of the window, you can scroll it any direction, move it, alter its size or close it altogether. The only difference is that Gem's windows also have a Full box: you click this once to make the window fill the screen and click it again to return the window to its previous size. This would be a useful addition to the Mac.

Another small difference is in the use of pull-down menus. On the Mac, you pull down a menu by pointing to it and holding down the mouse button. You may then drag the mouse to the option you want and release the button. In Gem, the menu drops down as soon as you point to it, and the option is selected by a single click.

GEM DESKTOP

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	■	☐
Ease of use	☐	☐	☐	■
Documentation	☐	☐	■	☐
Value for money	☐	☐	☐	■

☐Desktop provides a more natural way of using DOS and its utilities than the A> prompt. This way of doing things is likely to become the norm.

Desk accessories are also common to both systems. These are mini-applications which can be invoked from their own menu, either from the desk top or within other programs. Gem has just two of them, a clock and a calculator, while the Mac sports seven, including the indispensible scrapbook. Gem also lacks the equivalent of the Macintosh clipboard, a handy means of cutting and pasting between programs.

But it is from the programmer's point of view that the real differences between Gem and the Macintosh emerge. When you program the Mac, you are locked into a fairly fixed configuration. Access to the graphical interface involves working closely with the hardware and with the Mac's ROM-based service routines, and this can be quite an undertaking. You can do a lot of Mac tricks in certain high-level languages like Microsoft Basic and Mac Pascal, but these are interpreted rather than compiled and so do not appeal to software vendors.

The Macintosh is controlled by a piece of software called the finder. This, together with the ROM routines, serves as operating system, Wimp manager, and desk top. It is highly machine specific, and adding non-Apple hardware like third-party hard discs generally involves obtaining a modified version of finder.

By contrast, Gem works in co-operation with existing operating systems, its role being confined to servicing programs that want to use the graphics interface. The programmer can communicate with DOS as before, and can continue to use all his or her favourite tools like keyboard enhancers and RAM discs. And you can use any language that permits calls to compiled library routines — although the calling sequence is particularly geared to C.

HIGHLY PORTABLE APPLICATIONS

Because all interaction with graphics devices is routed through a set of drivers, Gem programs can be highly portable. This does not mean that you can port Gem itself from an IBM to an Apricot and expect it to work. But once you have Gem on both systems, your application code can be successfully transferred, which is more than can be said for packages that try to do their own clever displays by directly accessing the computer's screen-mapped memory.

This approach also means that applications written for non-Gem environments can be used in a Gem system without change. Familiar programs like WordStar and dBase will run quite happily whether they were invoked from Desktop or the DOS command line, and they will not be put off by any Gem routines that happen to be resident in RAM. What is more, the user is not tied to Gem and can return to normal DOS operation whenever he or she feels like it.

But although these are important advantages, Gem will not succeed if it merely provides a standard, intuitive mechanism for invoking non-standard, non-intuitive applications. The future of Gem depends critically on how readily the likes of Micropro and Ashton-Tate incorporate the Gem brand of Wimps into their mass-market products.

So far the prospects are good, with around a dozen major houses promising Gem adaptations of their packages. The products include Thorn EMI's Perfect range, the Pegasus accounting system, Lifetree's Volkswriter, Plan from Chang Labs, SPI's Open Access, Compsoft's Delta, and the Prospect Graphics Library.

It is true that all these represent just announcements rather than actual discs and manuals on dealers' shelves. But with this sort of muscle behind it, Gem certainly looks like being off to a good start.

CONCLUSIONS

■With its Mac-like user interface, its availability on a range of business micros, and its ability to work with existing applications software, Gem certainly looks like being a winner.

■At first sight the Gem environment is nice and friendly to programmers, especially those who do not want to work too closely with the graphics hardware.

■In spite of a few rough edges, Desktop is a highly acceptable alternative to the DOS command line. It can be mastered very quickly and so should appeal strongly to computer novices. PC

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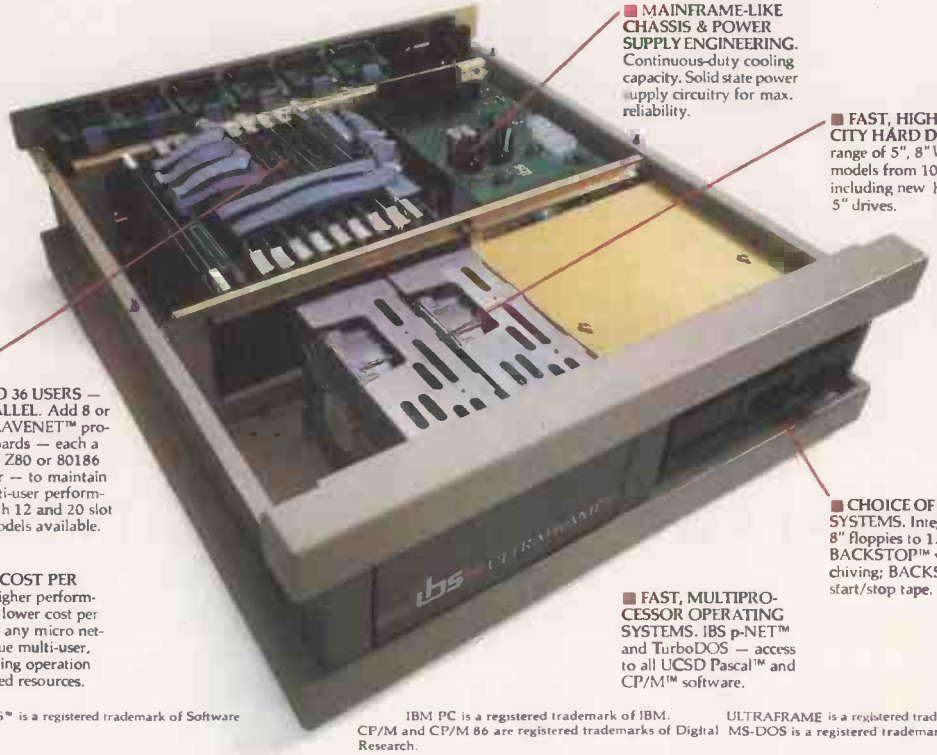

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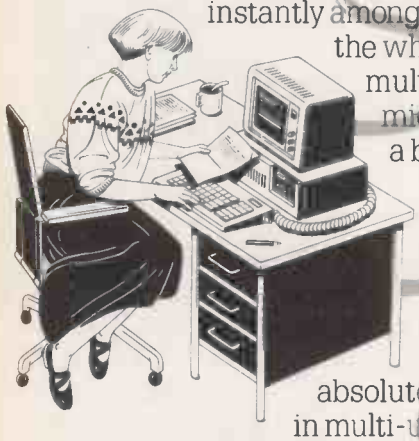

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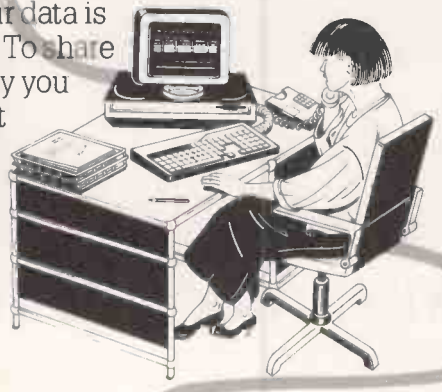

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56

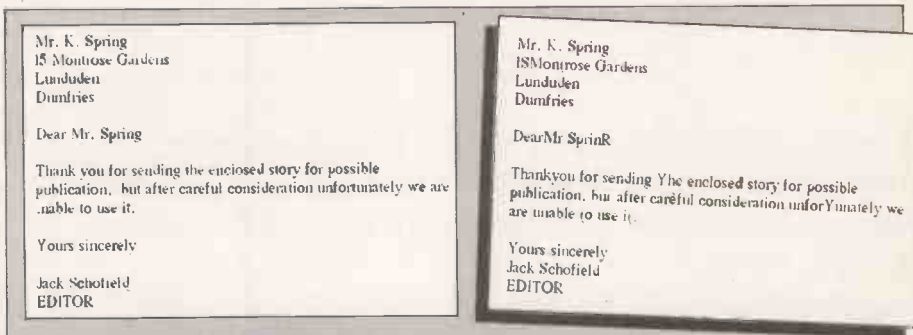
● **Circle No. 116**

PC8

OMNI-READER
AUTOMATED TEXT INPUT

By Ian Stobie

By far the cheapest optical character reader so far — but one with severe limitations.



Mr. K. Spring
15 Montrose Gardens
Lunduden
Dumfries

Dear Mr. Spring

Thank you for sending the enclosed story for possible publication, but after careful consideration unfortunately we are unable to use it.

Yours sincerely

Jack Schofield
EDITOR

Mr. K. Spring
ISMontrose Gardens
Lunduden
Dumfries

DearMr SprinR

Thankyou for sending Yhe enclosed story for possible publication, but after careful consideration unforYunately we are unable to use it.

Yours sincerely
Jack Schofield
EDITOR

The Omni-Reader is much better at reading some typefaces than others. With an original typed in Letter Gothic results were almost perfect (left), but Eletto, the typeface most of our documents are written in, confused it (right).

Omni-Reader is a very cheap optical character reader, designed for use with machines like the Apricot, Macintosh and IBM PC. It lets you read the information on typewritten pieces of paper directly into the computer, without the need to retype it. At £399 Omni-Reader is far cheaper than any competing product, but it does have significant limitations: for some jobs it turns out to be genuinely useful, but for others it is useless.

The problem Omni-Reader sets out to address is an important one. Many tasks such as maintaining membership lists or keeping catalogues up-to-date are highly suitable for computerisation but involve typing substantial quantities of data into the system in the first place. Since most of this data already exists on paper, a cheap way of inputting it directly would save the cost of retyping.

Optical character recognition (OCR) systems designed to do this have in fact existed for some time, but are expensive — in the £6,000 to £15,000 price range. These prices place them outside the reach of the individual user.

Since Omni-Reader is intended for users with comparatively small volumes of data to enter, Oberon, who manufacturers it, is probably justified in making it slower and less flexible to get the price down. Reading proceeds line by line, and is almost a manual process in that the user has to physically move the read head over each line of text by hand.

Omni-Reader's other obvious limitation is in the range of material it can handle. You are restricted to reading the output from typewriters, and only the more common electric ones at that, but not printed documents or poor-quality typescript.

Physically Omni-Reader has a flat baseboard on which you place the document you wish to copy. A transparent ruler is free to move up and down the document but is kept strictly parallel to the lines of text. Slotted losely on to the ruler, so that it is free to move in a left to right axis, is a black plastic box which contains the optical read head. At the top of the baseboard are a set of indicator lights, four of which show the pre-programmed typefaces Omni-Reader is set up to recognise: Courier 10- and 12-pitch, Letter Gothic and Prestige Elite.

Connecting the Omni-Reader up to the Mac we used for this review proved simple enough: it just plugged into the Mac's serial port. We also had Oberon's optional Omni-Reader software, available for an extra £40, which makes the installation process relatively straightforward.

All the typewritten text in our office has either been typed on old manual machines or an Olivetti ET 111 electric typewriter with carbon ribbon and Eletto 12-pitch printwheel. A look in the Omni-Reader manual showed that Eletto is somewhat similar to Prestige Elite 12, so setting the Omni-Reader to this fount we tried reading several documents. It takes a while to get the hang of gliding the read head across the text at the right speed. If you get it right the Omni-Reader beeps once and the text appears magically at your current cursor position on the screen. However, we never got 100 percent accuracy with Eletto, more like 90 to 95 percent.

Text typed with an Olivetti Letter Gothic printwheel was much better — near 99 percent most of the time. But this was still not much use to us as none of our existing documents are typed in this face.

Oberon quotes a reading speed of 150 wpm, although we got nowhere near this. I expect a few days practice would speed you up, but I am not convinced that even then I could achieve 150wpm.

Generally, Oberon is realistic about the limitations of its device. Previous claims that the Omni-Reader would be able to read ordinary printed text have been abandoned. Such a task seems to be technically beyond the device, as printed founts are generally a good deal smaller than typewriter founts at typically 16 to 20 characters per inch as against the typewriter's 10 or 12.

SPECIFICATION

Description: input device which optically reads typewritten text off pieces of paper into a suitable computer
Hardware required: IBM PC, Macintosh, or ACT Apricot; also will work with any machine equipped with a suitable RS-232 interface
Typefaces recognised: Courier 10- and 12-pitch, Letter Gothic 12, and Prestige Elite 12
Reading speed: 150wpm claimed by the manufacturer
Manufacturer: Oberon International Ltd; made in U.K.
Price: £399 plus VAT; optional software to support IBM, Mac and Apricot is £40; available now
U.K. distributor: Oberon International Ltd, 2 Hall Road, Maylands Wood Estate, Hemel Hempstead, Hertfordshire HP7 7BH. Telephone: (0491) 34838

OMNI-READER

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	■	□	□	□
Ease of use	□	■	□	□
Documentation	□	□	■	□
Value for money	□	□	□	■

□Brilliant value if you happen to be one of the few people who wants to do what Omni-Reader can do.

CONCLUSIONS

■Omni-Reader is too restricted in what it offers to be of practical use to most people. However, some users may have masses of beautifully typed Courier documents which they are dying to get into a computer system, and for them Omni-Reader is worth a look.
■Omni-Reader is a cheap product and shows the way technology is evolving. PC

CMS 6502 RACK SYSTEM
NOT THE BBC MICRO

By Roger Cullis

This modular, rack-based system from Cambridge Microcomputer Systems allows technical and industrial users to build up a BBC-like micro tailored to their specific needs.

As an input/output device, the BBC Micro offer a wealth of facilities. It has parallel and serial outputs for printers, cassette, disc and LAN interfaces for data storage, sound and speech for aural communication and RGB, composite and modulated UHF for visual display.

There is, however, a lack of flexibility about the implementation. Regardless of whether you need all the functions, they are part of the package. You get the cassette interface, for example, even though you may always save your files to disc. Four-channel sound is there, despite the fact that your only application may be instrument control. Should you require more than one identical interface — to drive a serial printer and a modem, for example — then you would have to think again. There is no easy way of adding such I/O controllers. Hitherto, if you wanted to run BBC software on a 6502 machine you had nowhere to turn, unless you possessed your own manufacturing plant.

Now Cambridge Microprocessor Systems (CMS) has come up with a modular system which permits users to tailor the computer to their specific needs. The CMS system is based on a series of Eurocards, each one performing a particular function or group of functions. The cards are linked together by a backplane which is either a simple pcb or a mini-rack with its own power supply.

The heart of the system is a 6502 processor card. Unlike the Acorn 6502 second processor, which is simply a 6502 CPU with 64K of RAM, the CMS controller has a much more flexible memory arrangement, with the 64K bank being divided into separate blocks. The operating system is held in ROM at the highest memory addresses, while the lower addresses can be populated by read/write or read-only memory, or simply left empty.

The card has five 28-pin sockets which serve as memory carriers. To accommodate different types, each socket is provided with two banks of wire-wrap connector pins which can be linked in the appropriate configuration to suit the pin-out of individual devices. The manual shows arrangements for most popular byte-wide ROM, EPROM and RAM chips. A pre-programmed bipolar ROM controls the addresses at which the memory devices will be located in the memory map.

The CMS 6502 may be used as a second processor to the BBC Micro or it may have its own keyboard attached to a 40/80-column terminal card.

The system can be further extended by using additional controller cards which function simply as memory carriers when their processor chip is removed. In this manner, over 500K of memory can be directly addressed by using a software paging register to look after bank switching control.

Memory socket 5 has been mapped to support a 16K EPROM. The upper half is devoted to the operating system and monitor while the lower half is available for CMS special applications packages. One such package is a communications module to permit networking of a number of 6502 systems. Other packages control specific CMS I/O Eurocards.

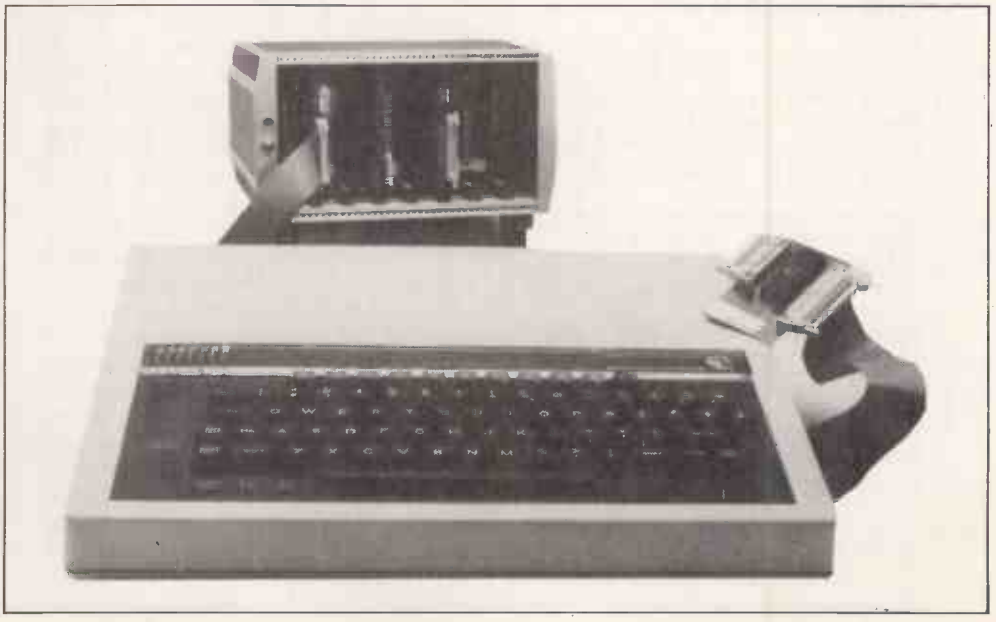
If an application requires a host language, this is mapped into &8000-BFFF. BBC Basic is one language which is available.

CMS supplies a sideways ROM for use when a BBC Micro model B or B+ is employed as the base processor. The controller card is initialised with either a Control-Shift or a *CMS command, and responds with the message

BASIC present (if it is installed at &8000-BFFF)
CMS (1.X)
Ram at XXXX — XXXX

SPECIFICATION

CPU: eight-bit 6502, clocked at 1MHz
Video: high-performance colour-graphics card; low-cost 40/80-column pixel graphics with teletex
Interfaces: comprehensive range of I/O facilities including A/D, D/A, serial, parallel, IEEE
Manufacturer: Cambridge Microprocessor Systems Limited, 44a Hobson Street, Cambridge CB1 1NL
Prices: 6502 card with memory chips and BBC Basic, £199 plus VAT; low-cost 6502 controller £119; BBC Tube interface and cables, £79; digital I/O, serial and parallel, £119; memory carrier, £79; high-performance graphics card, £299; 40/80-column teletext card, £149; 13-bit data acquisition, £189; high-performance analogue card, from £205; keyboard, £139; 8in. rack with power supply and backplane, £299



EXPANSION CARDS

The **High Performance Colour Graphics Card** is based on the Thompson EF-9366 graphics processor chip and has a DIN connector for an RGB-drive monitor. It offers 512- by 256-pixel resolution and is capable of drawing 1.5 million dots per second. In monochrome there are 16 grey levels, while the colour mode will support eight colours per pixel, eight flashing colours or eight colours with intensity control. The ROM holds 96 ASCII characters which may be displayed in a high-density text mode of 85 characters by 32 rows in any colour combination. Character size and style — vertical, horizontal or italic — are fully user-programmable. A hardware zoom capability allows characters to be magnified in the X and Y directions by up to 16 times.

The **40/80-column Video Terminal** is a low-cost alternative to the graphics processor card. In combination with the processor the video terminal card offers a convenient terminal emulator. It includes a Centronics parallel interface and an RS-422/423 serial interface. It has an 8K dedicated video memory expandable to 16K, full colour for foreground, background, border and palette, pixel graphics, and user-definable and teletext characters. It supports underlining, and reverse and flashing video.

On the **Versatile Interface Board** four 6522 versatile interface adaptors (VIAs) provide 80 independent digital I/O and control lines. A 6551 Asynchronous Communications Interface Adaptor (ACIA) controls a serial interface in RS-422/423 configuration. One half of a VIA drives a fully buffered Centronics printer port. Serial transmit and receive rates and data format may be set under software control.

The **12-bit/Analogue Interface Card** is designed for fast real-time data acquisition. It has eight multiplexed ADC input channels with true 12-bit accuracy and stability. There are also up to four DAC output channels, each having an op-amp current-to-voltage converter followed by an inverting amplifier with potentiometer-controlled gain to provide an output voltage of 0-10V at 10mA. There are seven TTL channels available for external control.

The high-performance **Analogue/Digital Interface Board** offers 16 analogue input channels with 13-bit resolution and 16 digital output lines capable of switching up to 50V at up to 0.5A. Each line has an individual LED status indicator.

Based on the MC-68488 General Purpose Interface Adaptor, the **IEEE Talker/Listener Controller** CMS IEEE card can act as a talker, listener or bus controller. The card meets all of the IEEE-488 1978 electrical specifications. As a bus controller it can control up to 14 devices on the instrumentation bus.

Unlike the Acorn 6502 second processor, the CMS device is endowed with a monitor which will perform useful operations such as memory dumps, priming CPU registers, cyclic redundancy checks, memory moves and verification, and screen mode changes. The operating system implements standard Acorn OS calls at the expected locations and, in addition, has an extra call Osmon, with a corresponding indirection vector Monv, at &FFC5 and &022E respectively. These locations correspond to those of the Acorn GSRead call and CNPV indirection vector which are not required for a second processor.

Another feature of the CMS card is a real-time clock with battery backup. The clock serves simultaneously as a watch/calendar, alarm and timer. Each function may be read or set and enabled or disabled individually by a defined monitor call.

The battery backup serves another purpose. In conjunction with CMOS RAM it may be used to preserve a transient program. For example, it is quite feasible to load in a program using a BBC Micro base processor, remove the Tube connection, unplug the CMS 6502 card from the rack and power supply and then replace it to continue running the program. This also provides a stunning demonstration of the ruggedness of the CMS system, breaking all of the accepted rules about powering down before making a disconnection.

Another indication that the CMS system is intended for industrial control rather than data processing is its performance in the standard Benchmark tests. It is slower than the standard BBC model B by a factor of 2, and than the Acorn 6502 second processor by a factor of 3. The reason for this is that it is clocked at 1MHz, rather than the 2MHz and 3MHz of the Acorns. The slower clock rate greatly simplifies the timing problems associated with the connection of peripherals and makes the system less susceptible to electrical noise, something likely to be important in an industrial environment.

There is a good selection of expansion cards for use in conjunction with the 6502 processor. Some of those available are described in the box above.

Hitherto, control applications have fallen strictly within the province of the assembly-language programmer. This restriction has now been swept away with the launch of Multi-Basic 85, an extension of BBC Basic designed for the control of input/output devices in the CMS system. Whereas previously it was necessary to spend several months becoming familiar with the techniques of low-level languages, now an engineer with a knowledge of Basic and the characteristics of the I/O devices can cobble together a suitable program in a matter of hours.

Multi-Basic is supplied in two forms, either as a sideways ROM located at &8000 or as a normally mapped ROM at &4000. The ROMs are initialised respectively with the *Multi command or a Basic Call to &4400. The language adds a block of

(continued on next page)

BENCHMARKS

The standard Basic Benchmarks were run — see *Practical Computing* January 1984, page 102. The differences between the three systems are due in large part to differences in the clock speeds.

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Av.
CMS 6502	1.21	6.00	15.67	17.04	19.89	29.44	44.51	95.11	28.61
Acorn 6502 second processor	0.42	2.10	5.49	5.98	6.96	10.30	15.55	35.37	10.27
BBC model B — 6502	0.65	3.16	8.20	8.93	10.42	15.41	23.26	52.55	15.32

(continued from previous page)

commands suitable for particular peripheral devices.

Up to 100 CMS systems equipped with a Versatile Interface Board may be linked together in an RS-422 network using the Supervisor. RS-422 was chosen because it uses balanced lines and will operate more satisfactorily in the noisy environments expected in industrial control applications. The Supervisor applications software is supplied with two powerful tools — a screen-driven utility SNet to assist in the installation and testing of a network, and a subset of Multi-Basic commands, functions and procedures for remote station access.

Seven procedures are provided for the read/write of the system versatile interface adaptors (VIAs). Typical of these is Configure which has the syntax

CONFIGURE [<register name>; <device address>; <bit pattern>]

and is used to set up a 6522 VIA register. A complementary command, Fetch, will read a VIA bit pattern and save it to memory.

There are three procedures which initialise, read from and write to analogue devices. As there are two digital/analogue cards in the CMS system, it is necessary to indentify which type is to be serviced.

There are six procedures by means of which the time as HH/MM/SS, date as YY/MM/DD, and period as week number/day number, may be set or read. Multi-Basic also provide six test functions for comparing the date, time and period with preset values,

The CMS system has five timers. Two of them correspond to the five-byte timers in the BBC Micro and the remaining three have four-byte accuracy. Each timer may be serviced by means of the commands RD_Timer or Set_Timer accompanied by the appropriate parameters.

A CMS system equipped with Multi-Basic can perform a number of background operations or tasks while it is running a program in the foreground. This is made possible by interrupting the foreground program at intervals to perform the background task or tasks.

There may be any number of tasks, defined in a manner similar to the procedures of BBC Basic, between the Task and Exit keywords. A trivial example is

```
10 *EVENTSON :REM keyword to enable
   EVENTS
20 TASK fred
30      I%=I%+1: PRINT I%
40 EXIT
```

Up to eight tasks may be active at any time. They are set in action by the Enable command and this may be at regular intervals or conditional on the pre-occurrence of a particular event.

CMS 6502 RACK SYSTEM

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	☐	■
Ease of use	☐	☐	☐	■
Documentation	☐	■	☐	☐
Value for money	☐	☐	■	☐

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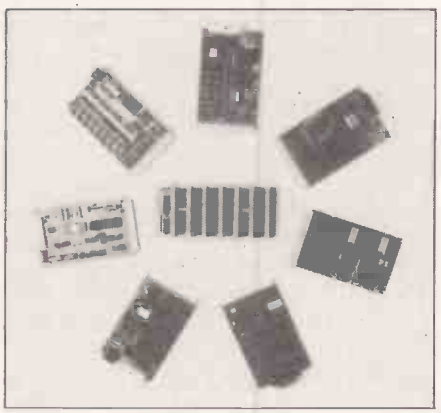

CONCLUSIONS

■ Although it will run BBC Basic programs, the CMS 6502 system is not a substitute for the BBC Micro.

■ Its main strengths are its flexibility and expansion capability.

■ It opens a new dimension in the development of industrial control since it is no longer necessary for the engineer to be an assembly-language programmer. PC

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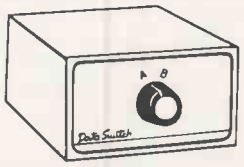

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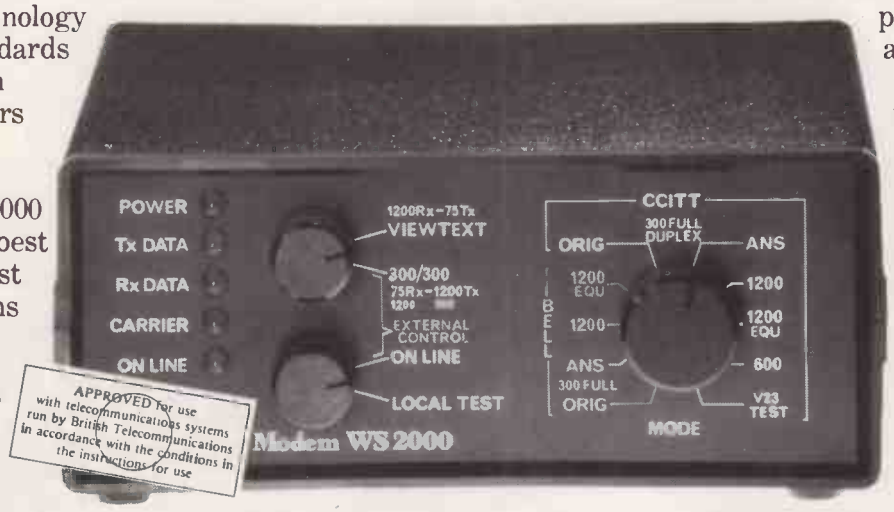

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VIENNA PC
WHITER THAN WHITE?

By Glyn Moody

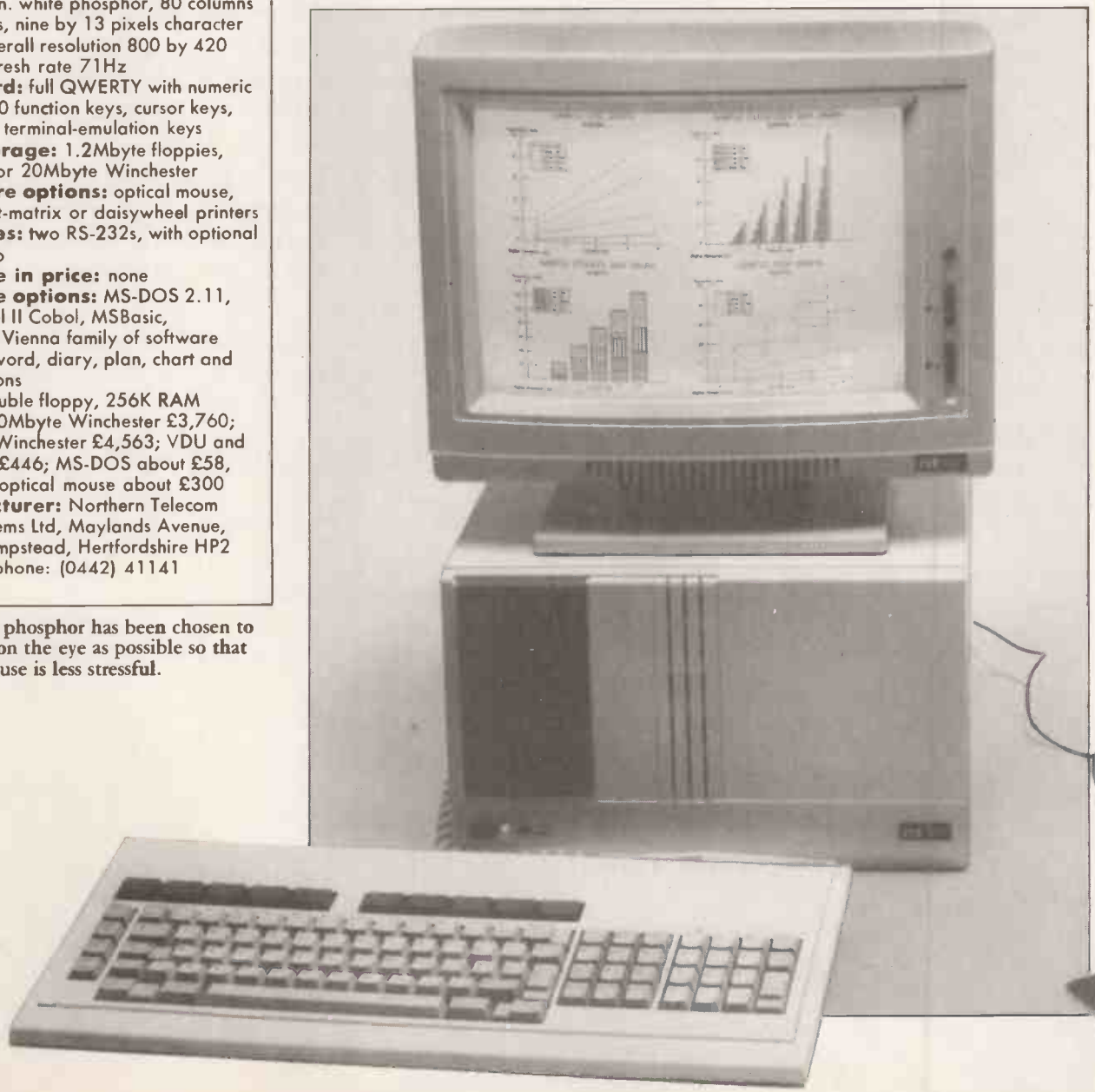
Designed as part of an integrated office automation system, this stylish 80186-based micro with superb graphics can function equally well as a stand-alone machine.

SPECIFICATION

CPU: 80186 running at 8MHz; a second 80186 is dedicated to graphics handling
RAM: 256K as standard, expandable up to 768K
ROM: 16K self-test and bootstrap
Dimensions: main unit box 13.7in. (350mm.) wide by 16.5in. (420mm.) deep by 8.5in. (216mm.) high
VDU: 15in. white phosphor, 80 columns by 27 lines, nine by 13 pixels character matrix; overall resolution 800 by 420 pixels; refresh rate 71Hz
Keyboard: full QWERTY with numeric keypad, 10 function keys, cursor keys, IBM 3270 terminal-emulation keys
Mass storage: 1.2Mbyte floppies, 10Mbyte or 20Mbyte Winchester
Hardware options: optical mouse, ink-jet, dot-matrix or daisywheel printers
Interfaces: two RS-232s, with optional further two
Software in price: none
Software options: MS-DOS 2.11, Gem, Level II Cobol, MSBasic, GWBasic, Vienna family of software including word, diary, plan, chart and paint options
Price: double floppy, 256K RAM £3,100; 10Mbyte Winchester £3,760; 20Mbyte Winchester £4,563; VDU and keyboard £446; MS-DOS about £58, Gem and optical mouse about £300
Manufacturer: Northern Telecom Data Systems Ltd, Maylands Avenue, Hemel Hempstead, Hertfordshire HP2 7LD. Telephone: (0442) 41141

The Vienna PC is a stylish premium product from the international telecommunications company Northern Telecom. Conceived principally as part of the Vienna Office, a complete medium-size integrated office-automation system, the Vienna PC can nonetheless function as a stand-alone 80186-based MS-DOS micro. It is notable chiefly for the fast high-resolution graphics capabilities of its white phosphor screen. The cost for a system with 256K RAM and a 20Mbyte Winchester is about £5,000.

The Vienna Office represents a major assault on the European market by Northern Telecom, which is the second-largest manufacturer of telecommunications equipment in North America, with total revenues of $4.4 billion in 1984, and 47,000 employees worldwide. The Vienna system,



The screen phosphor has been chosen to be as easy on the eye as possible so that prolonged use is less stressful.

including the PC, has been designed specifically for the European market, and initially is only being sold there.

Apart from its name and the various national keyboards and character sets available, the European slant is also evident in the concern for neat good looks, and in fact it won the European 1984 Ergodesign Award. The overall look of the three-piece setup is smart, and only marginally spoilt by the bulk of the main system box.

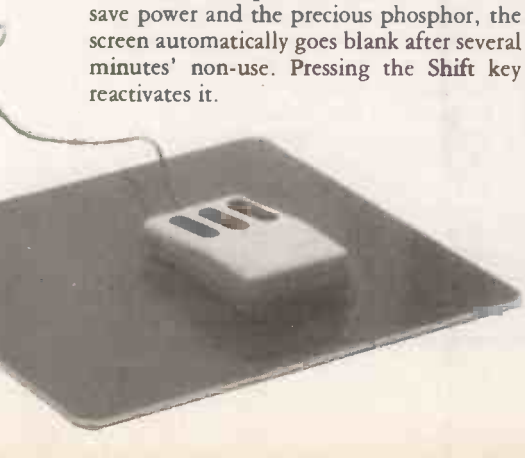
At the front of the main unit is the on/off switch and disc drive. The model reviewed here had one 1.2Mbyte floppy and a 20Mbyte Winchester. There are also dual-floppy versions and a 10Mbyte hard-disc model. Apart from the cable which goes to the power supply on the right-hand side next to the fan, the rear panel sports only a couple of RS-232 sockets and the main cabling for the terminal.

The terminal port occupies one of five expansion slots. Options available include extra RAM cards, taking the basic 256K up to a maximum of 768K, and two more serial ports. No parallel ports for printers are offered since Northern Telecom tends to sell its own varieties of serial printers, which can handle the full range of international character sets. For example, it sells an ink-jet printer from Siemens for about £600. There is no Reset button, which can be inconvenient.

The keyboard plugs into the VDU rather than the main systems box. It is ultra-thin, with keys that are nicely sprung but which may rock slightly too much for some. The keyboard layout is generous to a fault. In addition to standard QWERTY keys, numeric keypad and 10 function keys, there is also a facility for emulating an IBM 3270 terminal. To this end there are extra markings inscribed on the sides of many keys as well as additional keys. There are extensive soft-key definition facilities.

PAPER-WHITE SCREEN

Perhaps the chief point of interest of the new system, and certainly its chief glory, is the screen and graphics facilities. Northern Telecom has made efforts to procure a very high-quality display unit suitable for intensive office work, the visual properties of which match those of paper as closely as possible. The unit chosen has a white phosphor of a creaminess which makes even the Mac's white screen look garish. Easiness on the eye is enhanced by the 71Hz refresh rate for the screen, which makes for a rock-steady picture. The overall resolution is an impressive 800 by 420 pixels, with a nine by 13 matrix for alphanumeric characters. To save power and the precious phosphor, the screen automatically goes blank after several minutes' non-use. Pressing the Shift key reactivates it.



BENCHMARKS

The figures below show the time in seconds taken to run the standard Basic Benchmarks — see the January 1984 issue of *Practical Computing* for details. The Vienna emerges as a respectably fast machine, marginally slower than the RML Nimbus, also an 80186 MS-DOS machine, and even closer to the IBM PC/AT.

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Av.
Vienna — 80186	0.6	2.2	4.8	5.0	5.2	10.0	15.6	16.6	7.4
Sprite — 80286	0.5	1.6	3.5	3.5	4.2	7.8	11.6	9.3	5.3
Nimbus — 80186	0.5	1.8	3.9	4.0	4.6	8.5	13.2	13	6.2
IBM PC/AT — 80286	0.5	1.9	4.6	4.7	5.2	9.1	14.6	13.5	6.8

Wisely, Northern Telecom has capitalised on this high performance by allocating a second 80186 purely for screen graphics handling. The results are impressive, and nowhere is this more apparent than in the implementation of Digital Research's Gem. This is available for about £300, which includes the cost of an optical mouse. Like the keyboard, the mouse plugs into the base of the VDU.

OPTICAL TRACKING

Instead of using the trackerball principle of measuring the movement of the mouse by detecting how much a small ball in the base has rolled, the optical mouse employs a reflective sheet to work out the change in position. On the plus side, problems of dirt and slipping are avoided, but you are restricted in movement to the mirror pad, which may be useful on a crowded desk.

Gem is discussed in greater detail on page 50 of this issue. Whatever your feelings on the wisdom or otherwise of this approach, there is no denying that on the Vienna it looks very plausible. In particular, Gem graphics features, such as zooming, show Northern Telecom's micro to tremendous advantage. The images are drawn very fast, with excellent Infill routines and clean curved edges.

As a part of the Vienna Office, the Vienna PC is able to run most of the constituent application packages. These include all the usual options like word processing, spreadsheets, graphing and databases. Functioning as async terminals, Vienna PCs can also communicate with the Vienna Office central controller. Eventually it will be able to communicate via Ethernet and Cheapernet.

Paying the extra for MS-DOS, which is not included in the price of the hardware, opens up access to the large number of programs written to run under the operating system. Although the Vienna PC is not an IBM compatible, Northern Telecom claims it is possible to swap some data discs between them.

Northern Telecom has recognised that there is at least one PC-DOS product that many Vienna PC users could well want to use: Lotus 1-2-3. Therefore, it has adapted the program so that the low-resolution colour graphics will work on the Vienna's high-resolution monochrome monitor.

There is a uniform set of manuals for each of the component parts of the system. The user manual for the Vienna PC itself is well produced and comes complete with tasteful illustrations of Viennese sights but, regrettably, without an index. If it seems rather thin, this reflects Northern Telecom's desire to keep the user firmly outside the systems box. Even taking the cover off is awkward and for this review we decided not to violate the delicately textured paintwork. Installation procedures are normally carried out by an engineer from the company.

This whole approach reflects the fact that the Vienna PC is conceived of as very much an integral part of the whole office-automation strategy of Northern Telecom. That said, the PC exists in its own right as a serious and viable business system. Its overall design, its speed, and above all its superb graphics facilities are strong recommendations for it.

VIENNA PC

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	☐	■
Ease of use	☐	☐	■	☐
Documentation	☐	■	☐	☐
Value for money	☐	☐	■	☐

☐The Vienna PC is an up-market MS-DOS machine with an up-market price tag. The graphics on its white phosphor display are superlative.

CONCLUSIONS

■The Vienna PC is stylish up-market MS-DOS micro, originally designed as part of a larger office system but quite able to stand on its own feet.

■The high-resolution white screen is one of the best we have ever reviewed. It could well overcome the continuing reluctance on some people's part to come to terms with the dreaded VDU.

■As befits such a classy system, the price is not cheap at around £4,000. Similarly, the size of the system box means that it is no retiring wallflower.

■Although it lacks IBM compatibility, the Vienna PC is well enough served by MS-DOS programs and the packages which form the Vienna Office. Provided you are content with functional rather than fancy software, being locked out of the IBM-clone world should prove no desperate problem.

■Anyone impressed by the Mac approach to micro life but wishing to remain within the MS-DOS fold may well find the fast and effective implementation of Gem very tempting on the Vienna.

■Minor grouses include the closed box approach and the lack of a Reset button. PC

WORD PERFECT 4.0
THE ALL-ROUNDER

By Susan Curran

This word processor for the IBM PC and compatibles is good enough to challenge WordStar as the standard general-purpose package.

Word Perfect is one of the many U.S.-produced word processors for the IBM PC and compatibles. This review is of version 4.0, which I tested on an IBM PC/XT with 256K of RAM. On most compatibles, the program will work with a minimum of 192K. It requires two disc drives and will handle colour if you have a colour monitor.

This is a general-purpose word processor, with a great deal of power and a correspondingly high price tag. The normal cost is £425, though it may still be available through lower-priced launch offers. The producer, Satellite Software International, is also offering a special trade-in price of £250 for those who have a copy of various other well-rated IBM word-processing packages, including WordStar, Multimate and Samna Word.

The version which I reviewed was not anglicised. However, as we go to press SSI has released the U.K. spelling dictionary, along with a database and spreadsheet package which link to Word Perfect.

Word Perfect is a clean screen word processor: it comes straight up with an editing screen, which includes nothing but a brief note of the document number, page, line and cursor column position. It is possible to swap between documents 1 and 2, but not to window both at once. There is no ruler marking tabs and margins, and there are no on-screen control codes — not even for hard Returns. As far as possible, text is laid out on-screen exactly as it will be printed. Line spacing is echoed correctly on-screen, though justification is not reproduced.

SPECIAL CODES FOR FORMATTING FEATURES

Almost all the formatting features are handled by special codes. The Tab key produces a special Tab code, for example, rather than a row of spaces; the Indent key an Indent code. These codes are incorporated into the document, and have an effect upon its format either immediately, or when it is printed. The effect of many of the codes, including header and footer codes, page positioning and page numbering, is not obvious on-screen. In order to revise such features it is necessary to inspect the codes, and delete them if necessary before entering new ones, on a special Reveal Codes screen.

This should not be confused with the sort of toggled Codes On/Codes Off arrangement that programs such as WordStar employ. The Reveal Codes mode is cumbersome in the extreme, and cannot be used for normal editing. Only a few lines are displayed at once, with the text often dwarfed by a mass of lengthy narrative code descriptions. The cursor can be moved, but haltingly, and with much screen flicker. It is not possible to insert text or carry out other commands in this mode, only to delete.

Almost all commands in the program are handled via the function keys. The 10 keys are each given four different functions, used alone and with Shift, Control and Alt. A four-colour template is provided with the program, which explains as clearly as is possible which combination does which. All the same, I do not like this arrangement. It is inevitably confusing when, for example, f7 is used for Exit, Print, Math/Column mode select, and Footnote select. Fortunately, there is a Cancel key which enables you to undo the effect of mistakenly chosen selections. There is also an Undelete buffer. These provisions ensure that with familiarity the program operation is not as horrendous as it appears at first sight.

WORD PERFECT 4.0

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	■	☐
Ease of use	☐	☐	■	☐
Documentation	☐	☐	☐	■
Value for money	☐	☐	■	☐

☐ If I were using Samna Word or WordStar on a PC, I'd be inclined to make the swap to Word Perfect.

Like so many IBM word processors, Word Perfect does not automatically reformat text on-screen when amendments are made to it. It is possible to reformat either by giving a Rewrite command, or by scrolling the cursor line by line down the text. Reformatting in either case is moderately fast, but tends to be a little hit-and-miss. If lines are shortened by deletions, sufficient words are not always brought up from the next line to straighten the right-hand margin, and it is necessary to fiddle around deleting spaces in order to format adequately. I also found disconcerting the program's tendency to keep reformatting while blocks are being defined. There is no way of switching off the reformatting during this type of operation.

One other formatting failing is the tendency of Word Perfect to leave occasional spaces at the start of lines in mid-paragraph, producing a jumpy left-hand margin. Again, it is possible to edit them out, but they should not be there in the first place.

The program scrolls very smoothly in all directions, and the cursor commands are clear and effective, though not as copious as in some programs. Word Perfect shows page breaks on-screen, but it is not particularly page-orientated, and text can be moved across pages at will. Page breaks are adjusted dynamically as editing progresses.

The program defaults to right justification, which is not echoed on-screen, and to a very energetic hyphenation routine, which perpetually requests hyphenation decisions, not all of them sensible. I was relieved to find that these and other defaults can be altered in the setup program. The hyphenation zone can be abolished or set to different widths. Word Perfect defaults to a push-forward Insert mode, but it is possible to toggle between this and an Overwrite mode. Among other defaults which can be selected are widow/orphan protection to keep paragraphs neat, underline style, and page number position.

It is difficult to think of any command that is missing, or that is not handled well. There are all the usual block moves, copies

SPECIFICATION

Description: word-processing package with built-in mail merge, indexing and spelling checker
Hardware required: IBM PC with at least 192K of RAM — graphics card is optional; also available for various MS-DOS machines including the ACT Apricot, and some brands of local area network
Publisher: Satellite Software International Inc., Orem, Utah, U.S.A.
Price: £425 plus VAT; £250 when traded for existing word processors
U.K. supplier: Sentinel Software Ltd, Wellington House, New Zealand Avenue, Walton-on-Thames, Surrey KT12 12PY. Telephone: (0932) 231164.
Available now

This is Word Perfect's newspaper-style columns feature. It is possible to define up to five text columns across the page, and the program helps in calculating suitable spacing for evenly or unevenly sized columns. Here, I am using two even columns with a three-character spacing in between, and justification to even up the effect. Column 2 appears on screen beneath column 1, but on paper the two will of course print out side by side. It is easy to move text from column to column following edits.

● **Multi-column printing: up to five columns are possible.**

I. This is an automatically-numbered outline.
II. It provides for up to seven levels of
    A. indentation, and the entire
    B. outline can be revised and
    C. renumbered again and again.
III. Though this outline is generated directly on the keyboard, it is also possible to produce tables of contents automatically from documents which contain numbered subheadings.

● **Flexible formatting outlines can be generated automatically or from the keyboard.**

This is how Word Perfect text looks after light editing. I have made several insertions into this paragraph in order to show the failings I mention in the text. You can see that there is an occasional raggedness to be seen in the left margin, and that the right margin (though the text has been reformatted after the edit) still misses some short words that would have fitted from previous sentences. Though these imperfections can be dealt with manually (through deletions and insertions) they are an annoyance when editing lengthy passages. 'The' a few lines above is an example of what I mean.

For this sample I have switched on the 'hyphenation zone' with its default size. I find the hyphenation excessive during my normal work, so my version of the program omits hyphenation in its default settings. The program asks for hyphenation decisions during text entry, as well as in subsequent reformats. The zone size can be varied to suit individual requirements.

● **Edited text sometimes ends up looking decidedly ragged.**

and deletes, and no annoying restrictions on their use. Search and replace has many options, and works efficiently. There is a handy Indent command, which will indent either or both margins. Tab and margin changes are easily handled, and there is a Binding Width command allowing for alternate left and right wide margins. There are headers and footers — up to three of each, which will work on an odd/even basis — a footnote or endnote system, provision for producing tables of contents, a newspaper-style columns feature, and a maths mode which will handle simple calculations.

It is a pleasure to find a program with a simple to use macro feature. Macros can be used to automatically call up often-used words, saving repetitive typing. For instance, I used Alt-W as a macro name for Word Perfect, in writing this review. More complex macros can include command sequences, and could, for example, streamline an elaborate form-letter operation. All macro definitions are automatically stored on disc.

File handling is sensible, and there is a neat List Files menu from which it is possible to edit, delete, rename or prepare outside files for editing using Word Perfect. The program will automatically back up files during editing sessions, and you can select the backup interval for yourself.

The merge feature seems easy to use, though I did not attempt to push it to its limits. Text can be retrieved from a secondary record file, or entered from the keyboard. Fields in the secondary merge file can be used in the primary document in any order. Merged documents can be saved in their merged form, or printed straight out. It is not possible to select or sort records for merging without using the additional database package, which I did not test.

PRINT TIME

The program is very good on printer support, and its printer section can be edited to cater for special needs. It will queue files for background printing, and there is full support for queue handling. It is possible to print blocks, pages or full documents without first saving them. Special printer commands, such as Escape sequences, can be sent to the printer from within the program.

The spelling checker works fast and efficiently, and all checking is done in context. The program claims to have a 100,000-word dictionary, but it seemed to offer a lot of common words for confirmation, not all of them obviously because the version I used was unanglicised. It is possible to add to the dictionary, edit it, or create subsidiary dictionaries. There is a wild-card lookup, to enable you to check the spelling of words when typing them. It is only possible to obtain a word count as a side-effect of a spelling check.

My only major difficulty with the various commands came with the page formatting. Endless attempts failed to position the text properly on the paper in my FX-80, and I sometimes could not induce the Top Margin command to work properly, or the conditional End of Page command. As the program seemed so reliable otherwise, I blame this on my own blindness to some special requirement.

DOCUMENTATION

It seems to be obligatory now for word processors to have fat manuals. Word Perfect's is at least well arranged, and the reference section is cut down to a well-filled 112 pages. The tutorial section is much more expansive, and I found it to be a little exasperating. It takes you key press by key press through a fairly random selection of program features, with the emphasis on rote following rather than comprehension. However, I did not find the program difficult to learn.

There are special training-orientated manual sections to cover the more complex features of the program, including the merge facility and the maths feature. The help features on disc are comprehensive and context-sensitive.

The program comes on unprotected discs, unless you buy the special educational version. I had no difficulty in installing it on my computer, or in adapting the defaults. I have used it almost full-time for a month, and carried out some very heavy editing of long — up to 20 pages, single spaced — documents on it. In that time, I have not succeeded in hanging the program, or losing more than a couple of words of text unintentionally. In my opinion, it does a very good job of sustaining reliability without hedging users around with too many restrictions and confirmations of commands.

CONCLUSIONS

■ On first acquaintance, I found Word Perfect a rather unattractive program, with confusing key assignments and appalling, clumsy code handling. With experience these prove to be less of a drawback.

■ The formatting imperfections are exasperating. Otherwise the program is extremely usable, very reliable and very powerful.

■ At £425 plus VAT it is expensive, and its lack of U.K. support is a foiling.

■ Overall, I have not seen a better all-round PC word processor. PC

MAC MUSIC
PROGRAMS OF NOTE

By Glyn Moody

Two music packages which apply the Macintosh's visual interface to good effect.

Writing music on present-day micros is a laborious process. Either you have to specify each note as a pitch and a duration, or else there is some complicated system using a reconfigured computer keyboard. Furthermore, limitations in the character sets available mean that, at the end of the day, the results are crude and of little practical use to a musician. What is needed is a high-resolution system that can cope with the very special characters and layout logic of notes and staves, and which also has a way of placing notes on the staves that is natural to the user.

The Mac is an obvious contender. To start with, its graphics-based icon system parallels the representation of music by an array of functional symbols. Equally, the mouse is ideal for placing notes on staves. To harness these capabilities for music processing, all that is needed is software that handles the logic of note groupings, key signatures, time signatures and so on.

TRUE MUSIC PROCESSOR

Professional Composer is a package offering just such facilities. It has been written by Mark of the Unicorn Inc. for the Fat Mac. It should be emphasised that this is not just another music synthesiser package, though it does have limited playback facilities. It is a true music processor which allows you to enter and manipulate musical notation as easily as spreadsheets and word processors handle numbers and words.

Professional Composer can cope with up to four single staves, a double piano stave, or a single stave combined with a piano stave. As a default, single staves bear a treble clef; you can change a clef by pulling down the Symbols menu. Selecting Clefs causes a palette bar to appear on the left-hand side of the screen on which can be found alternatives like bass, tenor, alto and unpitched percussion clefs!

Time and key signatures are called up from the Basics menu, which is pulled down in the same way. On selecting them, windows appear which allow standard time signatures to be chosen, or more unusual ones to be entered by hand. Another window allows you to scroll through the keys — both major and relative minor — and select the appropriate key signature.

The method of entering notes is similarly mouse-orientated. A small cursor is moved around the stave and clicked to select a particular pitch. Notes of various duration can be placed at this pitch by pulling down a Symbols menu, and selecting Notes. This causes a palette bar to appear on the left-hand side of the screen on which can be found the musical symbols for notes ranging in duration from a breve to a hemidemisemiquaver. Accidentals including double sharps and double flats are also obtained from here.

Other palette bars allow rests, dynamics, ornaments and articulations to be added in precisely the same way. Ornaments and dynamics appear over and under the notes respectively.

In addition to this visual, two-stroke system of entering notes, it is also possible to speed up the process by using the mouse in conjunction with the keyboard. Pitches are still chosen using the on-screen cursor, but note-durations are determined by the key which is depressed at the same time: D is a crotchet and C a quaver, for example. Holding down the Shift key as well gives you rests instead.

A line of music can be built up relatively easily and quickly. Errors can be corrected by placing the cursor to the right of the offending note and pressing the Backspace. One problem with this is that deleting a whole string of notes requires you to move the cursor several times, unlike word processing where Backspace/Delete moves the cursor back for you.

SPECIFICATION

PROFESSIONAL COMPOSER

Description: A music processor which allows you to enter and edit music on a conventional stave, play it back and generate high-quality printed output
Hardware required: 512K Apple Macintosh
Price: £429 plus VAT
U.K. distribution: P&P Micro distributors Ltd. Telephone: (0706) 217744

MUSIC WORKS

Description: Synthesiser with printout facilities
Hardware: 128K Apple Macintosh
Price: £68.30 plus VAT
U.K. distribution: Softsel Computer Products Ltd. Telephone: 01-844 2040

PROFESSIONAL COMPOSER

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	☐	■
Ease of use	☐	☐	☐	■
Documentation	☐	☐	☐	■
Value for money	■	☐	☐	☐

[ ] A genuine innovation that could do for composers what the word processor has done for authors — if only it were cheaper.

As well as the host speed and metronome markings brought in from the Basics menu, it is possible to place text in a variety of styles on the staves. This allows expression marks and lyrics to be added.

The Edit menu allows you to cut and paste or copy and paste just as with text systems. Sections are first selected by dragging the cursor over them. Transpositions by key or by interval are available from the Variations menu. Music can be saved at any time with a single mouse operation.

INTELLIGENT ATTEMPTS

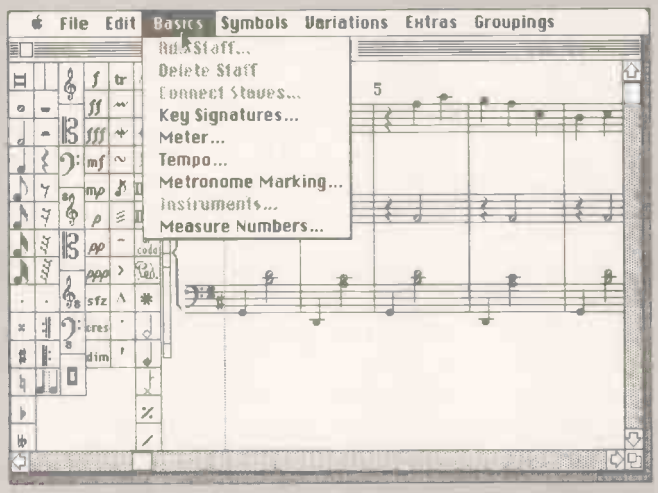
Chords can be built up on each stave, but it is not possible to have simultaneous notes of different duration in a chord on the same stave. The program is sufficiently intelligent to space out notes in an attempt to align main beats. Initially no check is made as to whether there are too many or too few notes in a bar, though an option on the Extras menu will carry one out. Bar lines must be entered by hand.

On their own the features mentioned so far would produce output that was functional, but hardly exceptional or indeed practical for the performer. Professional Composer does, however, have many more refining features that enable music entries to be brought to printed music quality.

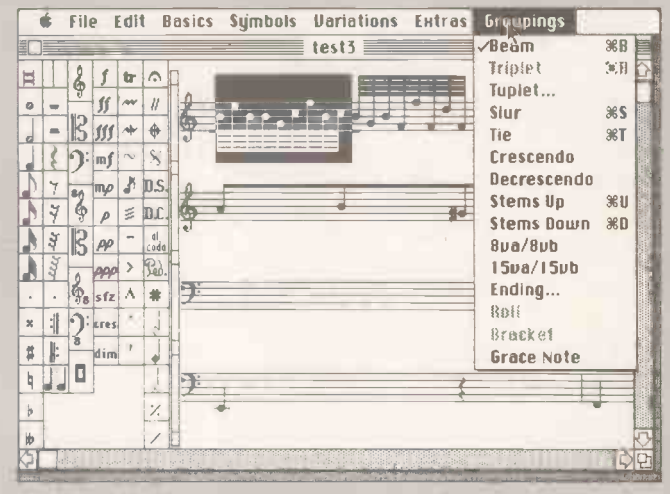
Most of the more advanced features are called up from the Groupings menu. As its name suggests, this is primarily concerned with functions of groups of notes. For example, the raw input of notes results in a rather ragged row of separate heads and tails. By selecting a group and then using the Beam option from Groupings, the tails of notes are neatly joined up. Triplets and n-tuplets can be specified if required; you can mark five notes to be played in the time of

(continued on page 72)

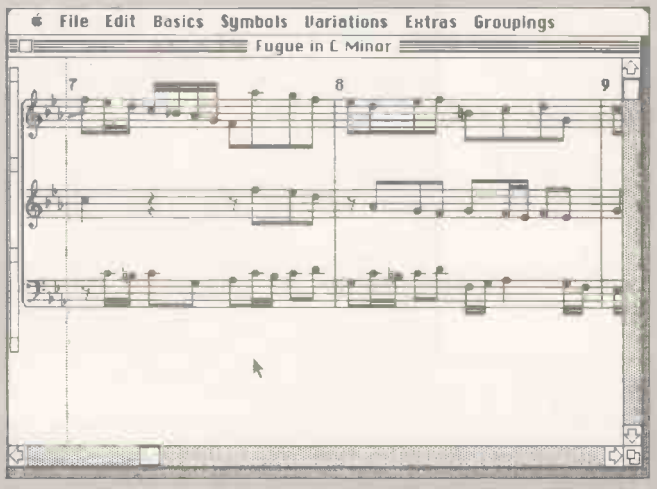
PROFESSIONAL COMPOSER



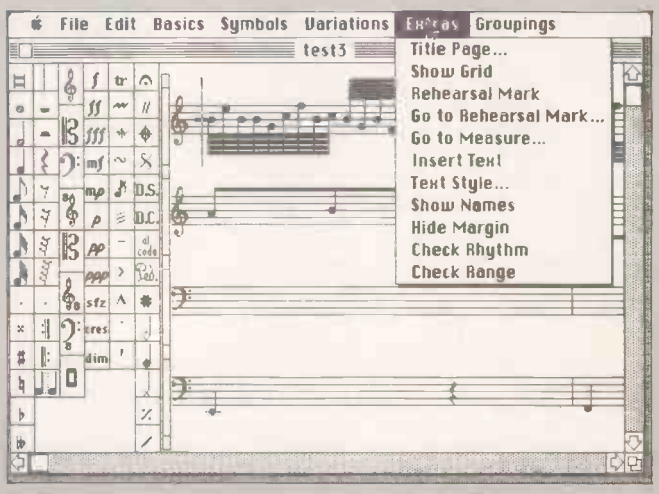
Professional Composer allows you to select musical notes and signs from palette bars called up from the Symbols menu. The Basics menu handles keys, tempo and metres.



After a group of notes has been selected, the Beam command on the Groupings menu joins them up. Similarly, slurs, ties and crescendos can be formed.

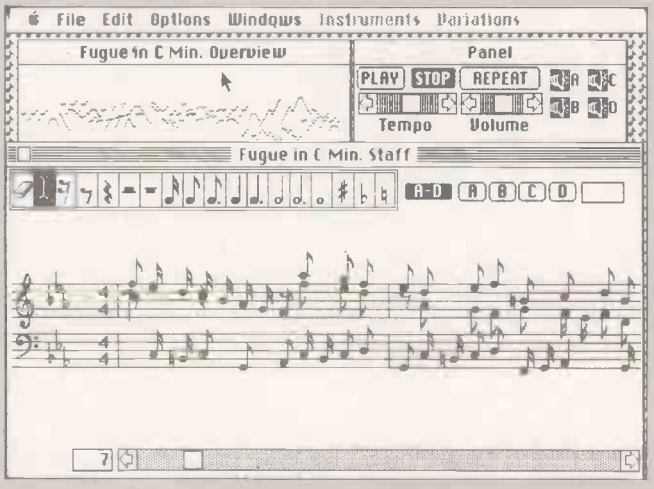


Professional Composer's version of Bach's fugue in C minor from *The Well-tempered Clavier*. The beams of note groups have been joined using the Groupings menu.

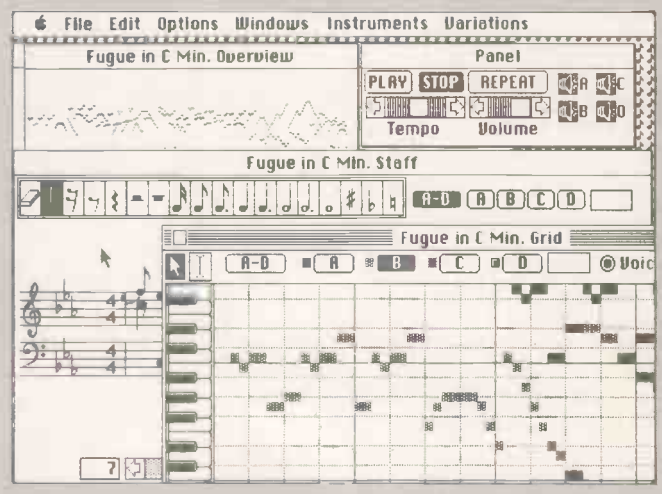


The Extras pull-down menu allows text to be inserted, and rehearsal marks set up. You move within the score by using the scroll bars at the bottom of the screen.

MUSIC WORKS



The same Bach piece produced by Music Works. The tempo and volume can be altered using the cursor by sliding them along. The musical Overview is in the top left-hand corner.



As an alternative to conventional musical notation, it is possible to use a piano keyboard to place notes by daubing them on a grid. Different voices use different shadings.

(continued from previous page)

four, and so on. Other features available from the Groupings menu include crescendos, 8va/8vb, rolls and slurs.

It is details of this kind that make Professional Composer such a considerable advance. They allow you to cope with most types of music likely to be encountered in the ordinary run of things, though some of the more adventurous experiments of contemporary music are beyond the program's capabilities. Another limitation is that only a maximum of four staves can be used. Within those limitations, the quality of the final printed output is excellent, and certainly good enough to be played from. Both full scores and parts can be produced. In combination with, say, a laser printer it is probably good enough to use as commercial artwork.

Before initiating the printing process you may invoke a Preview facility. This allows you to view on-screen a reduced image of the page as it will appear on the printer.

Although Professional Composer is not intended as a synthesiser, it does have a very useful though limited playback feature. It is not possible to change the speed or the timbre, nor does the playthrough pay any attention to markings on the score. But it does provide a very simple and quick aural check on the notes you are feeding in. In particular, it is very easy — and enjoyable — just to throw in a few notes, see what they sound like, and then edit them as required. To this extent, Professional Composer opens up whole new vistas in composition.

As befits a top-notch product, the manual is excellent. After a short introduction — enough to get you up and playing — with plenty of screen dumps and white space, there is a comprehensive run-through of the facilities. A short reference guide to the various menus follows, then a glossary and list of symbols used, and their meaning. There is a good index.

BEYOND THE REACH OF MOST MUSICIANS

The main problem with the whole package is the price: £429 plus VAT is quite unrealistic. No composer short of Andrew Lloyd Webber is going to be able to afford both a 512K Mac and this program. Music copyists, for whom potentially it also represents a breakthrough, will find it way beyond their means. It is probably only viable for music publishers and fat cats on the rock and commercial music scene. Nonetheless, Professional Composer gives a glimpse of features which the next generation of music processors could well offer for a more affordable price.

In comparison, the price of Music Works from Hayden Software is something to sing about: £68.30 plus VAT. But it should be said at the outset that not only is it not in the same class as Professional Composer, it is not strictly speaking competing.

Music Works does offer extensive facilities for entering music, but it is geared much more to making the Mac into a easy-to-use synthesiser. As a rough indication, it can be said that Music Works produces output at about the first level of Professional Composer — that is, without the subtleties of note groupings and so on. Music Works does, however, offer some interesting additional features.

The main screen for note entry has two staves, with fixed treble and bass clefs; up to four voices can be added, all of which are displayed on the two staves. As on Professional Composer, a mouse-driven cursor is used to place a note on the stave and to select the duration from a small palette bar. One refinement over the other package is that the cursor rather neatly turns into the symbol selected. Notes are removed from the stave by selecting the Eraser symbol, which in practice is more exact than the backspace technique of Professional Composer.

The range of symbols is more restricted: the longest note is a semibreve and the shortest a semiquaver. There are no double sharps or flats. In some other respects, though, Music Works is more sophisticated.

MUSIC WORKS

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	■	☐
Ease of use	☐	☐	☐	■
Documentation	☐	☐	■	☐
Value for money	☐	☐	☐	■

A cheap way of turning the Mac into an easy-to-use synthesiser.

For example, after you have chosen a time signature from the Windows menu, any notes you enter are automatically apportioned within bar lines, taking account of any notes already present. Similarly, bars are filled out with rests where necessary. One problem is that no matter where the other notes in the bar are positioned, rests tend to float upwards, which can make for a slightly confusing layout.

Music Works also caters for those who cannot read or write music. From the Windows menu, selecting Grid causes a small piano keyboard to appear at the left of the screen. Notes are then entered by daubing small blobs opposite the relevant position on the keyboard. Durations are determined by the length of the blob, and the grid is used to set the temporal position in the bar. The vertical and horizontal scroll bars are used to move to different parts of the keyboard or grid. An indication is given of the current octave and note.

As with Professional Composer, there is a range of cut, copy and paste facilities for speeding entry of music. It is also possible to transpose sections. One innovative feature is the window dubbed Overview. Using dots and lines it present a scaled-down version of your score, giving you an interestingly global view of a piece. Compositions are limited to 1,024 crotchet beats, that is 64 bars of 4/4 time or 128 of 2/4, which precludes the possibility of setting up longer pieces on Music Works.

Music Works comes into its own as a music synthesiser. In playback, you can alter the loudness and speed. If you are really enamoured of your masterpiece you can loop it indefinitely. As the score is played, a vertical line moves across the Overview window as an indication of relative position. Double-clicking the Overview window during playback causes the relevant bar to appear in the main stave.

It is also possible to assign a number of instruments to voices. These show up on the grid version of the music by small letters that appear within the heads of the blobs themselves. The range is rather limited: a piano, organ, trumpet, chime and kazoo. Changes can be made to the sound envelopes using the Variations menu.

More interesting is the possibility of setting up two synthesisers. The first starts from a basic sine wave, and the second from a square wave. Using the cursor it is possible to modify these on the screen to produce weird and wonderful waveforms which can be tried out and modified if necessary in another effective application of the Mac's visual approach.

A GOOD FIRST STEP FOR NOVICES

All in all, Music Works is well suited to anyone who wants to experiment with music on their Mac. It would also form quite a useful introduction to the whole world of musical notation for someone with little or no previous experience.

Instead of the grand ring-bound manual of Professional Composer, there is a useful down-to-earth stapled booklet which includes a quick run-through of basic musical terms and ideas. There are also numerous examples included on the disc, which should provide food and background music for thought.

CONCLUSIONS

- Professional Composer offers a simple and effective way of entering and editing music. Its range of facilities allow both full scores and parts to be printed out to high quality.
- Music Works uses similar techniques to turn the Mac into a limited but eminently usable synthesiser. There is also a printout feature.
- Professional Composer is overpriced for its likely end-market of musicians. Later products of this type will probably be progressively cheaper.
- By contrast, Music Works seems very reasonably priced at just under £80 including VAT.
- Limitations of Professional Composer include only allowing a maximum of four staves, and restrictions on how chords can be built up.
- Music Works is also limited to four voices, which correspond to the four internal voices of the Mac.
- The manual accompanying Professional Composer is superlative. That for Music Works is workmanlike and quite adequate. PC

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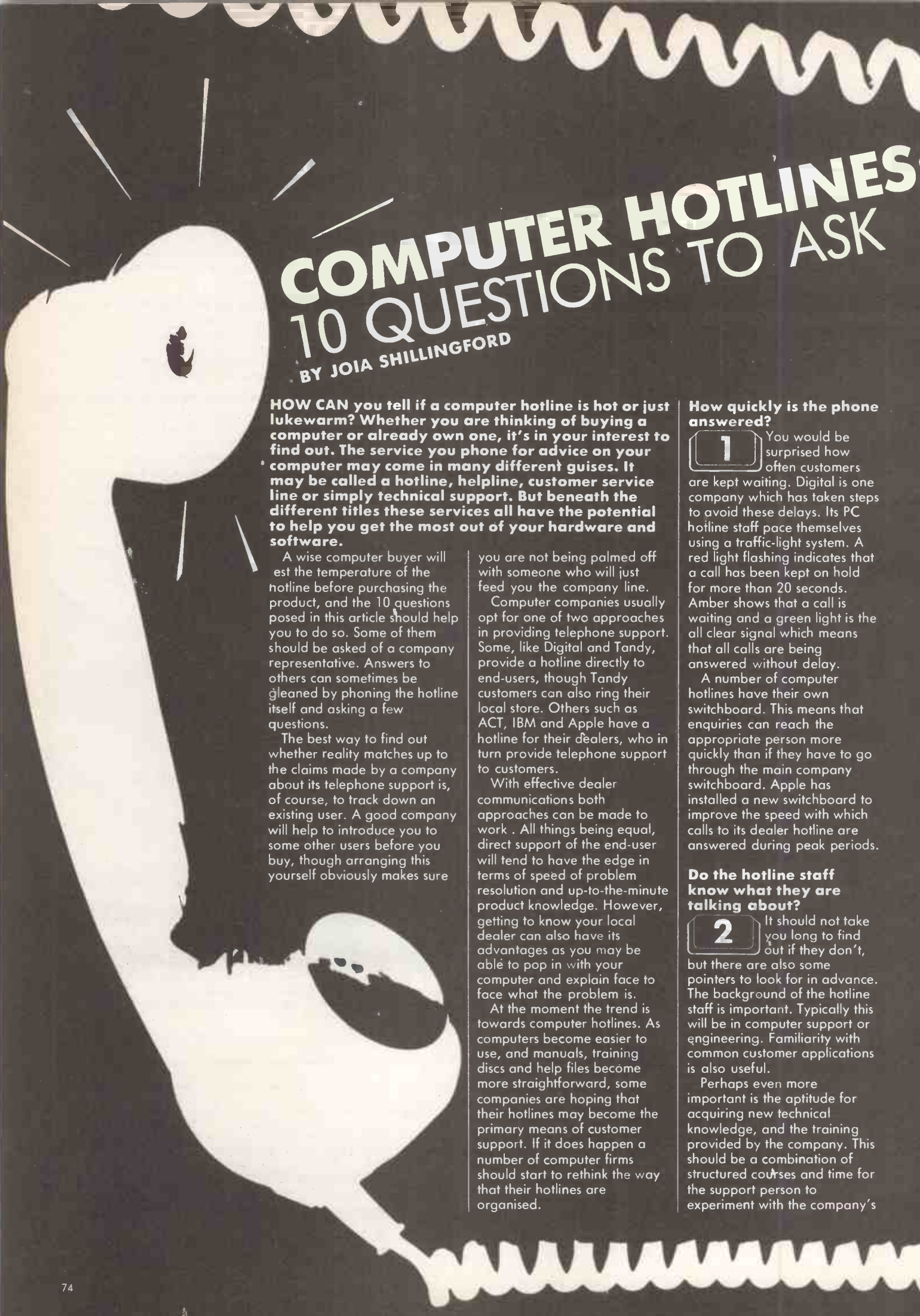


COMPUTER HOTLINES
10 QUESTIONS TO ASK

BY JOIA SHILLINGFORD

HOW CAN you tell if a computer hotline is hot or just lukewarm? Whether you are thinking of buying a computer or already own one, it's in your interest to find out. The service you phone for advice on your computer may come in many different guises. It may be called a hotline, helpline, customer service line or simply technical support. But beneath the different titles these services all have the potential to help you get the most out of your hardware and software.

A wise computer buyer will est the temperature of the hotline before purchasing the product, and the 10 questions posed in this article should help you to do so. Some of them should be asked of a company representative. Answers to others can sometimes be gleaned by phoning the hotline itself and asking a few questions.

The best way to find out whether reality matches up to the claims made by a company about its telephone support is, of course, to track down an existing user. A good company will help to introduce you to some other users before you buy, though arranging this yourself obviously makes sure you are not being palmed off with someone who will just feed you the company line.

Computer companies usually opt for one of two approaches in providing telephone support. Some, like Digital and Tandy, provide a hotline directly to end-users, though Tandy customers can also ring their local store. Others such as ACT, IBM and Apple have a hotline for their dealers, who in turn provide telephone support to customers.

With effective dealer communications both approaches can be made to work . All things being equal, direct support of the end-user will tend to have the edge in terms of speed of problem resolution and up-to-the-minute product knowledge. However, getting to know your local dealer can also have its advantages as you may be able to pop in with your computer and explain face to face what the problem is.

At the moment the trend is towards computer hotlines. As computers become easier to use, and manuals, training discs and help files become more straightforward, some companies are hoping that their hotlines may become the primary means of customer support. If it does happen a number of computer firms should start to rethink the way that their hotlines are organised.

How quickly is the phone answered?

1 You would be surprised how often customers are kept waiting. Digital is one company which has taken steps to avoid these delays. Its PC hotline staff pace themselves using a traffic-light system. A red light flashing indicates that a call has been kept on hold for more than 20 seconds. Amber shows that a call is waiting and a green light is the all clear signal which means that all calls are being answered without delay.

A number of computer hotlines have their own switchboard. This means that enquiries can reach the appropriate person more quickly than if they have to go through the main company switchboard. Apple has installed a new switchboard to improve the speed with which calls to its dealer hotline are answered during peak periods.

Do the hotline staff know what they are talking about?

2 It should not take you long to find out if they don't, but there are also some pointers to look for in advance. The background of the hotline staff is important. Typically this will be in computer support or engineering. Familiarity with common customer applications is also useful.

Perhaps even more important is the aptitude for acquiring new technical knowledge, and the training provided by the company. This should be a combination of structured courses and time for the support person to experiment with the company's

products on their own. They should also have had a chance to work through the manuals and the records of common problem solutions, and spend some time answering calls on the hotline while under supervision.

Staff should be on the hotline phones regularly, not just as a fill-in between other tasks. This will enable them to consolidate their knowledge. Hotlines which are answered by whoever happens to be near the phone when it rings are unlikely to provide the user with satisfactory support.

Will you get called back if your problem can't be solved on the spot?

3 Though most computer hotlines say that they will call back if a problem can't be solved immediately, the less efficient ones sometimes forget. It is time wasting and annoying to have to keep ringing back to get an answer. Talk to other users to find out what a particular company actually does.

If the hotline staff can't resolve a tricky problem, do they have access to other technical staff who can?

4 A good hotline will be able to answer most people's questions most of the time. However, problems will occasionally arise which require a fix from the development team. This means that there must be clear escalation procedures for problems that have been reported to hotline but cannot be solved by the hotline staff.

Tandy's hotline telexes the firm's Texas headquarters when it needs further assistance. Apple U.K. uses the phone or electronic mail to contact its technical specialists in the U.S. Digital has brought a large number of its technical specialists — including those who operate the hotline — under one roof. Previously they had been scattered among several locations up and down the country. Customers benefit from this policy of pooled expertise because some support staff of Digital's PC products will be close at hand.

At what times is the hotline open?

5 There is no point in paying for hotline support if it is not there when you need it. Apple offers an 8.30a.m. to 6.30p.m. helpline. Digital's customers can have the support of a 24-hour helpline if they are willing to pay extra for cover outside office hours.

ACT and Tandy operate hotlines during office hours, but say that calls will often be answered at other times. IBM's dealer hotline is staffed from 9a.m. to 5p.m. Messages can be left with an answering service at other times.

Are the caller's details logged and analysed?

6 Many computer hotlines make a note of the customer's or dealer's name, company name, phone number, problem and the date of the call. Fewer make good use of the information they have gathered. Efficiently managed customer records mean that when you phone a hotline twice in one day — perhaps your problem wasn't solved the first time — you won't have to explain yourself all over again.

Any computer company interested in making improvements to its product or service should not overlook the importance of the feedback provided by callers to its hotline. Persistent calls about a particular piece of software may point to a bug, or an inaccurate or misleading passage in the manuals or help files. They may even indicate a need for simpler software or new software that can cope with a commonly required application.

IBM, Digital and ACT analyse hotline calls regularly, breaking the calls down into specific areas. Digital also gains useful feedback from an annual survey of how its customers have fared.

ACT looks at three main areas; applications and software, communications and networking, and languages and operating systems. Tandy has plans to analyse its log of calls, but does not yet do so. Apple analyses its call records from time to time.

Are the solutions to common problems recorded for reference purposes?

7 Both Apple and Digital log the answers to common questions in electronic databases. Users benefit because their questions can be answered quickly, and the company also saves money in the long run.

Apple has recently added a technical bulletin board to its older problem database to keep dealers informed of new solutions to technical problems. Apple's bulletin board runs on an Apple II and contains recent problem solutions. In the last year, Apple has also added technical agony aunt pages to its dealer magazine *Appletalk*.

Is the hotline supplied with all the necessary manuals and equipment?

8 The last thing you want to do when you ring a hotline is to wait while someone tracks down the appropriate manual. If you are the first person to explain that every time you hit the circumflex key a light comes on but nothing prints up on the screen, the hotline person should be able to copy your actions on a terminal just like the one you are using — preferably without moving away from a phone. In this way, finding out the solution to your problem should only take minutes.

The customer service line at Tandy has at its disposal every piece of equipment and software Tandy has ever sold in the U.K. ACT equipment is also on order in anticipation of the merger of ACT and Tandy telephone support departments.

Is there a charge for using the hotline?

9 Telephone assistance from dealers is usually free of charge. So is the hotline service they contact when a customer asks them something out of the ordinary. It is worth checking whether there is any charge for a user hotline.

Tandy's hotline is free of charge, Digital's is free for the first 12 months; subsequently customers can get hotline support if they have opted for an after-sales support contract. The Fixed Fee service is the cheapest of these and costs £25.

The benefits of a good hotline in terms of reduced down time and perhaps more efficient use of your system are likely to be well worth the charges you will have to pay.

What is the attitude of the hotline staff?

10 If you feel patronised by the hotline staff or blinded by computer science then their attitude is wrong. Pitching an explanation at the right level is a difficult skill to acquire, but experienced hotline people should have a feel for the type of user they are talking to. They should be able to differentiate between the boffin and the beginner, and provide anyone with an appropriate explanation.

The hotline person should avoid jargon unless he or she is sure that the enquirer will be able to follow it. A competent hotline person should have a friendly manner so that users feel at ease with them. Staff should not just be picked for their technical agility, but also for their ability to communicate well. PC

HOW TO AVOID THE BLUES

Compatibility is not everything. Glyn Moody introduces our selection of 10 micros from those you could dare to buy instead of an IBM clone.

As the business micro world turns a deeper shade of Big Blue every day, you might wonder if there are any reasons left for buying other than IBM. Does the adage "Nobody ever got fired for choosing IBM" mean you have to be a masochist to do otherwise?

The Apple Mac for one, shows you don't. There may have been a time when cynics — and that includes the odd journalist — were sceptical. Technically superb, the Mac was a closed system and perversely incompatible with the Apple II. Hence there were very few programs available for it — generally the kiss of death for a machine — and none of the third-party add-ons which made the Apple II so versatile and popular. It all looked a little too like the sad and sorry tale of the now-defunct Lisa.

But the biggest problem, software starvation, seems to have been fixed. A glance at the Spring issue of the Macintosh's *Buyer's Guide* reveals some 550 packages, not bad going for a machine that is less than two years old. Another small indication of the Mac's coming-of-age is Bill Gates's enthusiasm for the machine. Coming from the supplier of IBM's PC-DOS, this seems to pass beyond simple prudence in backing both horses in a two-horse race — see this month's Interview on page 81.

What is emerging in the Mac is an innovative and stylish machine that is also viable in a business context. If desk-top metaphors, mice and icons appeal, the Mac has very definite advantages over the stuffed-shirt approach of IBM.

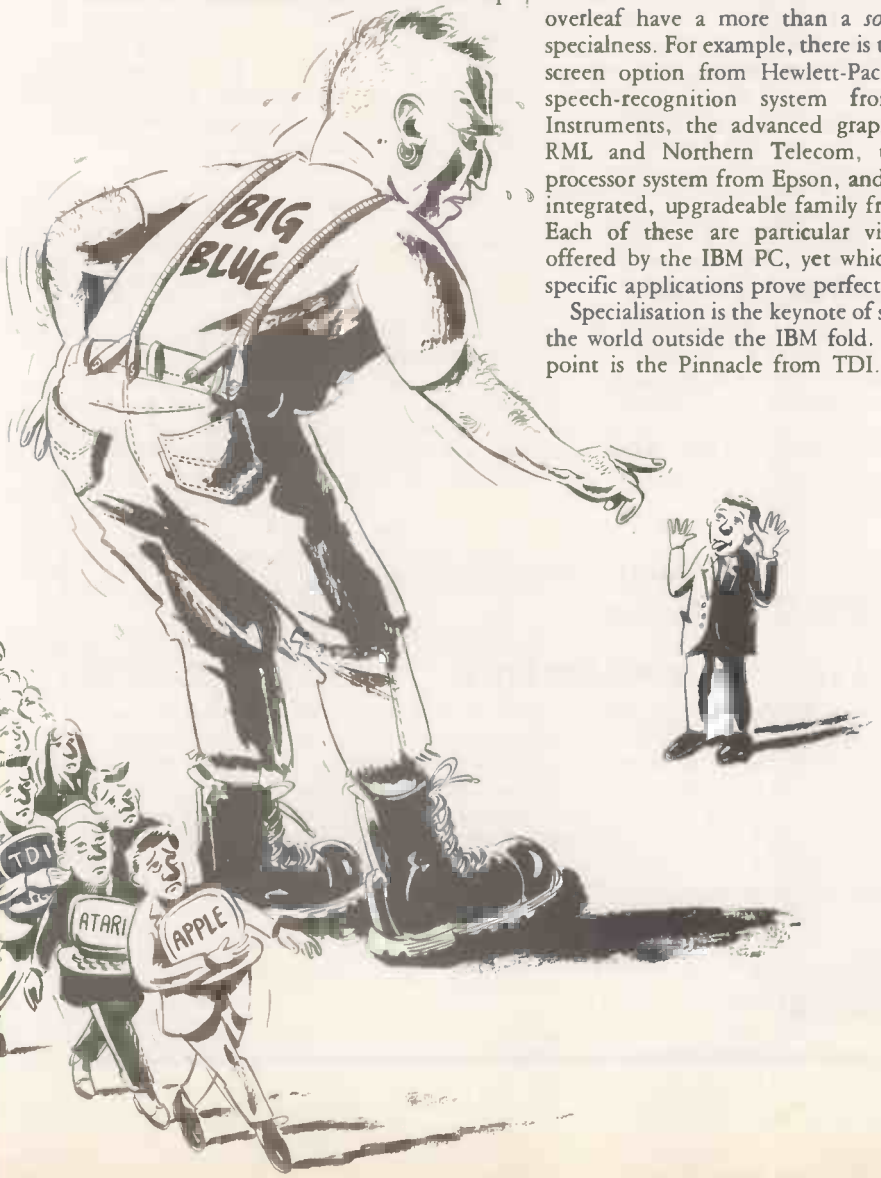
Ironically, the biggest threat to the Mac is unlikely to be the Big Blue bully, but Jack Tramiel's Mac-like Atari 520ST. Some uncertainty still surrounds this product: for example, can it possibly be that good at that price, and will there be any software? If it can, and there will, it could well be a very serious business proposition. And at £700, even the most hardened of IBM addicts might well be tempted.

Even sticking with boring old MS-DOS can have its advantages. If you make clones, then you have succeeded if you are as near to IBM as copyright laws allow — hardly a recipe for innovation or excitement. But without the Holy Grail of compatibility, you are forced to offer a little extra to compensate.

Most of the MS-DOS machines listed overleaf have a more than a *soupçon* of specialness. For example, there is the touch-screen option from Hewlett-Packard, the speech-recognition system from Texas Instruments, the advanced graphics from RML and Northern Telecom, the dual-processor system from Epson, and the fully integrated, upgradeable family from ACT. Each of these are particular virtues not offered by the IBM PC, yet which may in specific applications prove perfect.

Specialisation is the keynote of survival in the world outside the IBM fold. A case in point is the Pinnacle from TDI. Running under the powerful — but in business circles relatively obscure — p-System, this very fast machine is almost indifferent to the concerns of clonedom. If you want a p-System engine, perhaps for in-house development, or just a system with little degradation when supporting up to seven users, you can concentrate on specifics such as "Does it do what I want?" rather than generalities like "How compatible is it?"

Of course heterodoxy has its price. It is true you are likely to be cut off from the hottest mainstream developments, which almost certainly will come through on the IBM first. You will not be the first on your street with the latest colour integrated package complete with icons, pull-down windows, built-in expert system, and bells and whistles requiring the special 80386 board with 4Mbyte RAM expansion. But then are you buying a computer to use now or to be trendy with tomorrow? PC



SUPPLIERS

Apple Macintosh: Apple Computer (U.K.) Ltd, Eastman Way, Hemel Hempstead, Hertfordshire HP2 7HQ. Telephone: (0442) 60244. Circle no. 361.
Apricot: Apricot U.K. Ltd, Shenstone House, Dudley Road, Halesowen, West Midlands B63 3NT. Telephone: 021-501 2284. Circle no. 362.
Atari ST: Atari Corporation (U.K.), Ltd, Atari House, Railway Terrace, Slough, Berkshire SL2 5BZ. Telephone: (0753) 33344. Circle no. 363.
Epson QX-16: Epson (U.K.) Ltd, Dorland House, 388 High Road, Wembley, Middlsex HA9 6UH. Telephone: 01-902 8892. Circle no. 364.
HP-150 II: HP Ltd, PC Group, King Street Lane, Winnersh, Wokingham, Berkshire RG11 5AR. Telephone: (0734) 784774. Circle no. 365.
Pinnacle: TDI Ltd, 29 Alma Vale Road, Bristol BS8 2HL. Telephone: (0272) 742796. Circle no. 366.
RML Nimbus: Research Machines Ltd, Mill Street, Botley Road, Oxford OX2 0BQ. Telephone: (0865) 249866. Circle no. 367.
Sprite: Jarogate Ltd, 197-213 Lyham Road, London SW2 5PY. Telephone: 01-671 6321. Circle no. 368.
TI Professional: Texas Instruments Ltd, International Data System Division, Manton Lane, Bedford MK41 7PA. Telephone: (0234) 67466. Circle no. 369.
Vienna PC: Northern Telecom Data Systems Ltd, Maylands Avenue, Hemel Hempstead, Hertfordshire HP2 7LD. Telephone: (0442) 41141. Circle no. 370.

APPLE MACINTOSH £1,795

The Mac represents the *ne plus ultra* of the non-IBMulators. Most other machines run under MS-DOS — which is at least an approximation to IBM's PC-DOS — but Apple gives you idiosyncrasies all the way. The processor is a 68000, and the operating system quite different from the staid approach of practically all other machines. Even if the Mac did not pioneer the use of icons and the desk-top metaphor, it is certainly responsible for its popularisation. If you like this approach, or just want to be different, the Mac could be for you. The earlier problems of software starvation seem to have been largely overcome, with new and exciting packages every month. The only disadvantage is the price.

FOR Innovative and genuinely new. Sleek in looks and use.

AGAINST Limited expansion possibilities. Low disc capacities.

APRICOT PC £1,595

ACT'S Apricot is the U.K.'s one great hope among micro manufacturers. This Birmingham-based company has progressed from selling the Sirius to designing and building a very reasonably priced range of micros. At the bottom is the Apricot F1, costing just under £895 excluding a monitor, and offering a very cheap MS-DOS entry-level system. The mainstays of the family are the semi-transportable PC and XI, dual 3.5in. floppies and Winchester versions respectively. More recently 40Mbyte file servers have been introduced for the 32-user network which ACT also offers. More gimmicky and more fun is the Apricot FP, the transportable with built-in limited voice-recognition facilities. The fact that there is a complete compatible family is a tremendous strength.

FOR Compatible family. Large U.K. user base.

AGAINST Poor keyboard on F series.

ATARI 520ST £699.99

The Atari ST is the joker in the micro pack at the moment. Its spec is amazing: for a mere copper under £700, VAT included, you get a 512K micro with a 720K 3.5in. floppy, monochrome screen and a bundle of Digital Research's software including the innovative Gem package — reviewed on page 50 of this issue. Gem provides a Mac-clone front end, with all the paraphernalia of icons and a mouse. The question is: can Tramiel bring it off? With memories of another wonder machine — the Sinclair QL — and its attendant problems still fresh in the memory, a little scepticism would probably be advisable. Another factor to bear in mind is that there will be relatively little software available for the first year. But if the ST is still around after that, it could be unbeatable.

FOR Excellent spec. Cheap. Versatile.

AGAINST Limited availability. Lack of software.

EPSON QX-16 £2,100

The QX-16 is something of a hybrid system. While it certainly goes well beyond mere MS-DOS compatibility, it stops short of trying to ape the IBM PC even in simple matters like the keyboard layout or accepting expansion cards. The Epson further hedges its bets by including a Z-80 which eventually will allow you to run CP/M. But perhaps the chief interest of this system is its front end, called Taxi. Once again, this is modelled on flavour of the month, the Mac. What is special about it is that it simply sits on top of MS-DOS and lets you run unmodified files from it directly. This can provide a very soft and comfortable interface.

FOR Icon-based front end to MS-DOS. CP/M capability.

AGAINST Price. Hybrid system.

HEWLETT-PACKARD 150 II £3,300

The HP 150 began life as a machine based around a truly innovative concept. Instead of using an unfriendly keyboard — which many executives seem unwilling to do anyway — and rather than opting for trendy mice, Hewlett-Packard went for a touch-screen. This allows you to select the option you require, simply by touching the appropriate area on the screen. A grid of infrared beams detects the precise position. This seemed a nice idea in theory, but it has failed to win the hearts or the corporate desk tops of the world. As a result, HP has downgraded the touch-screen to add-on status. Nonetheless, if this approach appeals to you, the HP 150 II which includes the touch-screen is a solid machine with useful bundled software.

FOR Fast processing. Built-in printer option.

AGAINST Price. No parallel port.

PINNACLE £6,690

The Pinnacle is a thoroughbred machine produced as a joint venture between the British firm TDI, which is based in Bristol, and Pinnacle Systems Incorporated of Dallas. It uses the increasingly popular 68000, and is one of the first machines to push it to something like its limits. For example, the processor runs at a cool 12MHz with no wait states, which adds up to the fastest machine we have benchmarked. However, it is not a general business machine like the others in this Top Ten. In particular it is conceived of as a p-System engine, and it is not possible to run standard MS-DOS software. However, more standard operating systems like CP/M-68K and BOS are available, granting access to a number of ready-written packages.

FOR Speed. Multi-user capability.

AGAINST Mainly a p-System engine. Not totally user-friendly.

RML NIMBUS £1,695

Hitherto Research Machines has been better known as a purveyor of high-quality specialist machines to the educational market at an equally high price. But with the Nimbus it has produced an impressively fast and powerful general-purpose machine that could well appeal to a wide range of users because of its MS-DOS standard operating system and its exceptional graphics. These are largely due to an 80186 running at 8MHz in conjunction with a custom graphics chip designed by RML. The price is also very attractive: about £1,700 for a system with two 3.5in. discs, colour monitor and IBM-type keyboard. The machine is built to RML's customary high standard.

FOR Price. Speed. Graphics.

AGAINST Limited software on 3.5in. floppies.

SPRITE £5,630

Like the IBM PC/AT, Jarogate's Sprite is based on the latest chip from Intel, the 80286. Taken together with its 21Mbyte Winchester as standard, it provides a passable hardware imitation of Big Blue's next blockbuster, although it is not intended as a clone of any kind. The Sprite does have a PC mode under its operating system, Concurrent CP/M. During review, the operating system proved one of the few weak points in a generally impressive and solidly built machine. Later releases of Concurrent DOS will presumably have ironed out some of the bumps. A big plus is the built-in Ethernet interface, which in conjunction with the fast multi-user capabilities of the machine, means that the Sprite could well be a good buy for small- and medium-sized offices which are likely to expand.

FOR Speed. Built-in Ethernet. Expandability.

AGAINST Concurrent DOS is wobbly.

TI PROFESSIONAL £3,795

The TI Professional stands out from the crowd of MS-DOS machines by virtue of an add-on feature, its speech recognition. Using special circuitry you can train the micro to recognise groups of up to 50 words and short phrases, each one of which is assigned to a string of ASCII characters. Particular applications might be setting all the common functions like Block Move, Save, etc. in WordStar to be voice activated. In this way you can keep your hands permanently on the keyboard. It is also possible to store chunks of continuous speech, though this is currently very memory intensive. The main drawback is the price, which is a hefty £1,250 for the speech unit alone. ACT's FP machine has some of these voice facilities and costs about the same for the whole machine.

FOR Several voice input and output features.

AGAINST Cost of voice system. Memory-hungry.

VIENNA PC £3,100

The Vienna PC forms part of an office-automation system from the North American telecommunications firm Northern Telecom. It is reviewed in greater detail on page 66 of this issue. Apart from its 80186 main processor, its chief claim to fame is the very high-graphics resolution of 800 pixels by 420 pixels, available on its white phosphor screen. A further 80186 processor is dedicated to handling the bit-mapped graphics. These facilities are put to good use working with Digital Research's Gem, which provides a mouse-driven front end. The Vienna PC is unusual in that it offers a customised version of Lotus 1-2-3 which will run on its monochrome screen. There is a range of standard software applications available as part of the Vienna Office system.

FOR High-quality screen. Good graphics.

AGAINST Price. Bulk of systems box.

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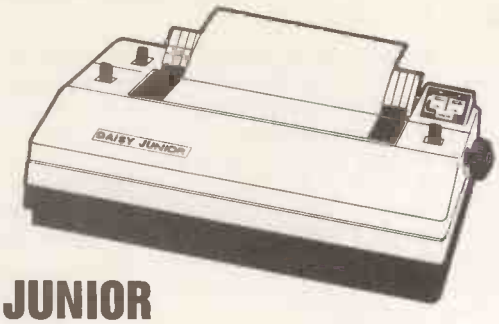

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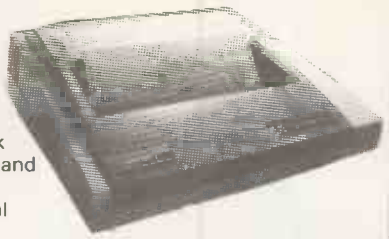

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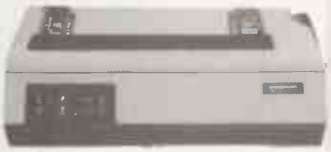

Character matrix (H x W)	9 x 7/18 x 40 selectable
Matrix dimensions (H x W)	3.08 x 1.52 mm/ 3.27 x 2.03 mm selectable
Print speed (10 cpi)	400/100 cps
Print quality	Data processing/correspondence
OCR character fonts	
Character set	128 characters
Character pitch	10/12/16.7 cpi with 9 x 7 matrix 10 cpi with 18 x 40 matrix
Characters per line: 132 characters at 10 cpi 165 characters at 12.5 cpi 220 characters at 16.7 cpi	
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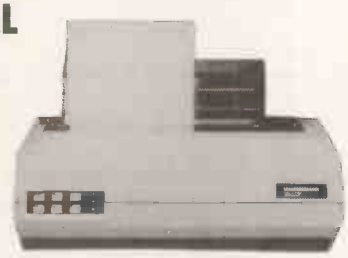

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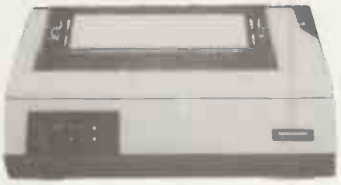

Character Matrix (H x W)	9 x 9
D.P.	18 x 48
Correspondence	3.25 x 1.9 mm
Matrix Dimensions (H x W)D.P.	
Print Speed @ 10cpi	400cps
D.P.	150cps
Correspondence	
Printhead	18 needles
Character Set	128 characters (ISO multinational
OCR-A. OCR-B	plus IBM PC
Barcodes	Optional
Large Character Printing	N/A
Characters per Line	
@ 10.0cpi	132
@ 12.0cpi	158
@ 12.5cpi	—
@ 15.0cpi	198
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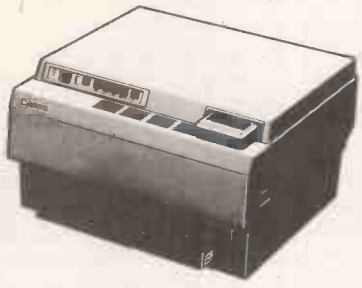
Canon



Print Mode: Landscape/portrait **Positioning:** all point addressable by 1/300 inch **Character Pitch:** Multiple Character Pitches in a line 10, 12, 13.3, 15 CPI, P.S. etc.**Line Pitch:** Multiple Line Pitch in one page 6, 8, 8.7 LP1 etc. **Multiple Font:** Maximum 15 fonts/page (internal font, font cartridge) **Overstrike Printing:** Available **Character Enlargement:** Doubling in two directions

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INTERVIEW

BILL GATES founder and President of Microsoft

INTERVIEWED BY GLYN MOODY

How are things going to pan out between the Mac and the IBM PC?
I THINK that's very clear: the Mac will be number 2. The Mac plus Excel is a far superior solution to the IBM plus 1-2-3. And until you have serious software, a machine is not a serious machine, despite the power and ease of use the Mac has brought. A year ago they had no software, now they've got a ton of software and that's helping a lot. But they need a few milestone packages which push it to the point where a guy who works with numbers says, "Look, get me a Mac, because the Mac with a Laserwriter lets me do my job in a far better way than I could do in the past."

In what way do you think Excel moves beyond the previous generation of packages?
OUR CLAIM is very simple: it's the world's greatest spreadsheet, it's the best way of working with numbers. And that was our very straightforward goal in doing the thing.

How do Topview and Windows sit together?
TOPVIEW is a very nice utility that allows you to run multiple applications. I don't know of a single software company that's writing applications that require Topview because there's really nothing Topview lets you do that's unique. It's not compatible with the network, it uses up a lot of memory, it doesn't use batch files: there are some limitations. Windows happens to run multiple applications, but Windows is a sub-system that supports graphics, and a graphics user interface. So unless you like the graphics applications we'll be including in with Windows, then you shouldn't buy Windows.

What has been the problem with the release dates of Windows?
WHEN you're building the foundation you're telling everyone to put their application on top of, it's a very significant responsibility to get the thing small and fast and good. We underestimated how tough that was going to be to get it exactly right. We've had good feedback from software developers in terms of what they really want, and speed and things like that. Also there were some things about "should we work with old applications?" and we decided we should; "should we work without a mouse?" and we decided we should. That's one of the more fantastic features we've put in. In our case it's a graphical user interface that doesn't require the mouse to use the menus although it supports it very fully. And it's a very substantial system, not only Windows itself but the development tools that go with it. We underestimated the process.

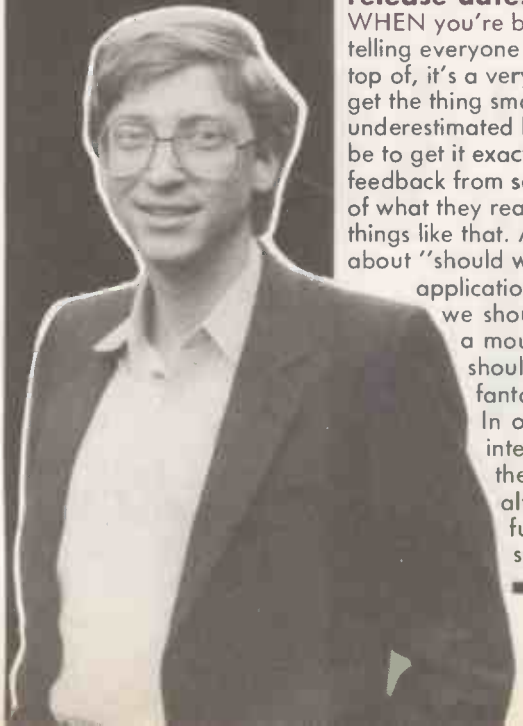
How important for Microsoft is networking?
WE HAVE two real thrusts. One is graphics, the other is networking. Networking has gone so smoothly and we've gotten so much support that it's probably gotten a little less attention. But it is one of our greatest successes to have people like IBM, ACT and HP — almost everyone is behind MS-Net — and therefore having all the software developers using the MS-Net protocols. It's gone super well for us. The key market right now that DOS machines sell into is the office market, and in the office market, all the machines will be networked eventually.

How do you see that squaring with the multi-user capacity?
THERE IS obviously some trade-off when you're solving a particular problem. In the long run, as people want to use graphical applications we think that a single user, networked, will be the dominant approach. But we see a very significant role for multi-user systems like 286-based systems running Xenix where the cost per terminal is much lower, and the ease of setting things up and controlling the data is far greater today than it is in the network case. So that's a market that will flourish. Because the 286 chip is really great: it's the first inexpensive microprocessor that has the performance, and the memory management. Coupled with a 20Mbyte hard disc it's the first popular machine that's adequate for Xenix and Unix-type applications. Because we got IBM to announce Xenix we're going to get applications momentum behind Xenix. It'll get it to critical mass.

Do you think Xenix will take off now?
OVER 70 percent of the Unix systems in the world today are Xenix so we've done very well with customers like Intel, Radio Shack and Altos. But even so it's fallen short of market predictions. I think the 286 will help that, and IBM's involvement will help that. We need to get up to like 400,000 systems in the next year-and-a-half to make sure that the software companies involved make a good living in Xenix applications.

How do you see PC-DOS developing in the future?
I'VE TALKED about multi-tasking, and I've talked about Windows being on top of that, and there are some extensions we can do in the network area. Another key thing is to track the Intel chip developments, the 286, and then the 386. That, in whole, is a full set of activities for the next three years. PC

Programming has always been central to Bill Gates's life. He took a programming job after leaving school and before going up to Harvard. He left university after only two years in order to set up Microsoft in 1974. Gates was also actively involved in the writing of code for Windows and adapting MS-DOS for the IBM PC. Today, looking even younger than his mere 29 years, Gates presides over a company whose latest turnover is expected to top $140 million. He and his co-founder Paul Allen remain the majority shareholders.



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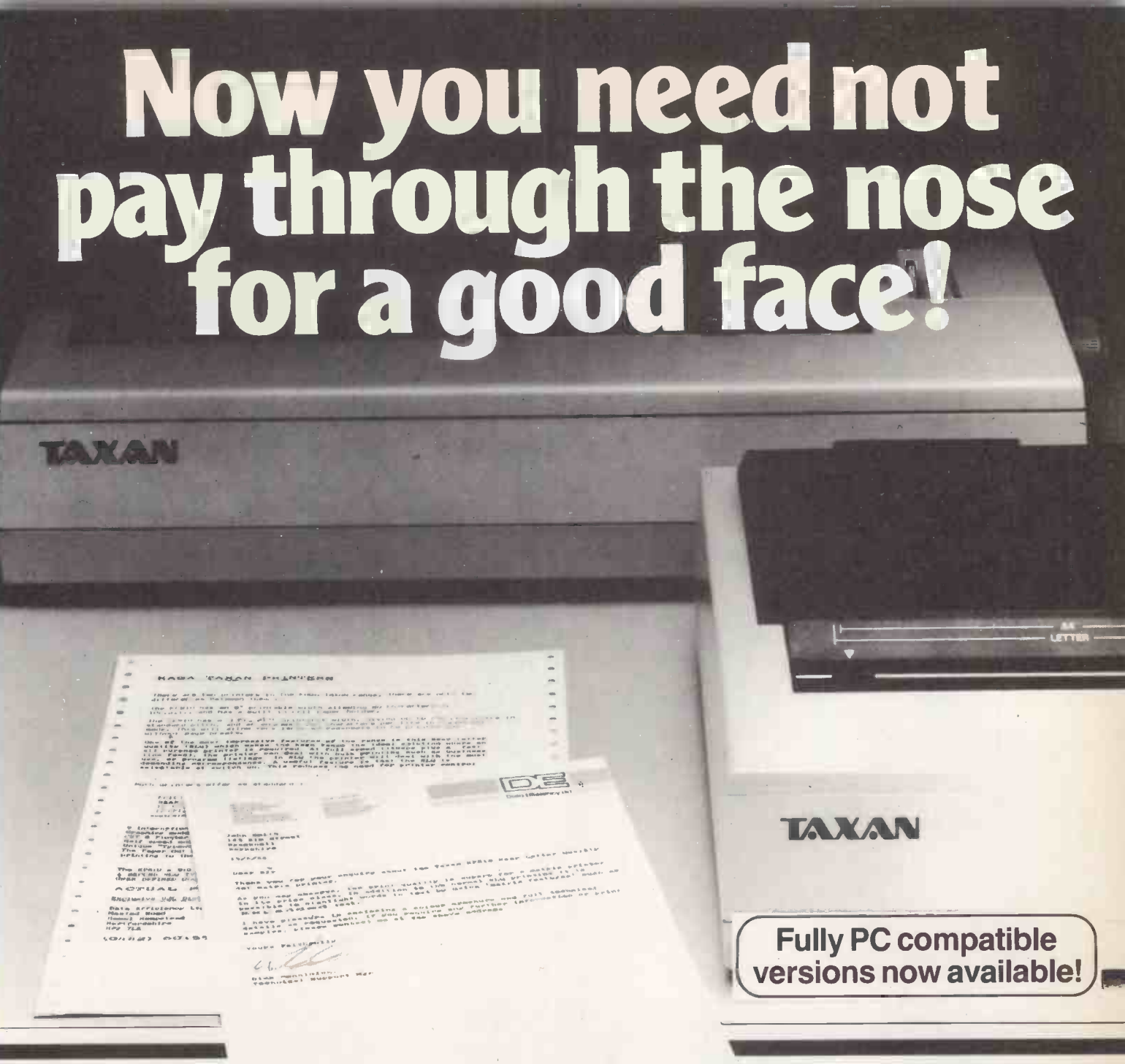

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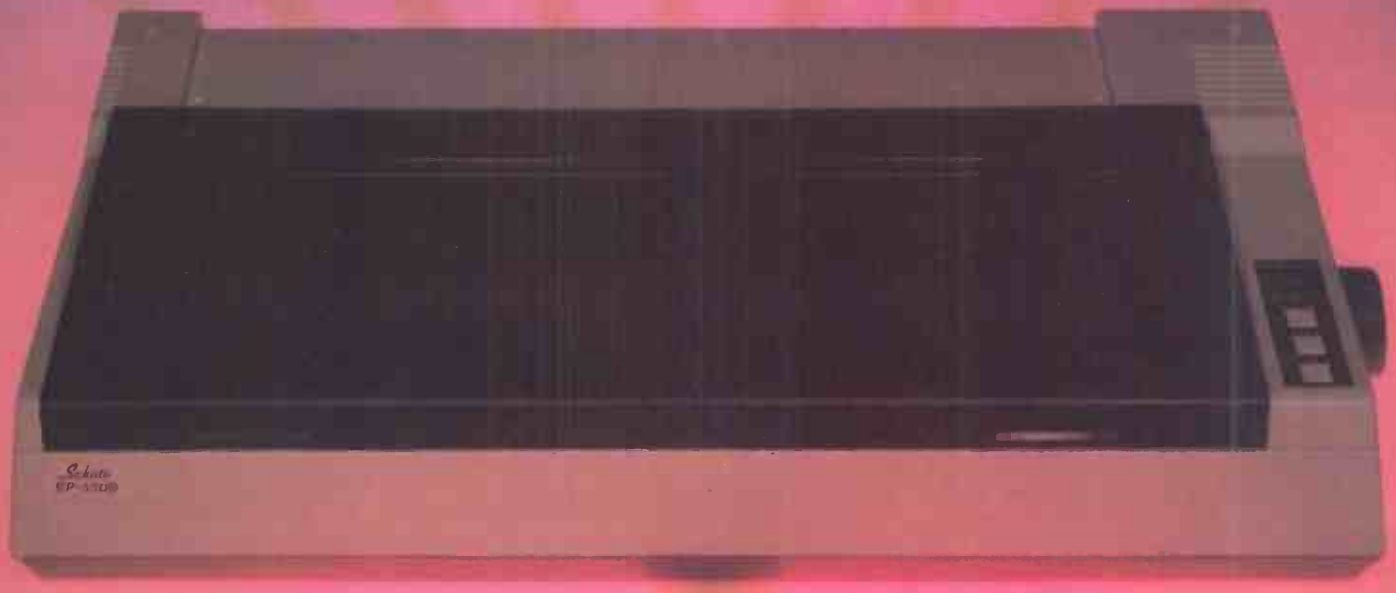

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84

PRINTERS

WHICH PRINTER?

Daisywheel and dot-matrix printers have captured the upper and lower ends of the printer market. Now they are being threatened by other types of printer which are quiet, cheap, fast and can produce high-quality output. Ian Stobie looks at the kinds of printer available.

For a long time daisywheel printers have dominated the market for high-quality personal computer printing, while dot-matrix printers have taken the lower-quality high-speed end. This picture is now changing. Daisywheel printers are under attack from two directions: at the top of the price range by laser printers costing little over £3,000 and at the bottom by a new generation of much improved matrix printers with prices starting below £300.

Noise is a fundamental attribute of daisywheel printers, as they work by impact — banging fully formed embossed characters through a ribbon on to the paper. It is not unusual for an unenclosed daisywheel to put out around 65db(A) or more, making it too noisy to sustain a telephone conversation in the same room. The only thing you can do to overcome the problem is to put the whole printer in an acoustic enclosure or a different room, which adds to the expense and inconvenience.

Daisywheel printers are slow because they work in basically the same way as electric typewriters, spinning a single character into position in turn and printing one character at a time. The top speed attainable with this technique is 90cps, but the more typical office machines range between about 20cps and 55cps. In fact, quoting speed in the industry-standard fashion of characters per second tends to overrate the amount of actual printing you can get through because cps figures make no allowance for things like the time wasted at the end of each line.

Despite their high-tech name laser printers are really little more than photocopiers with the electronics to allow computers to drive them. They print a page at a time and are capable of producing letter-quality output at high speed — from about the equivalent of 300cps. Because they are based on photocopier parts they are quite civilised for the office environment. They are very quiet compared to a daisywheel, coming in below the 55db(A) level, and sounding about a quarter as noisy. However, despite dramatic reductions in the price of the technology laser printers are still quite expensive: the cheapest, like the Canon LBP-8 and Hewlett-Packard Laserjet, still cost over £3,000. These machines really make most sense for the higher-volume daisywheel user, printing between 400 and 4,000 pages a month.

Dot-matrix printers have the reputation for being almost as noisy as daisywheels while giving lower quality. But they do print quickly, at speeds between 100cps and 500cps. Matrix printers mark the paper in a number of different ways, but all build up the character from a pattern of dots to get that familiar computer-printed look. Yet far from becoming obsolescent, matrix printers are going from strength to strength.

The latest machines have dramatically reduced noise levels and offer much better print quality. The previous generation of machines generally formed each character from a seven by five or a rather more readable nine by nine pattern of dots. The latest machines use nine by nine for printing at high speeds, but also let you print using an 18 by 18 matrix giving near letter quality, although admittedly at a slower speed. Characters formed on an 18 by 18 matrix still do not look as good as those produced on a daisywheel, but more expensive machines get closer using more complicated print heads containing 18 or 24 pins to mark the paper.

In this survey on printers we assess these two challengers to the daisywheel, until now the workhorse of word processing and other high-quality business printing. On page 92 we look at laser printers, including the new and very powerful Apple Laserwriter, while on page 89 we look at what the latest low-cost dot-matrix printer from market leader Epson is capable of doing for its price of £255.

(continued on next page)

Dot-matrix graphics.

Epson LX-80: NLQ at low cost.

Apple Laserwriter: top quality and speed.

DIFFERENT TYPES OF PRINTER COMPARED

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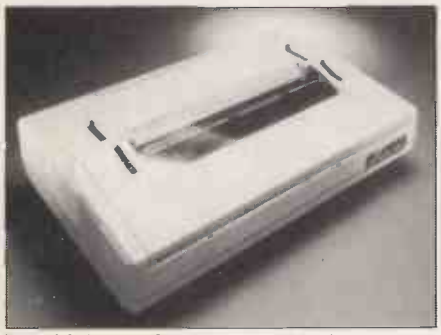
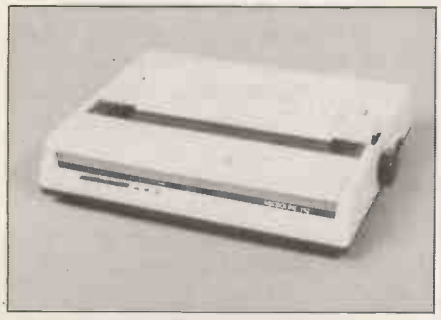
Apart from price, the most important factors to consider when comparing different types of printer are print quality, noise, paper choice and running cost.



The high-speed Qume 11/90 Plus.

Daisywheel These printers work by banging embossed plastic or metal characters through an inked or carbon ribbon on to paper. The characters are mounted on the end of a multi-stemmed disc which looks vaguely like a daisy, hence the name. Print quality is excellent and indistinguishable from a good-quality office typewriter. You can change the typeface by changing the daisywheel and almost all daisywheel printers offer proportional spacing which makes the output look better and saves space. Other advantages are the ability to print on normal office stationery and produce simultaneous copies with multi-part stationery. However, daisywheels are dreadfully noisy and slow. Speed is related fairly directly to price. For example, a cheap one like the £249 Uchida DWX-350 goes at 20cps while the faster £799 Juki 630 goes at 40cps. The Qume Sprint 11/90 Plus, which is probably the fastest daisywheel on the market at 90cps, costs £2,398.



Oki Microline 192: much quieter.

Dot matrix The most common type of matrix printer is the impact dot matrix, which works by banging a set of metal pins through inked or carbon ribbon on to the paper. The print head consists of a vertical line of pins which are moved horizontally over the paper, selected needles firing at each position to build up the pattern of each character and eventually an entire line. Print quality depends mainly on how many pins there are in the head, usually nine, 18 or 24. A modern nine-pin head produces readable output, forming characters on a nine by nine matrix, which is quite acceptable but not really good enough for business correspondence.

Many of these machines offer a near letter quality (NLQ) mode. Here print quality is improved by making a second, third or even fourth pass over characters already printed, filling in the dot pattern but incurring a speed penalty in the process. A more expensive way of getting better quality without speed loss is to have more pins in the print head, 18- and 24-pin heads being the most common. Such heads produce much better print quality but it is still not up to daisywheel standard.

Like daisywheels, matrix printers can print on ordinary paper and can be used with multi-part stationery to produce simultaneous copies, and running costs are low. Most people use special continuous fan-fold paper rather than standard office stationery, which means their printer has to be equipped with a tractor paper-feed mechanism, as this allows the machine to print unattended.

```
Normal print speed
 Near Letter Quality
hes - 10, 12, 17 & 5, 6
```

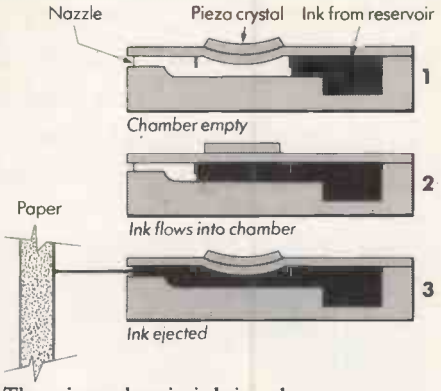
NLQ output is more presentable.

Graphics printout from Honeywell M-34.

Matrix printers are noisy, but the better modern ones such as the Oki Microline 192 at £399 are getting close to 55db(A). This machine has a nine-pin head and runs at 160cps normally, with a 40cps in NLQ mode available. A faster printer is Honeywell's M-34CQ, which also has a nine-pin head but runs at 265cps normally and 70cps in NLQ mode, and costs £945. One of the fastest matrix printers is the Anadex DP-6500 which runs at 540cps and costs £2,730.

Inkjet These work by shooting a fine stream of ink directly on to the paper without using a ribbon. In the most common design, ink emerges from a vertical bank of nozzles in a way analogous to an impact dot-matrix printer. The technique used to actually propel the ink varies; Hewlett-Packard machines use tiny heaters to literally boil it out, while Epsons squelch it out under mechanical pressure exerted by a set of piezo-electric crystals.

The great advantage of ink-jet printing is that it is quiet; the loudest noise usually comes from the paper transport mechanism rather than the printing itself. As most ink-jet printers build up characters in exactly the same way as a matrix printer the print quality is little different. In the long term ink-jet printers have greater potential as you



The piezo-electric ink-jet element.

can pack more tiny ink nozzles into a print head than metal needles.

The big problem with ink-jet printers is that they work best with very absorbent paper, which means you probably have to end up buying a special stock of ink-jet paper, which pushes up running costs. Most ink-jet models will print on ordinary computer paper or letterheads, but if the paper is at all shiny the ink tends to stay on the surface, making your output easy to smudge. Also it does not look so good when it does dry because the dots do not tend to spread out in the way that they should.

In speed terms most ink-jet printers are quite good, at least up to comparably priced impact dot-matrix printers. The Hewlett-Packard Thinkjet, which costs £399, prints at 150cps, using a 12-nozzle print head; HP claims a noise level of only 50db(A) for this machine. Epson's new SQ-2000 prints at 176cps using a 24-nozzle print head and costs £1,825.

Thermal transfer Epson P-80.

Thermal transfer Works by melting dye from a special ribbon on to paper. Like impact matrix and most ink-jet printers the characters are formed from a matrix of dots. Thermal-transfer printers are quite and very cheap to manufacture; the problem is the running costs are high and there is a lack of paper flexibility. The thermal ribbons can only be used once and are relatively expensive. Output quality tends to be best on smooth papers.

However, thermal-transfer technology is improving, and the best machines now offer good results on the right paper. Another advantage is that the technology does not

(continued on page 89)


PRINTERS
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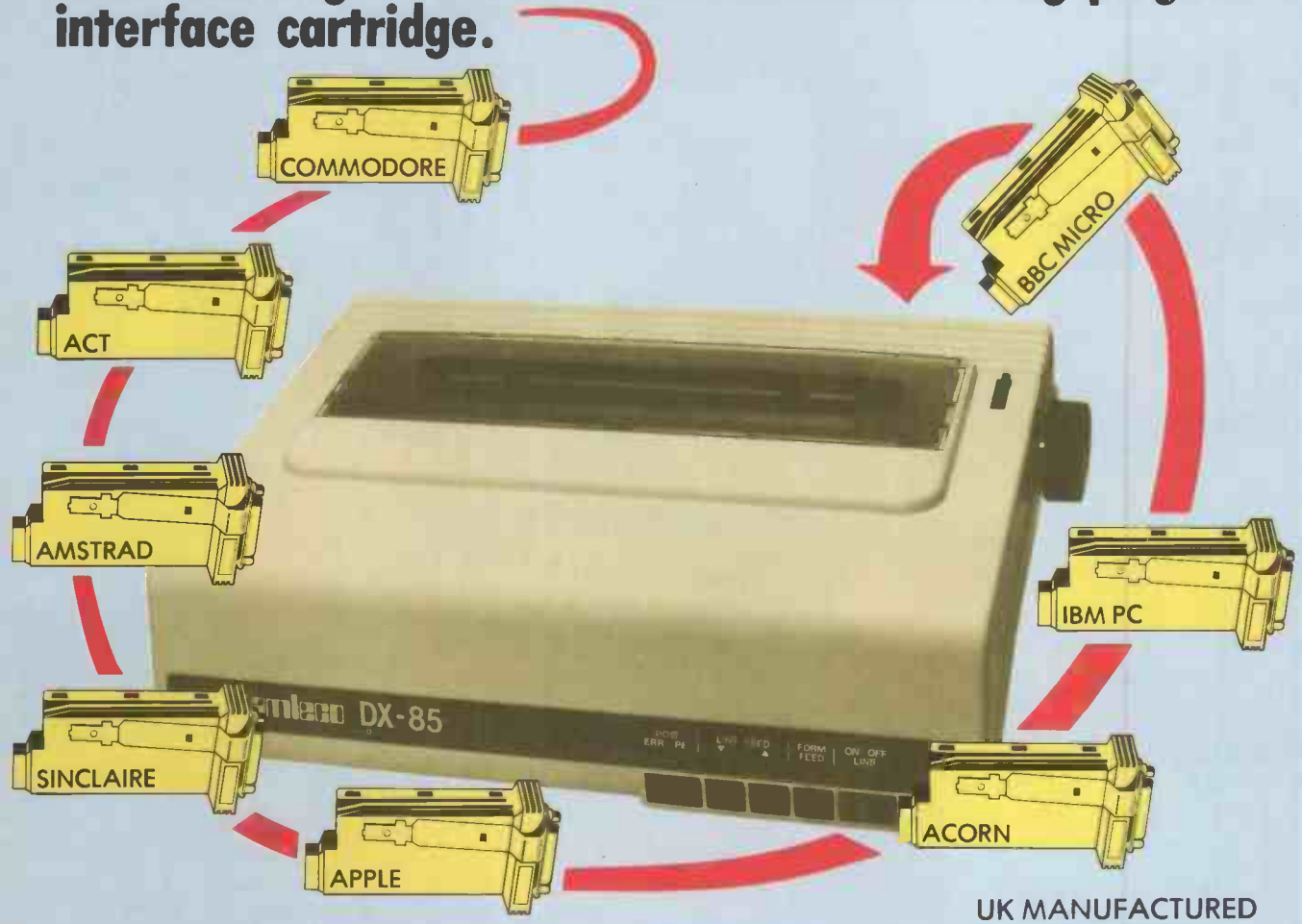
Suitable for direct connection to all leading PCs and Business micros using plug-in interface cartridge.



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(continued from page 87)

require much power, so many battery-powered printers use a thermal-transfer mechanism. The Epson P-80X, for instance, has a 24-element head, is battery powered and costs £250. One of the most impressive thermal-transfer printers is IBM's Quietwriter for the IBM PC, which at £1,316 offers excellent print quality at 60cps.

Laser These machines work exactly like photocopiers but with a lot of heavy computing power and a laser imaging system. Laser printers offer very good print quality, fast speed and quiet operation. Running costs are low since you can print on to ordinary copier paper, as well as letterheads and transparency foils. The price depends partly on speed, which ranges between eight and 12 pages a minute, but rather more significantly on how good the machine is at handling graphics and exotic type founts.

The lowest-cost approach is adopted by the Canon LPB-8, which at £3,195 produces print which looks much the same as that from a good daisywheel. Apple goes to the other extreme with the Laserwriter, which at nearly £7,000 lets you produce near typeset-quality material. For the ordinary office user Hewlett-Packard's middle way may be the most appropriate. Its £3,595 Laserjet prints like an IBM typewriter but has optional plug-in type founts and prints whole-page graphics at a lower resolution than the Apple offering — 75 dots to the inch, which is similar to a typical matrix printer.

Camera systems These work by photographing the screen. No comparison of printers would be complete without mentioning the option of photographing a display. This approach may make sense for preparing slides of graphics screens for graphics slides to be used in business presentations. If you know what you are doing the results can be of excellent quality, but the technique is only suitable for special use. Apart from simply using an ordinary camera, as most magazines do, there are a number of purpose-designed camera systems on the market. Best known is the Polaroid Palette, which costs £1,395 and works with Polaroid print or colour-slide film to avoid processing delays. PC

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Impact dot-matrix printers are already unbeatable for high print speeds at a modest price. Now their type styles are being smartened up as well.

THE NEW DOT-MATRIX STANDARD

By Jack Schofield

When Juki and Silver Reed launched their low-cost daisywheel printers, it looked for a while as though the dot-matrix manufacturers were in for hard times. Suddenly daisies approached dots in terms of price and convenience, while the image quality was far superior.

However, the dot-matrix market rapidly saw a dramatic improvement in quality with the launch of the Canon PW-1080 and Taxan KP-810/KP-910 printers offering a near letter quality (NLQ) option. As well as printing in ordinary dot-matrix type, these printers are able to print more carefully defined characters in a slower mode. Epson's entry into this market was the LQ-1500, with a 24-pin matrix able to print draft quality at 200 characters per second (cps) or near letter quality at 67cps. It is to take nothing away from the quality of the LQ-1500 to observe that it is not in everyone's price range.

EPSON LX-80

Epson's new NLQ dot-matrix printer, the LX-80, is about one-quarter of the price of the LQ-1500. It has a nine-pin matrix, and the printing speeds are 100cps for draft quality, and 16cps for near letter quality. The base price of this printer, £255 plus VAT, should ensure it has a wide appeal.

Unlike previous Epson printers, the LX-80 has low, sleek lines — somewhat like a sports car, compared to the boxy look of the previous models. The footprint is very slightly larger. There is some fluting on both sides, which is presumably there as much for its cosmetic value as to dissipate heat.

The front right of the LX-80 has the usual array of three buttons and four indicator lights. Again they have been restyled to look racy. They also have new functions, in that they can be used to select the type style when the printer is on. Pressing the top two buttons at the same time makes the Ready light go out and the On Line light start to flash. This is the Selectype mode. The On Line button can then be pressed up to six times to select the print mode. The options are: Reset, NLQ, Emphasised, Double-strike, Condensed and Elite.

It is possible to combine more than one of these options to get a grand total of 12 different styles, including double-strike/condensed/elite, though actually trying to do this gets very confusing. If you try for a style that is not allowed, however,

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the LX-80 simply ignored the incorrect entries. Of course, these styles can also be set by transmitting codes to the printer in the usual way, including codes embedded in text.

The LX-80's ROM has 96 ASCII characters in standard, italic and NLQ forms, plus 32 graphics characters and 11 international character sets. The international sets include the usual European languages with two sets to cover Danish and Japanese. They can be selected via software or by using the DIL switches.

In NLQ mode, the printer also offers four methods of justifcation. Text can be ranged left or right, centred or filled — which is Epson's term for justifying or aligning at both sides. For justification by the printer, text has to be sent to the buffer one paragraph at a time. Underlining, subscripts, superscripts, user-defined character sets and dot graphics are also possible, and the usual paper-spacing commands are available.

Lifting the lid at the front of the LX-80 reveals the very small, new ribbon cartridge. It is carried on the platform with the print head, instead of being a separate carriage-length ribbon of the usual Epson type. At £3.95 it costs about half as much, and it is easier to install. Sales of the LX-80 will undoubtedly be such that the ribbon is easy to obtain. However, there are already a couple of dozen similar and incompatible ribbons on the market. It seems a shame to have added yet another.

The nine-pin print head prints bi-directionally at 10, 12 or 17 characters per inch. In NLQ mode, the print head makes two passes per line, and prints in one direction only. The NLQ typeface has a total of 18 dots vertically, with the two rows of nine dots interlaced.

The back of the printer has a power socket, an I/O port, and — wonder of wonders — two small panels through which you can change the two DIL switches SW1 and SW2. For those who have struggled for years with old MX-80s and the like, it is a boon to be able to change these switches without unscrewing four screws on the base of the printer and lifting the lid off.

The back of the LX-80 also has a parallel interface, which peeps through a rather large hole. This is to allow room for an extra printed circuit board to be piggybacked on top, if this is required to provide a serial port. We tried fitting the Hanzon serial board, which provides full Apple Macintosh emulation, and it worked fine. Either of the Epson serial boards for the FX printers should fit. Epson also plans to provide boards for use with Commodore and Atari printers, which are currently non-standard in design. These boards should be available later this year.

One tradition which has, regrettably, been followed is that the ports are sited on the back, where the printer cables may interfere with the paper feed. Epson's only concession is a flimsy pull-out plastic paper guide to hold fan-fold paper away. This is marked "no handle" to discourage you from using it to carry the printer.

The LX-80 also features a 1K print buffer, which is very handy as it means you get back control of the micro more quickly, so you can start the next task. Epson also offers optional 32K and 128K buffer boards, but we did not have one to try inside the LX-80.

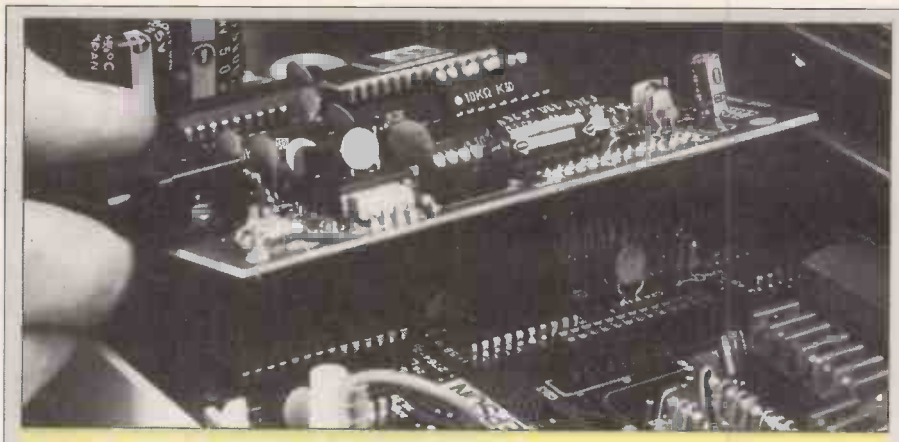
The manual is spiral bound, clearly printed, and vastly better written than some previous Epson handbooks. It has nine appendices, a good index and a useful Quick Reference card.

In use, the printer works fast and efficiently, as you would expect of an Epson. There is nothing special about the 100cps draft mode, and the italic fount is, as usual, slightly gappy. However, the NLQ mode produces a very attractive typeface, which is made even more readable by the fine serifs. The end result looks to be of a much higher quality than you would normally expect from a printer of this price.

There is only one major drawback to the LX-80: it is noisy. In draft mode the sound is somewhat high-pitched and penetrating; in NLQ mode it has more of a rasp to it. Standing the printer on a foam pad helps a little. In many situations the noise will not matter, but it is not ideal for a quiet office.

SPECIFICATION

Type: impact dot-matrix printer with nine-needle print head
Speeds: 100cps draft, 16cps in near letter quality mode
Typefaces: Pica and Elite with expanded, compressed and emphasised modes
Features: roman and italic printing, superscripts, subscripts, underlining, dot-addressable graphics
Paper: single-sheet friction feed, up to 8in. wide; tractor option
Ports: Centronics eight-bit parallel port; serial option; Commodore and Atari options to follow
Dimensions: 85mm.(3.3in.) x 420mm.(16.6in.) x 310mm.(12.4in.); weight 5.2kg. (11.5lb.)
Price: £255 plus VAT; tractor feed £20; cut-sheet feeder £55; ribbons £3.95
Supplier: Epson (U.K.) Ltd, Dorland House, 388 High Road, Wembley, Middlesex HA9 6UH. Telephone: 01-902 8892



NLQ FOR OTHER EPSONS

While the LX-80 replaces the current RX-80 model, the rest of the range has been upgraded, with a + added to the model number. The RX-80F/T+, RX-100+, FX-80+ and FX-100+ all now offer touch-selectable type styles as standard and an NLQ option. The 8647 serial and 8177 parallel boards can be retrofitted to existing FX-80 and FX-100 printers. The 8190 board offers a choice of two NLQ faces: roman and sans serif. During NLQ printing, the paper is advanced by half a dot between passes.

lazy dog.
lazy dog.

The fine serifs of the LX-80's NLQ type help to improve readability.

EPSON LX-80

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	■	☐
Ease of use	☐	☐	■	☐
Documentation	☐	☐	■	☐
Value for money	☐	☐	■	☐

☐Very good all-round performance and extra versatility at an attractive price. It sets a new standard for low-priced dot-matrix printers.

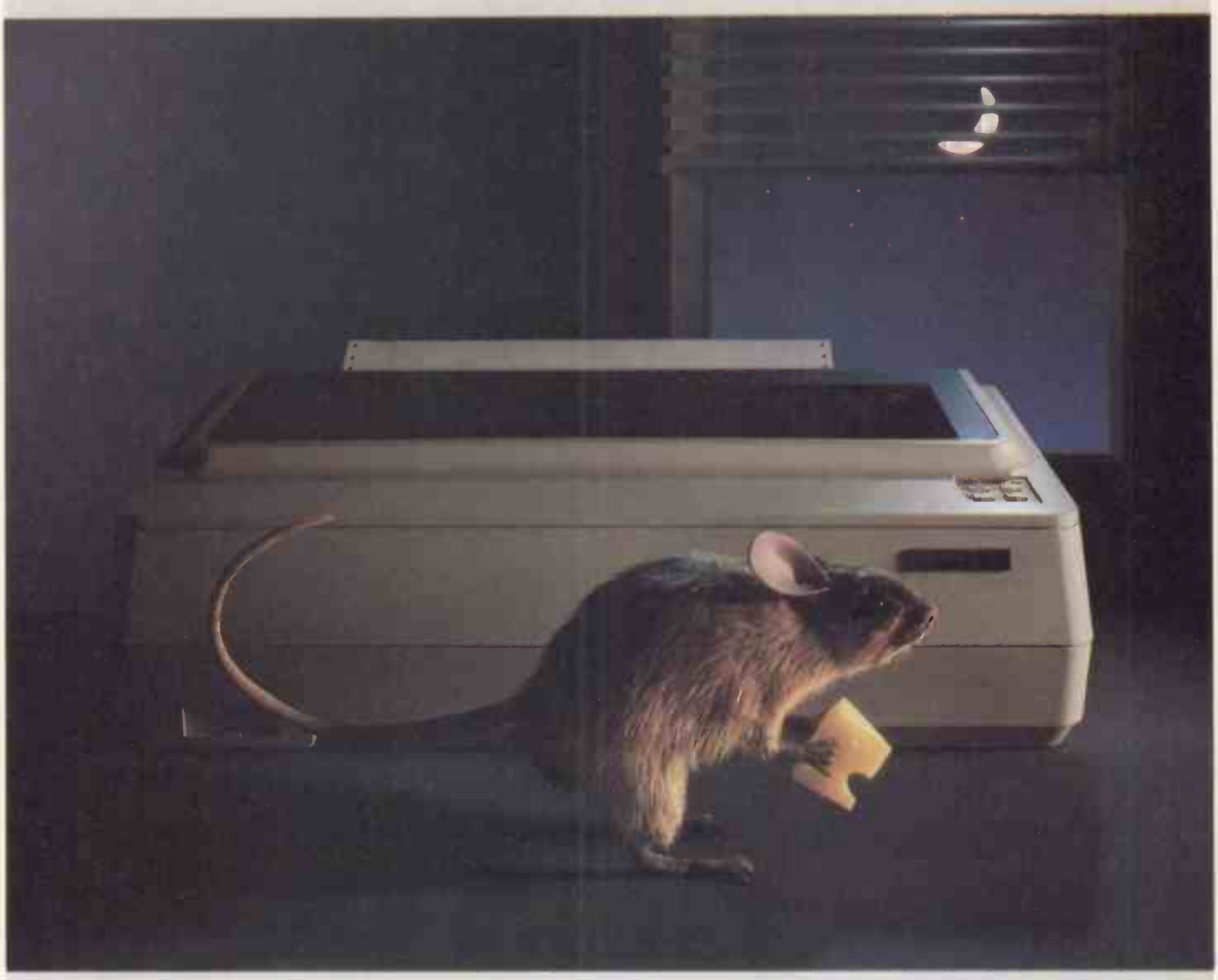
CONCLUSIONS

■The Epson LX-80 is versatile, thanks to its fast 100cps draft mode and 16cps near letter quality mode. The NLQ face is attractive and very readable, though not really suitable for business letters.

■The design shows several improvements over previous Epson models, and only the high noise level lets it down slightly. The availability of a low-cost cut-sheet feeder is a welcome feature, and unusual at this price level.

■The LX-80 is good value for money at £255 plus VAT, though the tractor feed adds £20 to the price for heavy users of continuous stationery. PC

The New MT 85/86 printers are as quiet as a...



Take a listen to the new MT85 and MT86 serial matrix printers. They're amazingly quiet. Which makes their performance definitely something to shout about.

The MT85 is a compact 80 column printer, while the MT86 offers a full 136 column width. Both print high speed draft output at 180 cps. And high quality correspondence at 45 cps in various typestyles. Then there's compressed, expanded and bold print for even more variety. And of course graphics.

Flexibility doesn't stop there either. Both printers take continuous fan fold and single sheet stationery in their stride. And they're totally compatible via plug-in interface modules – IBM PC and Apple Macintosh included.

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LASER PRINTERS: PHOTOCOPIERS WITH BRAINS

By Ian Stobie

Speed, flexibility and outstanding resolution are what you get for the substantial asking price of these units.

With prices starting at around the cost of many complete computer systems, laser printers need more than just the glamour of the word "laser" to justify them. In fact the machines are from the outside rather unglamorous, looking like small office photocopiers. However, inside they are packed with electronics and they have unequalled power to beautify documents sent to them for printing.

Laser printers are now cheap enough to compete with the daisywheel for the top end of the high-quality word-processing market. To the user, the laser holds out the promise of greater speed and much reduced office noise levels, as well as a great deal of choice in the final appearance of the printed output. Laser printers are inherently well suited to producing mixed text and graphics, which is an increasingly important requirement among business users. Most laser printers have no difficulty producing overhead-projector transparencies, and the more expensive machines like the Apple Laserwriter can produce near typeset-quality artwork suitable for later high-volume reprinting on a litho press.

Interestingly, the laser printer's flexibility in handling graphics and typography has little to do with the laser-printing method itself, which is just a way of marking the paper. The key thing is that a laser printer prints a whole page at a time and holds a complete image at full resolution of the page it will print in its own internal buffer. With this complete dot-for-dot page image held in its memory it makes sense to give the printer its own local processing power to manipulate it. Most laser printers can print in a range of different type sizes and styles, and reduce, enlarge and rotate the printed image.

Laser printers are therefore quite intelligent. But as memory and processor components are continuously falling in price, what laser printers can do today many other sorts of printer may be able to do tomorrow. Laser printers just happen to be first to make full use of the possibilities offered by the whole-page bit-mapped buffer.

Expensive laser printers have been around for the last 10 years, and it is still possible to spend several thousand pounds on a laser printer. Such machines are used for high-volume high-speed applications such as producing mass mailings of personalised letters complete with handwritten signature and company logo. Here we are only interested in the new generation of low-cost office laser printers, which all cost under £10,000.

One of the reasons laser printers have fallen in price, apart from the falling price of the necessary electronic components, is that photocopying technology itself is getting cheaper. Canon has pioneered the throwaway photosensitive drum, previously one of the most expensive parts of a machine. To get good-quality copies you must either have a really expensive drum which will last for years, or else one which is so cheap you can throw it away before it starts to deteriorate. The Canon-built printer mechanism used by both Apple and Hewlett-Packard uses a throwaway drum built into the same unit as the toner, which you have to renew periodically anyway. You replace the dual toner/drum cartridge every 3,000 or so pages. A new one costs just under £100.

The Ricoh LP-4120 laser printer.

Compared to a good daisywheel printer using carbon ribbons, laser printer running costs are not excessive, working out around 3p or 4p a sheet. The main difference is in the initial outlay, which is obviously higher. Even so, the comparison is more favourable to the laser than it looks at first sight. You do not need to buy an acoustic hood as the laser printer is inherently quieter, and a single-sheet feeder is already built-in.

The greater speed of the laser printer means you can do the work of several daisywheels. Assuming a full page of text and eight pages per minute, a laser printer is going at about 300cps, as against an absolute top speed of 80cps for the very best daisywheel. Taking these considerations into account the laser printer looks a good bet for anyone with a fairly heavy print workload — from say 500 pages a month upwards. At lower volumes a daisywheel printer will still be the more cost-effective solution.

LOW-COST LASER PRINTERS

	Speed (pages per minutes)	Graphics	Mechanism	Price
Apple Laserwriter	8	excellent	Canon	£6,995
Canon LBP-8	8	poor	Canon	£3,195
Hewlett-Packard Laserjet	8	good	Canon	£3,595
Ricoh LP-4120	12	average	Ricoh	£8,500

Suppliers: Apple, (0442) 60244; Canon, 01-773 3173; Hewlett-Packard, (0344) 773100; Ricoh from Nexel Ltd., (084421) 3151

HOW LASER PRINTERS WORK

Laser printing involves three stages — preparing a page image in memory, drawing it with light and finally transferring it to paper.

Stage 1. This starts with the arrival of a string of characters at the printer. In addition to the text itself this string might contain information about the type styles to be used, and graphics encoded in some form. The printer uses this information to build up a bit map of the complete page in memory.

Stage 2. The bit-map image is transferred to a light-sensitive drum. The drum is first given a uniform electrostatic charge. As the drum rotates it is scanned with a laser light which flickers on or off under the control of the bit map held in memory. Where the beam strikes the drum, charge is destroyed.

Stage 3. This stage employs exactly the same technology as many photocopiers. A strongly coloured plastic-based powder, called the toner, is brought into contact with the rotating drum. Toner can be given an electrostatic charge, and charged powder sticks to the parts of the drum which correspond to dark parts of the image. The toner image is then transferred to a sheet of paper, and finally melted on to it by hot rollers.

Different brands of laser printer adopt slightly different approaches at each stage. Printers with good graphics capability need much larger areas of memory. The Apple Laserwriter uses nearly 1Mbyte of RAM just for the page map.

Different manufacturers use different light sources at the laser imaging stage. Canon uses a semiconductor laser while Ricoh uses a more powerful gas laser which allows faster drawing on the drum. Laser printers used purely for typesetting may take special papers to get higher resolution, and so the second and third phases may be different.

Appearances can be deceptive — inside and out the Laserwriter resembles a photocopier.

APPLE LASERWRITER

Like several other new laser printers, Apple's Laserwriter is built around a basic printing mechanism supplied by Canon. But Apple's printer is at £6,995 about double the price of most other Canon-based machines. What accounts for the difference is the massive processing power which Apple has added, making the Laserwriter itself a more powerful computer than the Macintosh it connects to.

The Laserwriter is designed for use both as a dedicated printer for a single Macintosh, and as a printer attaching to a local area network, and thus shared between several machines. It comes equipped with an RS-232C interface so it can also be used with other brands of computer, such as the IBM PC. However, in this case you lose the Macintosh's graphics ability, and the Laserwriter then functions more as a faster, quieter daisywheel printer.

Used with Apple equipment the Laserwriter offers the ability to incorporate drawings into documents and to print anything you can display on the Macintosh screen. In addition you can print using the same typefaces that traditional typesetters use, such as Helvetica and Times.

Physically the Laserwriter looks like a small photocopier. It takes up a similar amount of desk space too, and weighs 77lb., but considering what it contains it is quite compact. It prints on to single-sheet paper, either ordinary A4 copier paper or letterheads, and comes with a 100-sheet input tray. You can also feed in envelopes and overhead-projector transparencies singly through a manual feed on the other side of the machine.

The Laserwriter connects to the Macintosh through an Appletalk connector box and cable. You need one box for the printer and one for each Macintosh you wish to connect to it; they cost £50 each. We were in fact using Appletalk as no more than a printer cable, as we only tried the Laserwriter with one Macintosh. According to Apple the system will still work with the printer placed up to 1,000 feet away from the machines it serves.

The way the Laserwriter and Appletalk work are fundamentally related. At £50 a connection Appletalk is a very cheap network, which reflects Apple's belief that the real network market lies in ordinary cost-conscious offices. But keeping the cost down means accepting lower transmission speeds. Appletalk is slow by network standards, sending no more than 29Kbyte of data a second.

The Laserwriter hardware can print at 90,000 dots per square inch, and at a full resolution this requires a bit map of almost a megabyte for each page. To assemble the bit map in the Macintosh itself would therefore make no sense, as transmitting each page

(continued on next page)

SPECIFICATION

Printing technique: laser xerography; uses Canon LBP-CX mechanism
Print processing: Motorola 68000 processor running at 12MHz, 1.5Mbyte of RAM, 0.5Mbyte of ROM containing Postscript interpreter and founts
Print quality: 90,000 dots per square inch; supports full-page graphics
Built-in founts: Times, Helvetica and Courier plus a set of special symbols; bold, italic, outline, etc. available for each fount; minimum fount size 4 point; other Mac founts can be printed at slightly lower resolution
Speed: eight pages a minute once printing commences; takes from a couple of seconds to several minutes to start up, depending on the complexity of the image
Noise: same as quiet photocopier, under 55dB(A)
Paper: A4 or foolscap photocopier paper, letterheads or overhead-projector transparency film; envelopes and labels can also be used via manual feed
Consumables: replacement drum and toner cartridge costs £99, last a claimed 3,000 pages
Interfaces: Appletalk and RS-232C
Compatibility: supports full Mac graphics through Appletalk; supports Diablo 630 daisywheel commands through RS-232C
Size: 715mm.(28.2in.) x 470mm.(18.5in.) x 410mm.(16.2in.); weighs 37kg.(77lb.)
Price: £6,995 plus VAT, available now
Manufacturer: Apple Computer Inc.; made in the U.S.
Supplier: Apple Computer (U.K.) Ltd, Eastman Way, Hemel Hempstead, Hertfordshire HP2 7HQ. Telephone: (0442) 60244

(continued from previous page)

across the network to the printer would take over half a minute. Instead, the Mac sends a compressed description of the page written in a language called Postscript. Typically it occupies less than 8K and transmits across Appletalk in less than a second. Inside the Laserwriter is a 68000 processor, 1.5Mbyte of RAM and 500K of ROM containing some pre-defined founts and a Postscript interpreter. The Laserwriter runs the Postscript program to generate the page-image bit map it needs to print from.

To use the Laserwriter with Mac software you need first to install the Laserwriter printer driver which generates the Postscript page descriptions. The driver must be present on every start-up disc you want to use with Laserwriter. The installation process is quite simple but it takes up a lot of disc space — usually around 98K. You can reduce this by throwing away founts you do not want to use.

Postscript is actually a proper programming language, like Logo or Forth, and the printer driver is really a program generator. Postscript describes a page in terms of the mathematical properties of the shapes on it rather than as a bit map or any other static data description.

The significance of Postscript is that it is completely independent of the hardware used, and a description in Postscript remains the same whatever the resolution of the system, unlike a bit map. Postscript is being adopted by a number of different companies, and has some chance of becoming an industry standard. It was developed independently of Apple by Adobe Systems Inc., a company formed by a number of people from Xerox's Palo Alto Research Centre. Parc is widely recognised as the source of many of the best ideas in the computer industry, including the windows, icons and mouse interface adopted by Apple for the Macintosh itself.

This gives the Laserwriter good prospects for broader compatibility outside the Apple universe. After all, the Laserwriter just expects a page to arrive in Postscript, it does not matter where from. If, for example, you have access to a proper typesetting machine which runs Postscript, it may be possible to typeset directly from Mac print files.

We used the Laserwriter with several packages, including Macwrite and Macpaint, and there is no doubt that the output quality is impressive. The resolution of 300 dots per inch horizontally and vertically compares very favourably with the 80 by 80 offered by the Imagewriter, Apple's conventional dot-matrix printer for the Mac. The output generally looks like a very good photocopy of typeset material, without the random splodges found on many photocopiers. We did not have time to print enough copies to see whether quality degrades as the drum nears the end of its life after a claimed 3,000 pages.

While the Laserwriter's resolution looks good to the untrained eye, professional typesetting systems generally start at resolutions of 400 dots per inch. The difference is noticeable, especially at the small type sizes, but the Laserwriter is probably good enough to allow companies to produce more price lists, catalogues and reports in-house.

There are some definite drawbacks to using the Laserwriter. Before printing each new page there is a delay of about 30 seconds on most of the text pages we printed, and up to 10 minutes on some complex graphics pages. Apple quotes a speed of eight pages a minute, but this refers to subsequent copies of the same page once the Laserwriter has figured out how to print the image.

None of this would matter if you could do something else on you Mac while waiting for the Laserwriter to print, but on our setup we could not. We understand that spooling software to allow this is still being written. Obviously, on a network several people have to be able to send jobs to the printer and get on with productive work while their jobs wait to be printed. At the moment, this problem restricts the Laserwriter to producing multiple copies of fairly short documents.

With text, best results are obtained from the Laserwriter when you print in Helvetica, Courier or Times, its built-in founts. You can print in other Mac founts such as Venice or Geneva, but these are not much improved in resolution terms over the Imagewriter. Normally the printer converts any Mac fount, such as New York or Geneva, to the nearest good Laserwriter fount, unless you override this function.

The Laserwriter lets you scale the printed image to make it either bigger or smaller, or turn it sideways. This is particularly useful for making overhead transparencies, which we found came out very well. For producing graphics, the Laserwriter works best with Macdraw. The printer driver can easily convert Macdraw images into Postscript commands, producing very fine lines and good resolution. The Laserwriter cannot do much to enhance Macpaint pictures, as they already consist of bit maps at about the resolution of the Mac's screen; they come out crisp and clear but still consisting of big, discernable dots.

It is likely that we will be seeing a new crop of graphics packages that make full use of the Laserwriter. One obvious application area is page makeup for people who want to produce professional-looking newsletters and brochures for volume printing at a proper print shop. We hope to review several such packages soon.

One advantage to using a fount originally designed for typesetting is that it lets you put more text on a page. This is because founts such as Times and Helvetica are proportionally spaced. By contrast Courier, originally a typewriter fount, is monospaced - each character takes up the same width on the page.

Helvetica

One advantage to using a fount originally designed for typesetting is that it lets you put more text on a page. This is because founts such as Times and Helvetica are proportionally spaced. By contrast Courier, originally a typewriter fount, is monospaced - each character takes up the same width on the page.

Courier

Laserwriter's output: using founts designed for typesetting saves space and looks neat.

APPLE LASERWRITER

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	☐	■
Ease of use	☐	☐	■	☐
Documentation	☐	☐	☐	■
Value for money	☐	■	☐	☐

☐A wonderful, creative tool from Apple, but unless you can share the cost among several users in a network it is expensive.

CONCLUSIONS

■Undoubtedly a superb printer, the Laserwriter, has speed, quietness, stunning graphics and professional-quality typefaces going for it.

■These spectacular features probably double the price. Many Apple users might have preferred a more modest machine like the HP Laserjet, at a price closer to a top-line daisy-wheel printer.

■Once it gets going the Laserwriter is quick, but you may have to wait some minutes before the machine starts to print a new page, especially with graphics. It would help if the machine let you get on with something during the wait, but it does not. Print spooling is definitely a necessity.

■Apple's documentation for the Laserwriter is superb. It is full of helpful, illustrations and suggestions, and is written in clear English. PC

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Then, exclusively for the IBM PC and compatibles are the BP 5420I and BP 5200I.

The BP 5420I combines most of the features of the BP 5420 printer with all IBM characters, symbols and graphics as standard. The BP 5200I operates at 206 cps (draft) and 103 cps (NLQ) and represents one of the best value printers of its kind on the market.

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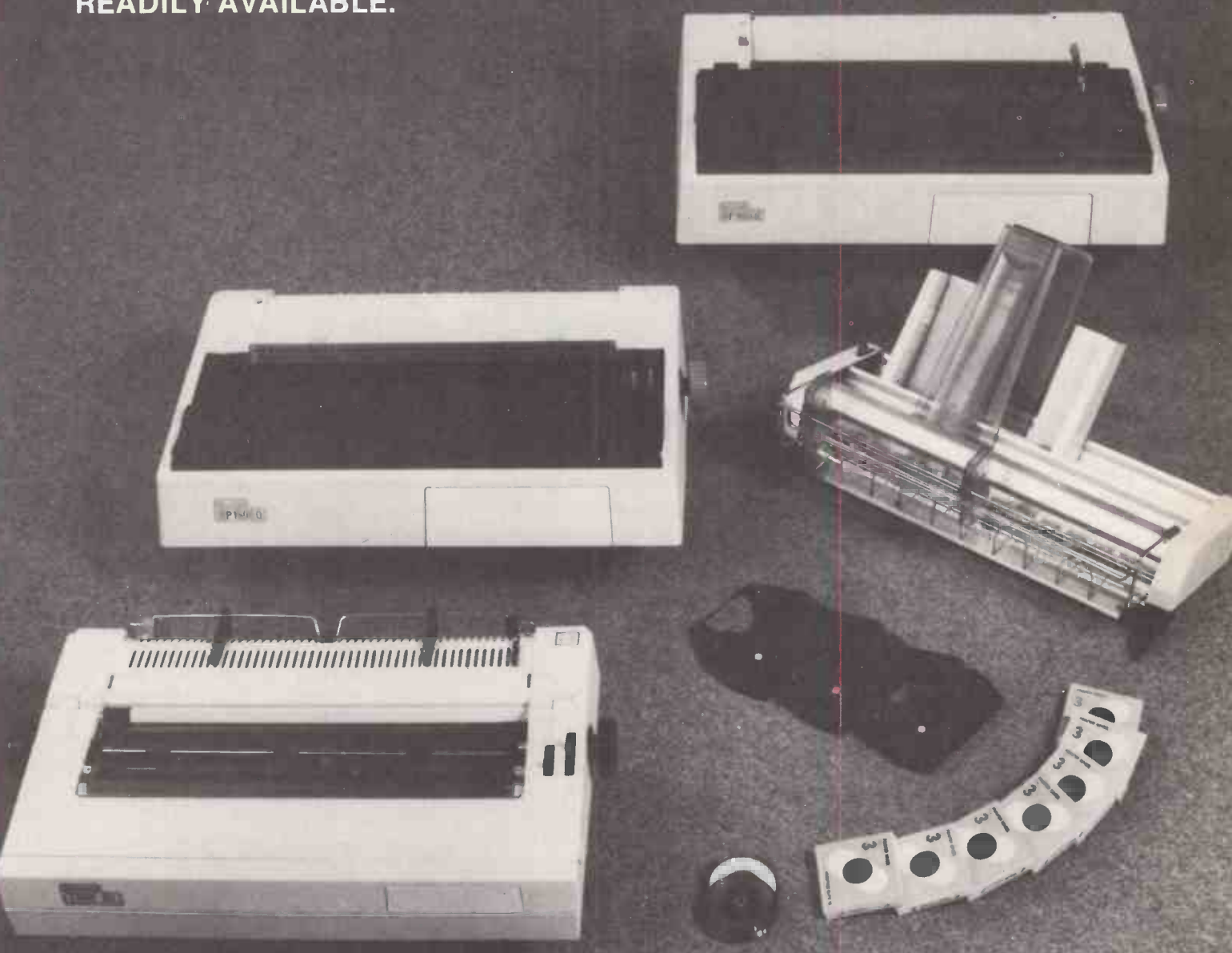

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OPEN FILE

CONTENTS

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We welcome serious software for any of the micro systems listed opposite, especially short routines and utilities. Programs can be in machine code, Basic or any other 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, which should be listed from a fully debugged, working program. 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, inverse video characters or any other non-standard symbols 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. A stamped addressed envelope is appreciated.

If you write in with a comment, correction or enquiry please state the machine and the program title.

We pay at least £10 for any programs used, or £35 per page and pro rata for part pages.

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PROGRAM PORTABILITY

Kenneth Haynes explains how IBM PC programs can be written with an eye to transferring them on to Apricot micros.

PORTABILITY is not simply a question of choosing the right language and the right compiler. What matters most is programming technique.

When using Basic, machine-specific code should be avoided. This is because this type of programming in Basic tends to use a surprisingly large amount of code and leads to the inevitable path of two separate program source codes. It is a practice which should be avoided as it can lead to a host of problems when the time comes to modify or update your program code. If machine-specific code is to be used, it would be advisable to use a library-orientated language such C.

There is surprisingly little incompatibility between IBM Basic (Basica) and the Microsoft Basic supplied with the Apricot, MSBasic, with the exception of some display, communication and initialisation functions. First, we will look at the two functions which are the basis for most program incompatibility problems; the Clear Screen and the cursor positioning screen addressing functions.

As you can see from table 1, the Basic formats for the IBM and Apricot are quite different. This is because Basica is MSBasic which has been adapted especially for the IBM PC, whereas the version of Basic supplied with the Apricot has not been modified. At first sight this may seem unfair. After all, if IBM can do it, why not ACT? While ACT has not modified the supplied Basic it has, however, supplied the programmer with a staggering number of Escape sequences, some of which are so powerful that the IBM equivalent would take up 10 times the amount of program code.

An example of this is Escape " ", which copies the entire screen display into the keyboard buffer, which is 2K in size. Although this is rather an obscure example, it does illustrate the sheer power and ease with which the Escape sequences can be utilised. However, a full listing of the Escape sequences is not supplied with the Apricot's documentation, thus making the purchase of the *Apricot Technical Reference Manual*, which retails for around £25, a necessity for the serious programmer.

The main problem is to be able to utilise either of the formats shown in table 1, in such a manner that we may still utilise the same program code. Table 2 shows the most commonly used solution for such a problem: the Include statement.

This method is fine for most programs, but large programs with tight memory constraints or programs with which the execution speed is paramount should utilise an assembly subroutine. The reason for this is that the Include method involves the constant reassignment of the row and column co-ordinates prior to the cursor addressing routine being called. Having utilised a cursor addressing assembly routine, the routine would no longer be placed in the Stdi/o.inc file — see table 2 — and the call would remain resident in the program code.

The call would now read

nnnn CALL LOCATE%(10,10)

where Locate% is an integer variable which contains the offset to the assembly routine address. The segment to the address is set using the Def Seg statement prior to the call. Clearly, some assembly knowledge is required and great care should be taken to observe the Call statement's conventions. Table 3 shows one way of passing the row and column co-ordinates to the assembly routine and sending the appropriate codes to the VDU.

Manuals of previous releases of Basic have been less than helpful when it comes to explaining assembly language interfacing with Basic, and the Basica and MSBasic manuals supplied with the IBM and Apricot computers appear to be no exception. However, if you can lay your hands on a copy of the *Sirius 1 Basic-86* manual you will find that it covers the subject admirably, and is useful even to the less experienced assembly programmer. You will find all the information you will need to utilise the technique described on pages 16 and 104 to 107 of the manual.

Table 4 lists the compiler compatible functions — that is, those functions which the compiler will accept — which differ between Basica and MSBasic. It is those

TABLE 1.

	IBM	Apricot
Clear Screen	10 CLS	10 PRINT CHR$(&H1B)+CHR$(&H45);
Position Cursor	20 LOCATE (ROW,COL)	20 PRINT CHR$(&H1B)+CHR$(&H59)+CHR$(ROW+32)+ CHR$(COL+32)

TABLE 2.

```
10 REM Program code.
20 ROW = 10 : COL = 10 : GOSUB 1000
    —
    —
    —
999 $include: Stdi/o.inc
```

Using the Include technique. The file Stdi/o.inc should contain one of the machine-specific formats shown in table 1.

TABLE 3.

```
push    bp
push    ax          } Save register contents
push    dx
mov     bp,sp       ; Copy stack pointer into bp
mov     ah,06h      ; Set up ah for function 6
mov     dl,1bh      ; Escape code
int     21h         ; Send code to VDU
mov     dl,59h      ; ASCII for "Y"
int     21h         ; Send code to VDU
mov     al,byte ptr 6 [bp]  ; Move row co-ordinate into a1
add     al,20h      ; add 32 decimal to row co-ordinate
mov     dl,al
int     21h         ; Send code to VDU
mov     al,byte ptr 4 [bp]  ; Move column co-ordinate into a1
add     al,20h      ; Add 32 decimal to column co-ordinate
mov     dl,al
int     21h         ; Send code to VDU
pop     bp
pop     ax          } Restore register contents to entry values
pop     dx
ret     4           ; Number of arguments * 2
```

How the row and column co-ordinates can be picked up by the cursor position function. The row and column arguments are passed via their addresses.

```
11020 A1%(1)=0
11030 GOSUB 19000
11040 RETURN
12000 REM ****** OPEN WK ******
12010 A1%(0)=1
12020 A1%(1)=0
12030 A1%(3)=10
12040 FOR I=0 TO 9:A2%(I)=1:NEXT
12050 GOSUB 19000
12060 RETURN
13000 REM ****** INPUT LOC ******
13010 A1%(0)=28
13020 A1%(1)=1
13030 A2%(0)=1
13040 A3%(0)=16383
13050 A3%(1)=16383
13060 GOSUB 19000
13070 RETURN
18000 REM ****** CALL GSX ******
19000 DEF SEG=&H61:GSX%=0
19010 CALL GSX%(A1%(0),A2%(0),A3%(0),A4%(0),A5%(0))
19020 DEF SEG:RETURN
Ok
```

Machine-specific code should be avoided at all costs.

functions which were added to Basica to enable the programmer to access some screen- and communication-handling routines which are the ones to avoid.

The Apricot functions in table 4 which have no Basic equivalent in MSBasic should not be used. IBM's Pos function will return the current column position of the cursor. On the Apricot it will return a value between 1 and 2,000, depending on the position of the cursor, relevant to the entire screen where the screen display is 25 lines by 80 columns.

A similar problem occurs with IBM's CrsLin function which returns the cursor's current line number. Again, the nearest to this in MSBasic is Pos. If the cursor position needs to be calculated, the best method to use would be to place the appropriate code in the Include file Stdi/o.inc as in table 5. Then Gosub 2000 will place the screen relative position of the cursor into the integer variable Position%, and we can work out the row and column co-ordinates from this value.

However, care should be taken so as not to use the variable Position% for any other purpose. The function Width can be utilised in much the same way as Pos(X) except no returned value is required. If the program is to be used with either a monochrome or colour monitor, Basic is not the best language to use as, depending on the number of monitor dependent functions, a global variable will need to be intialised and a conditional call made to whichever routine is needed, depending on the type of monitor indicated by the global variable. This produces far more program code than would normally be acceptable and the program execution speed would be reduced. Again, this problem could be overcome by using assembly-language routines, but this calls for a far greater level of expertise and would dramatically increase the development time and costs. In this case, a library-orientated language should be used.

As any C programmer will know, a program written in the C language is nothing more than a series of functions. So, in the case of our incompatible functions, no provision would have to be made in the program code for them.

The Clear Screen function in listing 1 is programmed to clear the Apricot's screen. So in order to make it flexible we must remove the function Clear_Scr and place it in a separate source file. In this case, we would put all the VDU related functions — Clear Screen, cursor positioning, direct screen addressing, etc. — in libraries called, for example, vdu_apr and vdu_ibm. We would link in the appropriate file at link time, that is

```
A>ln myprog vdu_opr
```

Bearing in mind that we may be using machine-specific code, thought should be given to the other areas in which creating libraries would be advisable. For example, input/output functions and, if possible, grouping together other machine-specific functions which fall into neither of the categories mentioned.

To the programmer unfamiliar with libraries it may seem a little confusing at first, but all we are doing is following the basic C programming conventions, which can be picked up in very little time by those familiar with another programming language. As I mentioned earlier, the colour monitor does add a further complication to our task but using the C language the solution is quite simple.

For example, suppose that we wanted the program to leave the screen blue every time we used the Clear Screen function, we could just add the statement Color 10,1 prior to clearing the screen. But this statement would not be valid on a monochrome monitor, so in order to overcome this problem we use a global variable, the status of which indicates whether we have a colour or monochrome monitor attached to the computer. This basic principle will work with all the monitor related functions as shown in listing 2, where col_mon is the global variable.

It is possible to place all the machine-specific functions in one library, but this is bad programming practice as it tends to make finding a particular function difficult.

When using C you must carefully plan the use of such functions prior to their implementation, otherwise you may well end up with a program full of functions which call another function which in turn calls another function and so on, just to perform the simplest of operations. PC

TABLE 4.

IBM	Apricot	Comments
Beep	PRINT CHR$(7);	Apricot format should be used on both machines.
Circle	—	
Cls	PRINT CHR$(&H1B)+"E";	See table 1.
Color	—	
Com	—	
CrsLin	Pos	Format difference.
Draw	—	
Key	—	
Line	—	
Locate	PRINT CHR$(&H1B)+ CHR$(&H59)+CHR$(ROW+ 32)+CHR$(COL+32);	See table 1.
LOf	—	
MkDir	—	
On Com	—	
On Key	—	
On Pen	—	
On Strig	—	
Open "Com...	—	
Paint	—	
Pen	—	
Play	—	
Point	—	
Pos	—	Format difference.
PSet	—	
PreSet	—	
Screen	—	
Sound	—	
Stick	—	
Strig	—	
VarPtr$	—	
Width	—	Format difference.

The compiler-compatible functions which must be avoided in order to maintain machine-independency. Many IBM commands have no equivalent on the Apricot.

TABLE 5.

IBM	Apricot
2000 POSITION%=POS(DUMMY%)+ CRSLIN(DUMMY%)	2000 POSITION%= POS(DUMMY%)
2010 RETURN	2010 RETURN

LISTING 1.

```
main()
{
printf("text text text");
*/ When a key is pressed, the next function
    (clear_scr) will clear the screen.    /*
clear_scr();
exit();
}
clear_scr()
{
putchar(27);
putchar ("E");     */ Clears the Apricot's screen /*
}
```

LISTING 2.

```
function_name()
{
if (! col_mon)
{
*/ monochrome function code */
}
else
{
*/ colour function code /*
}
}
```

OPEN FILE

MACHINE-CODE SUBROUTINES

David Dawe details the techniques required to link a machine-code subroutine to an MBasic program running under CP/M, with examples for 8080 and Z-80 systems.

MACHINE-CODE subroutines can often provide a solution to special requirements which are not catered for directly in MBasic. In addition, when certain processing tasks are proving annoyingly slow, a machine-code subroutine may be the answer. The code so produced is often faster in operation than that obtained by compiling pure MBasic source code.

Before you rush in to coding you must first decide where to put the machine code in memory. MBasic itself loads under CP/M at 100hex and stretches up to a little beyond 6000hex. Your Basic program and variables go above this and use the space up to CP/M's FDOS.

MBasic can be loaded using the /M: switch to free a space, but at this point you might not know what value to specify for the top of MBasic. So proceed by loading your Basic as normal and then type:

```
PRINT HEX$((PEEK(7)*256)
```

Location 7 contains the high byte for the starting address of the CP/M FDOS. On my 56K North Star using CP/M 2.2 I obtain the value C500hex. This now gives some idea of where code may be placed. If in future I boot up MBasic using:

```
A>MBASIC /M:&HC000
```

then I have 500hex bytes free for my machine code.

Alternatively MBasic 5 can resize itself using the Clear command:

```
CLEAR,&HC000
```

Now you might think that an MBasic program which Peeks location 7 and then resizes itself automatically using Clear would run with the same free space for machine code, whatever the size of RAM available. However, this approach is not without its drawbacks, since the code you need to use will probably have its origin fixed. Z-80 freaks hold your horses! I know you have relative jumps, but you don't have any relative Calls and any useful subroutine will contain Calls and so cannot be considered relocatable unless it contains some very clever stack manipulations.

The link between MBasic and machine code is via one of the two statements USR and Call. The former exists in MBasic 5 only to achieve compatibility with earlier versions. Use of Call is much better, and it is this technique that is covered here. Call provides the ability to use a machine-code subroutine, and in addition allows a number of parameters to be passed to the subroutine and also to collect the returned values.

As an example of Calling a machine-code program without parameter passing, let us write a routine to print "Hello" — a common introduction to many computing techniques. The procedure to print a string under CP/M is to write code that Calls the BDOS function number 9. A 9 must be placed in the C register, and the DE register pair must contain the address of the message to be printed. This message must terminate with a $ sign.

MBasic protects itself by saving all registers before responding to your Call, but if parameters are passed then the registers are required and you may have to save them in a local area or on the stack. It is unlikely that you will need to allocate a separate stack area since MBasic's is quite big enough. The source code is shown in figure 1.

The source code must be assembled to determine the object code. We also have to decide how MBasic is to place this code in memory at the location allocated. The process of assembly may use ASM or ZASM, etc., or it may be done manually by looking up the hex codes and calculating the decimal equivalents using an origin of C000. The manual method is just as quick for small routines and gives the results shown in figure 2.

Placing these values in Basic Data statements gives listing 1, our first program with a machine-code subroutine.

The next step is to write a program that passes a value to be processed by the subroutine. At this point it is important to realise the difference between the types of variable that MBasic uses, and the way in which they are stored. There are four types of variable: integer variables, such as A%, use two bytes; single-precision variables, such as A or A!, use four bytes; double-precision variables, such as A#, use eight bytes; and string variables, such as A$, use up to 255 bytes. Integer variables are stored low byte then high byte in the same way that machine code deals with 16-bit values. This means that providing the value you want to process lies in the range – 32,768 to 32,767 then you should always use integers as parameters to be passed.

Single-precision variables use a three-byte mantissa and a one-byte exponent, while double-precision values have a seven-byte mantissa plus one-byte exponent. The format is similar to the normal representation. String variables are as long as you make them, subject to the 255-character maximum, but there is a three-byte overhead which gives the length of the string and the address where it is stored.

The next example, which passes a parameter to the subroutine, is again chosen for its simplicity. It passes a value of A%, where A% is less than 128, and doubles it. This restriction ensures that the result can be contained in a single byte. The MBasic part of the program is simply to clear space as before, Input the value of A%, Call the subroutine, and print out the new value of A%. The Call is simply written as

```
CALL MLOC(A%)
```

but the hurdle we now have to overcome is how to locate where A% is stored in memory so that we can double it.

Having Called the machine code

LISTING 1.

```
10 REM MAKE AN AREA FOR THE CODE
20 CLEAR,&HC000
30 MLOC=&HC000

40 REM PUT CODE INTO MEMORY
50 FOR J=0 TO 16
60 READ N
70 POKE MLOC+J,N
80 NEXT J

90 REM CALL IT WHEN EVER I WANT IT
100 CALL MLOC
110 END

120 DATA 14,9,17,9,192,205,5,0,201
130 DATA 72,69,76,76,79,10,13,36
```

FIGURE 2.

Hex	Decimal
0E 09	14 09
11 09 C0	17 09 192
CD 05 00	205 05 00
C9	201
48 45 4C 4C 4F 0A 0C 24	72 69 76 76 79 10 13 36

FIGURE 1.

```
        MVI   C,9              ;BDOS function 9
        LXI   D,MESS           ;address locator
        CALL  5                ;call cpm
        RET                    ;return to MBASIC
MESS:   DB    'HELLO',10,13,'$' ;the message + CRLF & $

        LD    C,9
        LD    DE,MESS
        CALL  5
        RET
MESS:   DEFM  'HELLO'
        DEFB  10,13,36
```

the HL register pair contains the address of the location where MBasic is storing the value of A%. HL does not contain the value of A%. We must now pick up the value from the address pointed to by HL. This will give the low byte of A% — which is all that is needed since A% is small — doubles it and replaces it where it came from. The necessary code is shown in table 1. The calling program might be as shown in listing 2.

If the subroutine needs HL, then the present contents must be stored for later. The code in figure 3 does much the same as before but deals with larger numbers, as both bytes of the integer are considered in the doubling code. If you use Zilog code then the routine may be simplified by using some of the Zilog-only instructions.

The calling program is much the same as before but uses the following Data lines. Change the limit of the For statement in line 50 to 20:

1000 DATA 34,19,192,94,35,86,
33,0,0,25,25
1010 DATA 235,42,19,192,115,
35,114,201,0,0

Another example of passing a single parameter is given in the following very useful program. It is used to change the currently logged disc drive from within MBasic without going down to operating-system level. CP/M function number 14 is used by simply using the machine code shown in figure 4. Since this code is totally relocatable it can be placed anywhere in RAM. The MBasic program given in listing 3 Peeks CP/M to determine its size and places the subroutine at the top of RAM, having Cleared a space for it. This calling activity only changes the logged disc drive temporarily, until MBasic is exited. It is also necessary to change the least-significant nybble of location 4, where CP/M keeps a note of the currently logged drive, if you want to return to the newly selected drive after a System command.

When passing single- and double-precision variables you should proceed as before. But be careful, since the address passed in HL is the address of where to find the four- or eight-byte representation of the variable. Handling of these bytes by your subroutine will be much more complicated than using two-byte integer values.

String variables are handled similarly, but this time HL contains the address where you find the three-byte descriptor for the actual string. The first byte pointed to is the string length, and the next two are the string address. As an example, the calling program will pass a string of upper-case letters and the subroutine will change the string into lower case. The program also works for the opposite conversion.

The technique relies upon the similarity of the ASCII codes used for the upper- and lower-case letters. XOring the pattern for A with 20hex gives the pattern for a, and vice versa. The subroutine in 8080 code is shown in listing 4, and the calling program is shown in listing 5.

If more than one variable is to be processed then the Call takes the form

CALL(var1,var2.....varN)

and, having Called, the register contents are as follows: HL the

(continued on next page)

FIGURE 3.

```
        INTEL                          ZILOG

      ORG   ØCØØØH            ORG   ØCØØØH        ;origin of free space
      SHLD  KEEP              LD    (KEEP),HL     ;save  pointer
      MOV   E,M               LD    E,(HL)        ;xfer var to DE
      INX   H                 INC   HL
      MOV   D,M               LD    D,(HL)
      LXI   H,Ø               LD    H,Ø           ;zero HL
      DAD   D                 ADD   HL,DE         ;add DE to HL
      DAD   D                 ADD   HL,DE         ;twice
      XCHG                    EX    HL,DE         ;xfer result to DE
      LHLD KEEP               LD    HL,(KEEP)     ;restore pointer
      MOV   M,E               LD    (HL),E        ;replace var in memory
      INX   H                 INC   HL
      MOV   D,M               LD    (HL),D
      RET                     RET
KEEP:DS    2          KEEP:  DEFS  2
```

LISTING 4.

```
CØØØ                    ORG   ØCØØØH
CØØØ 46                 MOV   B,M       ;xfer length to B
CØØ1 23                 INX   H         ;xfer str addr to DE
CØØ2 5E                 MOV   E,M
CØØ3 23                 INX   H
CØØ4 56                 MOV   D,M
CØØ5 1A           MORE: LDAX  D         ;get char from string
CØØ6 EE2Ø               XRI   2ØH       ;modify the ASCII pattern
CØØ8 12                 STAX  D         ;put it back
CØØ9 13                 INX   D         ;bump pointer
CØØA Ø5                 DCR   B         ;decrement count
CØØB C2Ø5CØ             JNZ   MORE      ;done ?
CØØE C9                 RET
```

FIGURE 4.

```
INTEL                   ZILOG

MOV  E,M                LD   E,(HL)  ;get passed var
MVI  C,14               LD   C,14    ;BDOS fn 14
CALL 5                  CALL 5       ;go set drive
RET                     RET          ;return to MBASIC
```

TABLE 1.

Intel	Zilog	Hex	Dec
MOV M,L	LD (HL),L	7E	126
ADD A	ADD A,A	87	135
MOV L,M	LD L,(HL)	77	119
RET	RET	C9	201

LISTING 2.

```
10 REM MAKE AN AREA FOR THE CODE
20 CLEAR,&HC000
30 MLOC=&HC000

40 REM PUT CODE INTO MEMORY
50 FOR J=0 TO 3
60 READ N
70 POKE MLOC+J,N
80 NEXT J

90 INPUT "WHAT VALUE TO DOUBLE";A%

100 REM CALL IT WHEN I WANT IT
110 CALL MLOC(A%)
120 PRINT "THE DOUBLED VALUE IS ";A%
130 END
140 DATA 126,135,119,201
```

LISTING 3.

```
100 '***********************************************
110 '*************      XDISK      ***************
120 '***********************************************
130 '
140 'Program to change logged disk drive from MBASIC
150 '
160 'PROGRAM BY D F DAWE
170 'CORNWALL MICROELECTRONICS CENTRE
180 '
190 CLEAR ,PEEK(7)*256+PEEK(6)-10
200 INPUT "WHICH DRIVE IS REQUIRED.....";DRIVE$
210 D%=ASC(DRIVE$)-65
220 IF D%=0 OR D%=1 THEN 240 ELSE 200
230 RESET
240 POKE 4,(PEEK(4) AND &HF0)+D%
250 DEST=PEEK(7)*256+PEEK(6)-10
260 FOR J=0 TO 6
270 READ N
280 POKE DEST+J,N
290 NEXT J
300 CALL DEST(D%)
310 CLEAR,PEEK(7)*256+PEEK(6)-2
320 END
330 DATA 94,14,14,195,5,0,201
```

LISTING 5.

```
10 REM MAKE AN AREA FOR THE CODE
20 CLEAR,&HC000
30 MLOC=&HC000
40 REM PUT CODE INTO MEMORY
50 FOR J=0 TO 14
60 READ N
70 POKE MLOC+J,N
80 NEXT J
90 INPUT "WHAT IS YOUR STRING";A$
100 REM CALL IT WHEN I WANT IT
110 CALL MLOC(A$)
120 PRINT A$
130 END
1000 DATA 70,35,94,35,86,26,238,32,18,19
1010 DATA 5,194,5,192,201
```

LISTING 6.

```
        ORG   0C000H
        NUM   EQU  8          ;total number of vars
        SHLD AP1              ;save addr of var1
        XCHG                  ;xchg DE with HL
        SHLD AP2              ;save addr of var2
        MVI   A,NUM-2         ;count of remainder
        LXI   D,AP3           ;addr of local store
        MOV   H,B             ;xfer table addr to BC
        MOV   L,C
MORE:   MOV   C,M
        INX   H
        MOV   B,M
        INX   H
        XCHG                  ;point HL to local store
        MOV   M,C             ;save addr of var locally
        INX   H
        MOV   M,B
        INX   H
        XCHG                  ;restore table pointer
        DCR   A               ;decrement count
        JNZ   MORE            ;done ?

    <<    your subroutine fits in here    >>


      RET
  AP1  DS    2                ;store for addr of var1
  AP2  DS    2                ;store for addr of var2
  AP3  DS    (NUM-2)*2        ;store for var 3-8
```

LISTING 7.

```
        ORG     0C000H
;FIRST STORE PASSED PARAMETERS...HL & DE IN USE
        PUSH    HL
        PUSH    DE
;NOW MULT FN NUMBER IN A BY 2
        LD      A,(HL)          ;get function number
        CP      4               ;valid functions are 0 to 3
        JR      NC,ERROR        ;invalid  so return
        ADD     A,A             ;double it
        LD      C,A             ;and put in creg
        LD      B,0             ;zero breg
        LD      HL,TABLE        ;get table addr
        ADD     HL,BC           ;and offset to reqd jump
;HL NOW POINTS TO REQUIRED JUMP TABLE ENTRY
        JP      (HL)            ;go there
;
;
ERROR:  POP     DE              ;restore stack & return to basi
        POP     HL
        RET                     ;and return to MBASIC
;
TABLE:  JR      FN0
        JR      FN1
        JR      FN2
        JR      FN3

;FUNCTION 0 TO TRANSLATE TO LOWER CASE
FN0:    POP     DE              ;restore parms
        POP     HL
        CALL    COLLECT         ;reposition parms
MORE0:  LD      A,(HL)          ;get character
        CALL    FIX0            ;fix it
        INC     HL              ;bump memory pointer
        DEC     B               ;decrement char count
        JR      NZ,MORE0        ;more ?
        RET                     ;done
FIX0:   CP      'Z'+1           ;is it above letter 'Z' ?
        RET     NC              ;skip it
        CP      'A'             ;is it below letter 'A' ?
        RET     C               ;skip it
        ADD     A,20H           ;upper case bias
        LD      (HL),A          ;replace
        RET

;FUNCTION 1 TO TRANSLATE TO UPPER CASE
FN1:    POP     DE              ;restore addrs
        POP     HL
        CALL    COLLECT         ;reposition addrs
MORE1:  LD      A,(HL)          ;get character
        CALL    FIX1            ;fix it
        INC     HL              ;bump memory pointer
        DEC     B               ;decrement count
```

(continued from previous page)

address of var1; DE, the address of var2; and BC the address of an area of memory where MBasic is storing a table of two-byte addresses which indicate where the remaining variables may be found. When dealing with string variables the contents of HL, DE or the table address, as appropriate, will give the string descriptor location.

Your subroutine must know exactly the type and number of the variables to be passed. Having Called the subroutine we are immediately faced with the problem of unloading the registers of the vital information that they contain before we can use them ourselves. Thus we must set up a local storage area to accept them or use the stack. For a total of eight variables we might proceed using a local storage area, as in listing 6.

Listing 7 is a working example, coded in Z-80 mnemonics, of passing two variables. It uses the stack for noting the contents of DE and HL. The subroutine call takes the form

CALL MLOC(F%,A$)

where A$ is a string which is to be processed and F% controls what is to be done with it. Only alphabetic

LISTING 8.

```
100 CLEAR,&HC000
110 MLOC=&HC000
120 PRINT "DEMONSTRATION OF PARAMETER PASSING"
130 FOR J=0 TO 128
140 READ N
150 POKE MLOC+J,N
160 NEXT J
170 INPUT "Message required";A$
180 FOR F%=0 TO 3
190 CALL MLOC(F%,A$)
200 PRINT A$
210 NEXT F%
220 END
230 DATA 229,213,126,254,4,48,9,135,79,6
240 DATA 0,33,19,192,9,233,209,225,201,24
250 DATA 6,24,28,24,50,24,69,209,225,205
260 DATA 121,192,126,205,41,192,35,5,32,248
270 DATA 201,254,91,208,254,65,216,198,32,119
280 DATA 201,209,225,205,121,192,126,205,65,192
290 DATA 35,5,32,248,201,254,123,208,254,97
300 DATA 216,214,32,119,201,209,225,205,121,192
310 DATA 126,205,65,192,35,5,200,126,205,41
320 DATA 192,35,5,32,248,201,209,225,205,121
330 DATA 192,126,205,65,192,35,5,200,126,205
340 DATA 41,192,35,5,200,254,32,40,238,24
350 DATA 243,235,70,35,94,35,86,235,201,129
```

```
        JR      NZ,MORE1        ;more ?
        RET                     ;done
FIX1:   CP      'z'+1           ;is it above letter 'z' ?
        RET     NC              ;skip it
        CP      'a'             ;is it below letter 'a' ?
        RET     C               ;skip it
        SUB     20H             ;subtract bias
        LD      (HL),A          ;replace
        RET

;FUNCTION 1 TRANSLATE FIRST CHAR TO UC & REMAINDER TO LC
FN2:    POP     DE              ;restore stack
        POP     HL
        CALL    COLLECT
        LD      A,(HL)          ;first char
        CALL    FIX1            ;force upper case
        INC     HL              ;bump memory pointer
        DEC     B               ;decrement count
        RET     Z               ;done ?
MORE2:  LD      A,(HL)          ;get next char
        CALL    FIX0            ;force remaining chars to lc
        INC     HL              ;bump memory pointer
        DEC     B               ;decrement count
        JR      NZ,MORE2        ;more chars ?
        RET                     ;done

;FUNCTION 3 FIRST LETTER OF ALL WORDS UC REST LC
FN3:    POP     DE              ;restore stack
        POP     HL
        CALL    COLLECT         ;reposition addrs
LOOP:   LD      A,(HL)          ;first char
        CALL    FIX1            ;fix it
        INC     HL              ;bump memory pointer
        DEC     B               ;decrement count
        RET     Z               ;done ?
MORE3:  LD      A,(HL)          ;get next char
        CALL    FIX0            ;fix it
        INC     HL              ;bump memory pointer
        DEC     B               ;decrement count
        RET     Z               ;done ?
        CP      ' '             ;was last char a space ?
        JR      Z,LOOP          ;yes ..so treat next as first
        JR      MORE3           ;no ...treat for lc

;SUBROUTINE TO COLLECT PARMS AS REQD
COLLECT:EX      DE,HL           ;swop de & hl
        LD      B,(HL)          ;put length in b
        INC     HL
        LD      E,(HL)          ;low byte of string address
        INC     HL
        LD      D,(HL)          ;high byte of string address
        EX      DE,HL           ;swop back again
        RET                     ;done
```

characters are affected by this.

If F% is set to 0 then all translation is to lower case. If F% is set to 1 then all translation is to upper case. If F% is set to 2 then only the first character is translated to upper case; the rest will be lower case. If F% is set to 3 then the first character of each word is translated to upper case; the rest will be lower case. This is an excellent example since it shows how much faster strings can be processed by machine code, rather than by using MBasic's string-handling functions.

The demonstration Calling program is shown in listing 8. If you need to pass a number of values which are in the range 0 to 255, it might be easier to Poke them into the free memory area directly and let your subroutine take them up from there. You may even place results back into such locations and on returning to MBasic pick them up again by Peeking them.

On a practical note, the biggest problem you will face in using the ideas presented in this article is converting the machine code into the MBasic Data statements. The method I use is to write the source code using any standard editor, and then assemble it to produce the Intel standard .Hex file using ASM or ZASM/Link, etc. Having obtained the .Hex file I simply run the program shown in listing 9, which reads the .Hex file and writes a .Dat file which contains the MBasic Data lines as required.

The lines start from any line number and increment by 10. They have 10 items of data on each line. In addition, a final value is added to the data which gives the total number of items preceding it.

LISTING 9.

```
10 PRINT "********************"
20 PRINT "***** HEX2DAT *****"
30 PRINT "********************"
40 PRINT
50 PRINT "Program to convert a .HEX file into"
60 PRINT "a .DAT file which may be merged intoa MBASIC program"
70 PRINT "ready for POKEing into memoryas a M/C subroutine."
80 PRINT
90 PRINT "THE LAST ITEM IN THE DATA IS THE NUMBER OF PRECEDING BYTES"
100 PRINT
110 INPUT"STATE FILENAME TO CONVERT";N$
120 DIM B%(500)
130 OPEN "I",#1,N$+".HEX"
140 LINE INPUT #1,A$
150 GOSUB 440:FB=NB
160 CLOSE
170 OPEN "I",#1,N$+".HEX"
180 WHILE NOT EOF(1)
190       LINE INPUT #1,A$
```

(listing continued on page 106)

LISTING 10.

```
10 PRINT " DEMOSTRATION OF MACHINE CODE CALL"
20 PRINT
30 PRINT "Each time you hit a key I will"
40 PRINT "print a message using a m/c subroutine"
50 PRINT "Hit ESC to finish"
60 PRINT:PRINT
70 X$=INPUT$(1)
80 IF X$=CHR$(27) THEN END
90 CALL CODE
100 GOTO 70
```

LISTING 11.

```
PUBLIC  CODE

BDOS    EQU     5
PRSTR   EQU     9
CODE:   MVI     C,PRSTR
        LXI     D,MESS
        CALL    BDOS
        RET
MESS:   DB      'This message was printed',10,13
        DB      'by a machine code subroutine',10,13
        DB      'of a MBASIC program',10,13,'$'
        END
```

This figure is helpful since it gives the looping total for Poking the data into memory. The looping figure should be one less than the last item in the Data. The .Dat file may be loaded or even merged as required, since it is an ASCII-format file. I have been using this program for some time, and so far it seems to cope with all I have demanded of it.

If you have Bascom, the Microsoft Compiler, then any programs saved in ASCII can be compiled directly using the sequence:

A>BASCOM=PROGNAME

and then linked with

A>L80 PROGNAME/N,
PROGNAME/E

This is the standard use of the compiler. Watch out for the common pitfalls of using some form of coding that is acceptable for interpreted Basic but which is not supported by Bascom.

The more professional approach is to write your subroutine and MBasic program separately and combine them at link time. This avoids all the awful Poking and Data statements. Write the MBasic part of the program as before, but this need now only contain the Call statement. Since there are no Data, Pokes or even an address of the machine code, the interpreted version will not run as before.

Secondly, write the subroutine. This should have a label which is referenced by the Call in the MBasic statement, and is defined as a Public or Global variable. Use Bascom to compile the MBasic part and presumably M-80, as this is part of the compiler package, to assemble the machine-code part without an origin. Note that M-80 assumes a .Mac extension.

Finally, link the two together. The linker will decide where to place the subroutine in memory and arrange for the MBasic part to find it correctly, which is why you must not specify the absolute address of the subroutine in your program.

The MBasic in listing 10 makes a simple Call to a subroutine that prints a message. This program I have called MBDemo.Bas and saved it in ASCII format using

SAVE"MBDEMO",A

(continued on next page)

(continued from previous page)

Having returned to CP/M using the System command you can now invoke the compiler to produce a .Rel file from the MBasic source code with

A>BASCOM=MBDEMO

The machine-code routine I have called MCDemo.Mac simply prints the message. Note the Public declaration of the label Code, which will be searched for during link time. This subroutine, shown in listing 11, must now be assembled using M-80 to produce another .Rel file. To do this

A>M80=MCDEMO

You must now use the L-80 linker to link together the .Rel files which were obtained from the MBasic program and the sub-routine. You must also specify that the library file Baslib is to satisfy any references to code required by the linker. The command line

A>L80=MBDEMO, MCDEMO/S, BASLIB/S, DEMO/N/E

does this and also outputs the resulting code to a file called Demo.Com. This is the alternative compile and link procedure, invoking Obslib. The switches used in the link command are as follows: /S means search this file for undefined globals; /N means this is the name of the file to be saved; and /E means exit L-80 and return to CP/M. PC

LISTING 9.

(listing continued from page 105)

```
200       GOSUB 440
210       IF NB=FB+I THEN 250
220       FOR K=1 TO NB-(FB+I)
230               I=I+1:B%(I)=0
240       NEXT K
250       FOR J=10 TO LEN(A$)-2 STEP 2
260               X$=MID$(A$,J,1):GOSUB 500:L=Z
270               X$=MID$(A$,J+1,1):GOSUB 500:R=Z
280               I=I+1:B%(I)=L*16+R
290       NEXT J
300 WEND

310 INPUT "STATE NUMBER OF FIRST DATA LINE";LN
320 N=I
330 OPEN "O",#2,N$+".DAT"
340 I=0
350 PRINT #2,LN;"DATA ";
360 FOR J=1 TO 10
370       I=I+1
380       IF J<>10 THEN PRINT #2,RIGHT$(STR$(B%(I)),LEN(STR$(B%(I)))-1);"
390       IF J= 10 THEN PRINT #2,RIGHT$(STR$(B%(I)),LEN(STR$(B%(I)))-1)
400       IF I=N THEN 540
410 NEXT J
420 LN=LN+10
440 REM Find address for the bytes in A$
450 NB=0
460 FOR J=4 TO 7
470       X$=MID$(A$,J,1):GOSUB 500:NB=NB+Z*16^(7-J)
480 NEXT J
490 RETURN
500 REM CONVERSION SUBROUTINE
510 IF ASC(X$)>64 THEN Z=ASC(X$)-55
520 IF ASC(X$)<64 THEN Z=VAL(X$)
530 RETURN

540 PRINT #2,RIGHT$(STR$(I),LEN(STR$(I))-1)
550 CLOSE
560 END
```

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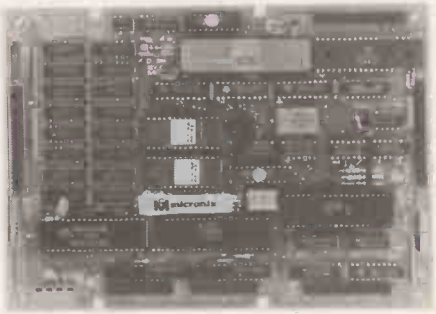

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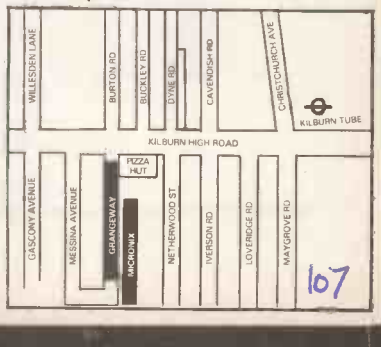


● Circle No. 164

BY NICHOLAS McCUTCHEON

ROM DISC

GAVIN CRADLE has submitted a program that enables paged ROMs to be transferred on to disc so that they can be loaded into and run from sideways RAM.

The program operation can be divided into five main actions. First list all the paged ROMs in the machine. Then you enter the number of the ROM to be saved, activate the selected paged ROM, and copy the ROM from &8000 to RAM at &3000. Finally you save 16K of RAM, starting at &3000.

The file name used for saving the ROM is its title. If the ROM's title is more than seven characters long the first seven characters are used. Any spaces embedded in the name are replaced with a - character, so Disc Doctor becomes Disc-do-. All ROMs are saved under the R. directory.

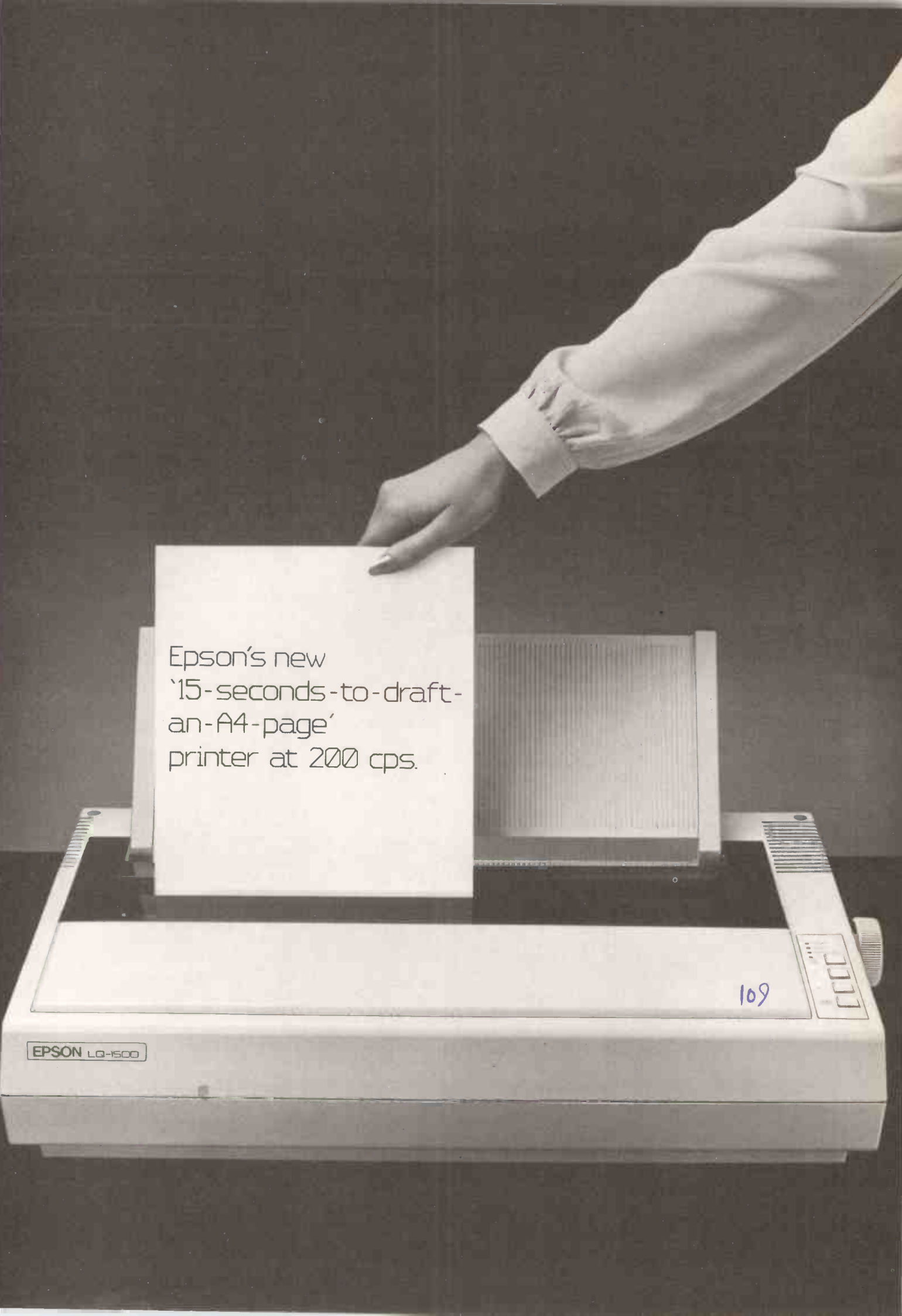
The program is written in Basic 1, and because line 270 sets P% to &1900 the program should be typed in, then saved. It can then be reloaded with Page set to &3000 to Run.

This utility is most useful for looking at any of the paged ROMs other than the DFS as the OS does not allow access to other ROMs while one is being executed. The object code can be saved and *Run later to save another ROM for inspection and/or running in sideways RAM.

ROM DISC

```
   10 REM M/C routine to copy a spe
cified paged rom down
   20 REM from &8000 to &3000 then
save it onto disc.
   30 REM
   40 REM Written by : Gavin J. Cra
dle.
   50 REM Started    : 8th February
 '85
   60 REM Finished   : 13th Februar
y '85
   70 REM BASIC 1 version.
   80
   90 MODE7:VDU23;8202;0;0;0;:PRINT
"Assembling in progress."
  100 oswrch=&FFEE
  110 osrdch=&FFE0
  120 osnewl=&FFE7
  130 osbyte=&FFF4
  140 oscli=&FFF7
  150 osword=&FFF1
  160 roml=&70
  170 romh=&71
  180 current=&72
  190 romno=&73
  200 froml=&74
  210 fromh=&75
  220 tol=&76
  230 toh=&77
  240 svl=&78
  250 svh=&79
  260
  270 FOR pass=0 TO 1
  280 P%=&1900
  290 [
  300 OPT pass*2
  310 .romdisc
  320             JSR init
 \Initialisation section.
  330             JSR proms
 \List all paged roms.
  340             JSR selrom
 \Select the rom.
  350             JSR move
 \Move the rom.
  360             JSR save
 \Save the rom.
  370             LDX #0
  380 .pf
  390             LDA fini,X
  400             BEQ opf
  410             JSR oswrch
  420             INX
  430             JMP pf
 \Inform the user that the
  440 .opf
 \rom has been saved onto
  450             JSR osrdch
 \disc and ask whether any
  460             CMP #78
 \more are to be moved.
  470             BEQ exit
  480             CMP #89
  490             BEQ romdisc
  500             JMP pf
  510 .exit
  520             LDA #0
 \Switch the escape key
  530             STA &258
 \back on.
  540             LDA #26
  550             JSR oswrch
  560             LDA #12
  570             JSR oswrch
  580             JSR osnewl
 \Clear the screen and
  590             RTS
 \return to BASIC.
  600 .init
  610             LDA #1
 \Switch the escape key
  620             STA &258
 \off.
  630             LDA #0
  640             STA froml
  650             STA tol
  660             LDA #&80
 \State where the rom is
  670             STA fromh
 \to be moved from and
  680             LDA #&30
 \where it is to be moved
  690             STA toh
 \to.
  700             LDA #&7C
  710             STA &7
 \Set HIMEM to its correct
  720             LDA #0
 \value for MODE 7.
  730             STA &6
  740             LDX #0
  750 .p1
  760             LDA title,X
  770             BEQ op1
 \Print out the title
  780             JSR oswrch
 \screen for the utility.
  790             INX
  800             JMP p1
  810 .op1
  820             JSR osnewl
  830             LDA #28
  840             JSR oswrch
  850             LDA #0
  860             JSR oswrch
  870             LDA #23
  880             JSR oswrch
 \Set up a text window
  890             LDA #39
 \that will leave the top
  900             JSR oswrch
 \four lines of the screen
  910             LDA #4
 \displayed.
  920             JSR oswrch
  930             LDA #170
  940             LDX #0
  950             LDY #255
 \Find out the high & low
  960             JSR osbyte
 \bytes of a table holding
  970             STX roml
 \details of the types of
  980             STY romh
 \roms in the machine.
  990             LDA &F4
 \Save the number of the
 1000             STA current
 \currently selected rom.
 1010             RTS
 1020 .proms
 1030             LDX #0
 1040 .p2
 1050             LDA roms,X
 1060             BEQ op2
 1070             JSR oswrch
 1080             INX
 1090             JMP p2
 1100 .op2
 1110             JSR osnewl
 1120             LDY #15
 1130 .list
 1140             STY &FE30
 \Patch in a rom.
 1150             STY &F4
 1160             LDA (roml),Y
 \Is there a rom in this
 1170             BEQ nsock
 \socket?
 1180             LDX #9
 1190             LDA #32
 1200 .p3
 1210             JSR oswrch
 1220             DEX
 1230             BNE p3
 1240             TYA
 1250             CMP #10
 1260             BMI less
 1270             LDA #49
 \Print out the rom
 1280             JSR oswrch
 \number.
 1290             TYA
 1300             CLC
 1310             ADC #38
 1320             JSR oswrch
 1330             JMP ptitle
 1340 .less
 1350             LDA #32
 1360             JSR oswrch
 1370             TYA
 1380             CLC
 1390             ADC #48
 1400             JSR oswrch
 1410 .ptitle
 1420             LDX #15
 1430             LDA #32
 1440 .pspaces
 1450             JSR oswrch
 1460             DEX
 1470             BNE pspaces
 1480             TYA
 1490             PHA
 1500             LDY #0
 1510 .pit
 1520             LDA &8009,Y
 \Print out the title
 1530             BEQ opit
 \of the paged rom.
 1540             JSR oswrch
 1550             INY
 1560             CPY #7
 1570             BNE pit
 1580 .opit
 1590             JSR osnewl
```

(continued on page 110)


Epson's new
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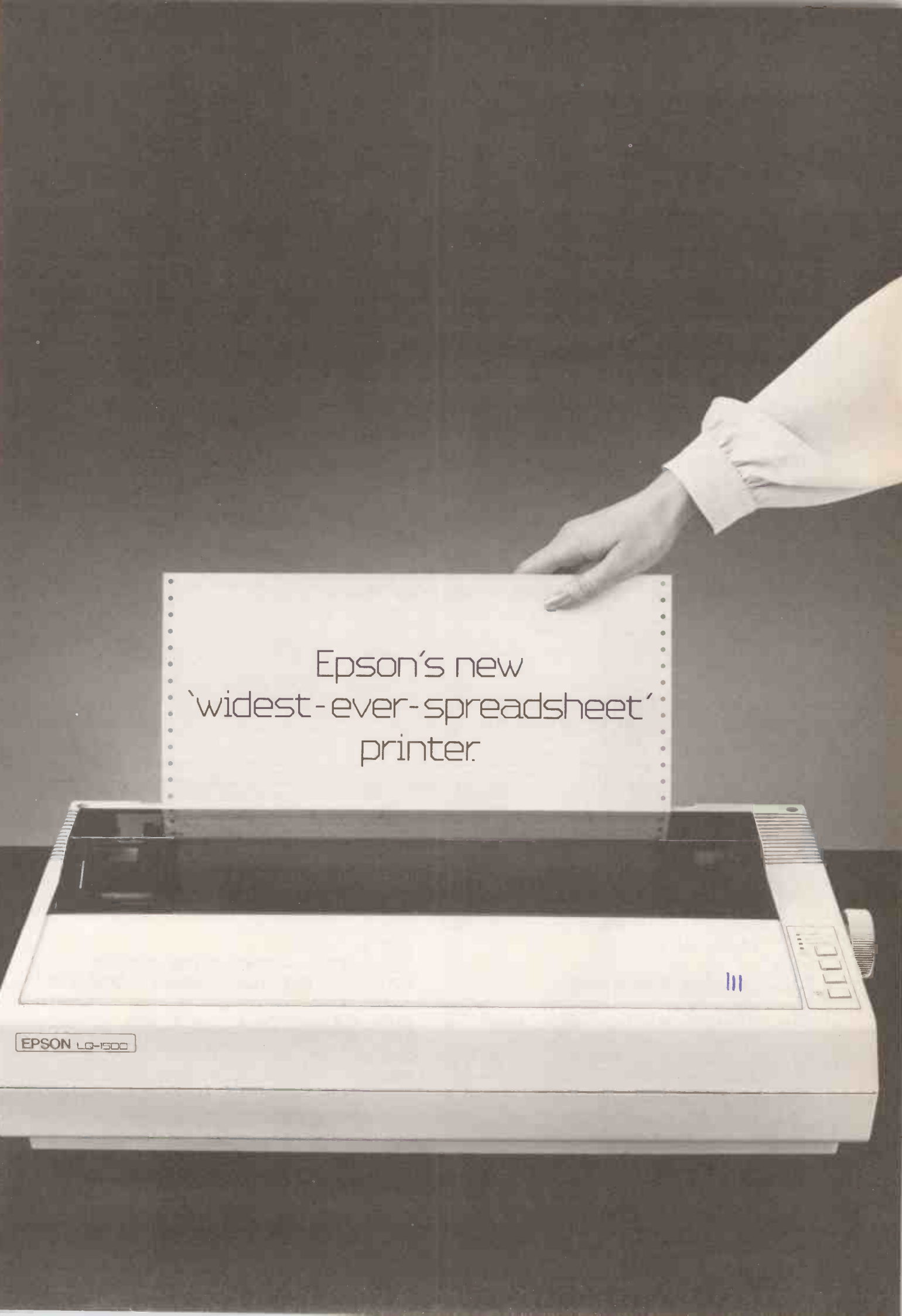
ROM DISC

(continued from page 108)

```
1600            PLA
1610            TAY
1620 .nsock
1630            DEY
1640            CPY #0
1650            BPL list
1660            LDA current
\Patch the rom in use
1670            STA &FE30
\before this routine
1680            STA &F4
\was called.
1690            RTS
1700 .selrom
1710            JSR osnewl
1720            LDX #0
1730 .p4
1740            LDA selprt,X
1750            BEQ op4
1760            JSR oswrch
1770            INX
1780            JMP p4
1790 .op4
1800            LDA #0
1810            STA romno
1820            STA &80
1830            STA &81
1840            STA &82
1850            LDX #block MOD 256
1860            LDY #block DIV 256
1870            JSR osword
1880            LDA &80
\Work out what the
1890            CMP #13
\number is of the rom
1900            BEQ error
\that is to be copied
1910            LDA &81
\onto disc.
1920            CMP #13
1930            BEQ lessten
1940            LDY &80
1950            CPY #50
1960            BCS error
1970            LDY &80
1980            CPY #48
1990            BEQ switch
2000            LDA #10
2010            STA romno
2020            LDA &81
2030            SEC
2040            SBC #48
2050            CLC
2060            ADC romno
2070            STA romno
2080            JMP check
2090 .switch
2100            LDA &81
2110            STA &80
2120 .lessten
2130            LDA &80
2140            SEC
2150            SBC #48
2160            STA romno
2170 .check
2180            LDY romno
2190            CPY #16
2200            BCS error
2210            LDY romno
\Ensure that there is
2220            LDA (roml),Y
\actually a rom in
2230            BEQ error
\this socket.
2240            RTS
2250 .error
2260            LDA #7
2270            JSR oswrch
2280            LDA #12
\Errors cause the routine
2290            JSR oswrch
\to clear the screen,
2300            JSR proms
\print out the rom titles
2310            JMP selrom
\& ask you to reselect.
2320 .move
2330            LDA romno
2340            STA &FE30
2350            STA &F4
2360            LDX #&40
2370            LDY #0
2380 .downl
2390            LDA (froml),Y
2400            STA (tol),Y
\Move the specified
2410            INY
\paged rom down from
2420            BNE downl
\&8000 to &3000.
2430            INC fromh
2440            INC toh
2450            DEX
2460            BNE downl
2470            LDA current
2480            STA &FE30
2490            STA &F4
2500            RTS
2510 .save
2520            LDX #sblock MOD 256
2530            LDY #sblock DIV 256
2540            STX svl
2550            STY svh
2560            INC svl
2570            INC svl
2580            INC svl
2590            INC svl
2600            LDA romno
2610            STA &FE30
\Save the specified
2620            STA &F4
\paged rom in the R
2630            LDY #0
\directory on the
2640 .name
\disc using the roms
2650            LDA &8009,Y
\name as the filename.
2660            BEQ ename
2670            CMP #32
2680            BEQ cspace
2690 .notspc
2700            STA (svl),Y
2710            INY
2720            CPY #7
2730            BNE name
2740 .ename
2750            LDA current
2760            STA &FE30
2770            STA &F4
2780            LDX #sblock MOD 256
2790            LDY #sblock DIV 256
2800            JSR oscli
2810            LDA #32
2820            LDY #7
2830 .cname
2840            STA (svl),Y
2850            DEY
2860            BNE cname
2870            RTS
2880 .cspace
2890            LDA #ASC"-"
2900            JMP notspc
2910 .title
2920 ]
2930        !P%=&20200716
2940        P%!4=&28839D84
2950        P%!8=&47202943
2960        P%!12=&6E697661
2970        P%!16=&202E4A20
2980        P%!20=&64617243
2990        P%!24=&202E656C
3000        $(P%+28)=" 10/2/85.  "
+CHR$156
3010        P%!40=&8D0D0A0A
3020        P%!44=&20202020
3030        P%!48=&20202020
3040        $(P%+52)=" ROM to disc
utility."
3050        P%!72=&208D0D0A
3060        P%!76=&20202020
3070        P%!80=&20202020
3080        $(P%+84)="ROM to disc
utility."+CHR$0
3090        P%=P%+105
3100 [
3110 OPT pass*2
3120 .roms
3130 ]
3140        !P%=&2020200C
3150        $(P%+4)="  Rom number.
"
3160        P%!17=&20202020
3170        P%!21=&20202020
3180        $(P%+25)=" Rom title."
3190        P%!36=&20200A0D
3200        P%!40=&5F202020
3210        P%!44=&5F5F5F5F
3220        P%!48=&5F5F5F5F
3230        P%!52=&20205F5F
3240        P%!56=&20202020
3250        P%!60=&5F202020
3260        P%!64=&5F5F5F5F
3270        P%!68=&5F5F5F5F
3280        P%?72=&5F
3290        P%?73=0
3300        P%=P%+74
3310 [
3320 OPT pass*2
3330 .selprt
3340 ]
3350        $P%="What no. rom do y
ou want to copy ?"+CHR$0
3360        P%=P%+35
3370 [
3380 OPT pass*2
3390 .block
3400 ]
3410        !P%=&30020080
3420        P%?4=&39
3430        P%=P%+5
3440 [
3450 OPT pass*2
3460 .sblock
3470 ]
3480        $P%="S.R.        3000
6FFF 8000 8000"+CHR$13
3490        P%=P%+32
3500 [
3510 OPT pass*2
3520 .fini
3530 ]
3540        !P%=&0A0A0A0C
3550        P%!4=&20202020
3560        P%!8=&20202020
3570        $(P%+12)="ROM successf
ully copied."
3580        P%!36=&0A0A0A0D
3590        P%!40=&0A202020
3600        P%?44=&20
3610        P%?45=&20
3620        $(P%+46)="Do you want
to copy any more ?"
3630        P%!76=&0A0A0A0D
3640        P%?80=&20
3650        P%?81=&20
3660        $(P%+82)=" Press 'Y' f
or yes and 'N' for no."+CHR$0
3670        P%=P%+120
3680 NEXT pass
3690 PRINT:PRINT"Use *SAVE ROMDISC
1900 ";~P%;" 1900 to savethe objec
t code."
3700 END
```


Epson's new
'widest-ever-spreadsheet'
printer.
EPSON LQ-1500

BY BILL HILL

ON RESET GOTO

ON OLDER versions of the Apple II + it was possible to accidentally press the Reset key instead of the Return key because of their proximity. Later versions of the II +, and the IIe, solved this problem by only allowing a Reset when the Ctrl and Reset keys are pressed simultaneously. Sometimes it would be nice to disable the Reset key so as to make a program idiot-proof. Jason Smith has sent in a routine to do just this.

When Reset is pressed, the Autostart ROM causes a branch to the address specified by the contents of addresses 1010 ($3F2) and 1011 ($3F3). The default values stores at these locations after DOS has been booted at power-up are the DOS Restart address.

Decimal		Hex	
Addr.	Contents	Addr.	Contents
1010	191	$3F2	$BF
1011	157	$3F3	$9D
1012	56	$3F4	$38

The value stored at address $3F4 is the result of an EOr of the value stored in $3F3 with the value $A5.

If you put a different address in these locations then you can force the Apple to jump to your own routine. The short machine-code routine starting at $300 in listing 1 will branch to a line number in a Basic program each time Reset is pressed.

Listing 2 is a Basic program that demonstrates how the machine-code routine can be used. The Basic program changes the Reset vectors to point to the machine-code at $300. To define which line the machine-code routine will jump to when you press Reset, set the Basic variable LI to the required line number and call the subroutine starting at line 200. Replace the Reset vectors with the original values when you have finished using the program. PC

LISTING 1.

ASSEMBLER

```
ORG     $300
JSR     $03EA       ;Make sure DOS is connected
JSR     $DAFB       ;Print a <CR>
LDA     £$00        ;Hi-byte of BASIC line no.
STA     $51         ;Store in Page Zero
LDA     £$00        ;Lo-byte of BASIC.line no.
STA     $50         ;Store in Page Zero
JSR     $D941       ;Find line in BASIC program
JSR     $D7D2       ;and start execution there
```

MACHINE CODE

```
0300: 20 EA 03 20 FB DA A9 00
0308: 85 51 A9 00 85 50 20 41
0310: D9 20 D2 D7
```

LISTING 2.

```
10  REM ON RESET GOTO DEMO

13  REM SET UP RESET VECTORS

15  POKE 1010,0: POKE 1011,3: POKE
     1012,166
16 :
20 LI = 100: GOSUB 200
25 :
30  PRINT : PRINT "PRESS 'RESET',
     OR ANY OTHER KEY TO END"
40  IF  PEEK ( - 16384) > 128 THEN
     250
45  FOR J = 1 TO 100: NEXT J
50  GOTO 30
60 :
70 :
99  REM  RESET WILL BRANCH TO LIN
     E 100
100  PRINT : PRINT : INVERSE
110  PRINT "YOU PRESSED IT!!":
     NORMAL
120  PRINT : PRINT
130  GOTO 30
140 :
150 :
199  REM   CHANGE LINE NUMBER
200 Z =  INT (LI / 256): POKE 775
     ,Z
210  POKE 779,LI - Z * 256
220  RETURN
230 :
240 :
250  REM  DEACTIVATE RESET VECTOR
     S
260  POKE 1010,191
270  POKE 1011,157
280  POKE 1012,56
290  END
```


Epson's new
'near-as-makes-no-
difference-to-
typewriter-quality'
printer.
113
EPSON LQ-1500

OPEN FILE

DIR BYTE-SUM

JOHN PALMER of Maidenhead doesn't like the fact that Dir only tells you how many bytes there are free on a disc, but not how many bytes your files add up to. He has therefore written a small Basic program, Dir.Bas, to do this.

To use it, you first type in the four-line batch file listed here, using the command

COPY CON BYTES.BAT

and press F6 or Ctrl-Z to end.

Bytes.Bat creates a disc file, Dir.Lst, which contains an image of the normal screen output. It then runs the Basic program Dir.Bas to list the specified files and print the number of bytes of disc space taken up. This Basic program finally returns you to the system level.

The variable parameter %1 enables you to specify the files required in normal syntax. For example, to list all the Basic files starting with Fred you would enter

BYTES FRED????.BAS

and it would tell you the space consumed.

The program works with both floppy and hard discs, and could be enhanced by including, say, Tree in the batch file, then modifying Dir.Bas to print a summary of the bytes in each directory and sub-directory. For hard-disc users, that would be really useful.

DIR BYTE-SUM

BASIC PROGRAM

```
100 REM    PROGRAM = DIR.BAS
110 REM
120 REM    A$ = INPUT RECORD CONTAINING D
IR LINE
130 REM    B  = INSTR TARGET VARIABLE
140 REM    C  = FILE COUNTER
150 REM    D  = BYTE COUNTER
160 REM    E  = BYTE TOTAL COUNTER
170 REM
180 CLS:OPEN "DIR.LST" FOR INPUT AS #1
190 WHILE NOT EOF(1)
200  INPUT #1,A$
210  B = INSTR(A$,"Volume"):IF B <> 0 TH
EN 270
220  B = INSTR(A$,"Directory"):IF B <> 0
 THEN PRINT A$:PRINT:GOTO 270
230  B = INSTR(A$,"bytes free"):IF B <>
0 THEN 270
240  B = INSTR(A$,"<DIR>"):IF B <> 0 THE
N PRINT A$:GOTO 270
250  IF A$ = " " OR A$ = "" THEN 270
260  C = C + 1:D = VAL(MID$(A$,13,9)):E
= E + D:PRINT A$
270 WEND
280 PRINT:PRINT C "files found, totallin
g" E "bytes.":PRINT:CLOSE:SYSTEM
```

BATCH FILE

```
ECHO OFF
DIR %1 >DIR.LST
BASICA DIR.BAS
ECHO ON
```

KEY UTILITY

```
10 REM TEST FOR SHIFTS, CONTROL, ALT, IN
S AND LOCK KEYS
20 DEF SEG=64
30 CLS
40 LOCATE 8,11:PRINT "INS  CPLK NMLK SCL
K ALT  CTRL LSFT RSHFT"
50 X=PEEK(23)
60 LOCATE 10,10
70 FOR I=7 TO 0 STEP -1
80 PRINT SGN(X AND 2^I);SPC(2);
90 NEXT I
100 GOTO 50
```

DOS PROMPT

```
PATH=C:\;DOS21UK
KEYBUK
WTDATIM
ECHO OFF
CLS
PROMPT Jack $t$h$h$h$h$h$h$_$n$g
TYPE MENU.TXT
```

SYSTEM CHECK

```
10 REM System Features
20 GOSUB 1000 ' Check system
30 CLS
40 SCREEN 0,0,0
50 WIDTH 80
60 PRINT "This IBM PC has :"
70 PRINT
80 PRINT RAM;"k Memory"
90 PRINT DISKS;"Floppy disk drive(s)"
100 PRINT HDISKS;"Hard disk drive(s)"
110 PRINT RS232;"Serial port(s)"
120 PRINT PPORTS;"Parallel port(s)"
130 PRINT GA;"Games adapter(s)"
140 PRINT " ";MON$(CM);" monitor"
150 PRINT " is the current display"
160 END
1000 REM SYSTEM
1010 DEF SEG=64
1020 RAM=PEEK(19)+PEEK(20)*256
1030 DISKS=1+(PEEK(16) AND 192)/64
1040 HDISKS=PEEK(117)
1050 PPORTS=(PEEK(17) AND 192)/64
1060 RS232=(PEEK(17) AND 14)/2
1070 GA=(PEEK(17) AND 16)/16
1080 MON$(0)="Monochrome"
1090 MON$(1)="Colour"
1100 DEF SEG=0
1110 CM=ABS((PEEK(1040)=157))
1120 RETURN
```

KEY UTILITY

ONE OF THE problems with the IBM keyboard is that you can't tell when any of the special keys have been pressed to set Insert, Caps Lock, Num Lock, Scroll Lock, Alt or Ctrl — or, indeed, the left and right Shift keys. If you want to write a user-friendly program, this is something you can take care of.

Mike Curtis points out that there is a simple way to tell by Peeking location 23, and his Key utility shows how it's done. If you run the program, this shows 0 when each of these keys is not pressed, and 1 when it is.

It is also possible to force the Control key on by

```
10 DEF SEG=64
20 POKE 23,4
```

DOS PROMPT

IT IS supremely easy to change the system prompt in PC-DOS. All you have to do is type the word "prompt", and then whatever you want the prompt to be, such as

PROMPT System crash

and press Return.

There are also some special features, described on pages 10 to 18 of the DOS manual, which enable you to get non-ASCII characters into it. Each must be preceded by the $ character.

For example, $d will set the date as the prompt, and $t the time. Especially useful for people with hard discs is $p, which makes the prompt into the name of the directory you are in at the time — such as C:/SALES/MPLAN or whatever. pg will include the >.

If you want to change the prompt, include a line in an Autoexec.Bat file so that this is done whenever the machine is restarted or turned on. An example is given above left.

In this case the time, $t, is reduced to show only hours and minutes by the use of repeated destructive backspaces, $h. The underline character, $_, starts a new line, and then ng provides the standard prompt, such as C>. The result is a two-line prompt of the form

```
Jack·15:17
C>
```

at 3.17pm. Resist the temptation to construct very fancy prompts. They become tedious if you see them often.

SYSTEM CHECK

ANOTHER small utility from Mike Curtis provides a simple way to check the facilities of an IBM PC, just as the IBM diagnostics disc does.

In line 1110, CM returns 0 if a monochrome monitor is fitted, and 1 if it is colour. PC


Epson's new
adhesive label
printer.
Epson's new
adhesive label
printer.
Epson's new
115
EPSON LQ-1500

OPEN FILE

PRINTING FOREIGN TEXT

A PROGRAM from Alan Mackay defines Russian, Greek and Turkish characters for the Epson FX-80 printer. It is written in Microsoft Basic avoiding machine-specific commands, and so should run with little alteration on most machines.

As many characters as possible are designed to correspond to similar characters in the familiar Latin alphabet, which makes it easier to find characters on the keyboard and recognise them on the screen. When the program is run, the appropriate character set is downloaded into the printer's memory and remains there until the printer is reinitialised or turned off. You can then go ahead and run other programs normally, but whenever a file is printed the characters will come out as the foreign equivalent.

The program should be of use in schools and other places where Russian, Greek or Turkish text is required but a special printer is not available. Labels can be stuck on the computer's keyboard if necessary to help with character identification.

ABCDEFGHIJKLMNOPQRSTUVWXYZ\[?/
АБЦДЕЖГХИЈКЛМНОПЮРСТУВШЖъЗЩЩЭЭ
abcdefghijklmnopqrstuvwxyz=-_]*
абцдефгхийклмнопюрстувшжызЧчЯяь

English to Russian.

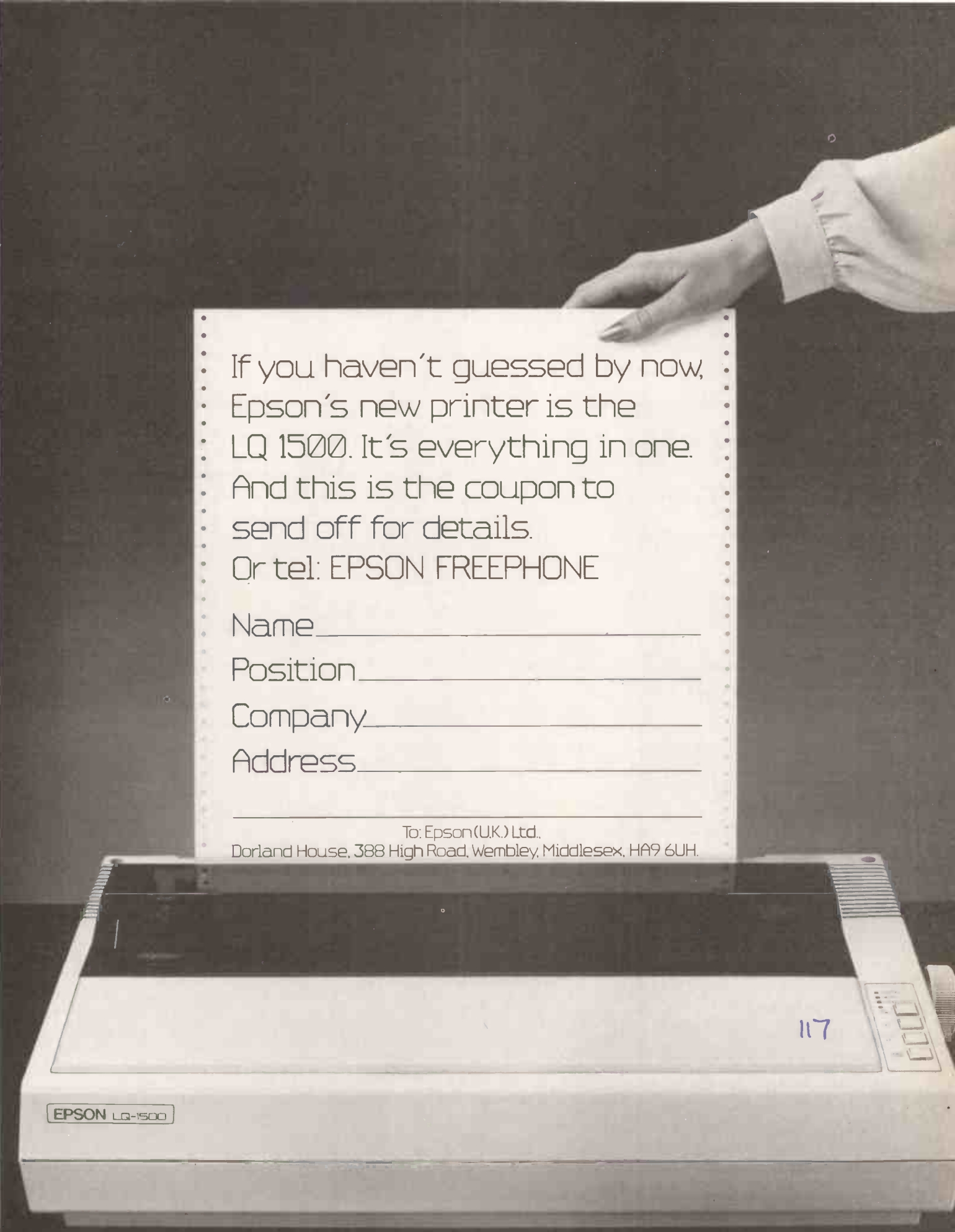
ABCDEFGHIJKLMNOPQRSTUVWXYZ
ΑΒCΔΕΦΓΧΙΗΚΛΜΝΟΠΘΡΣΤΩVΨΞΥΖ
abcdefghijklmnopqrstuvwxyz
αβςδεφγχιηκλμνοπθρστωνψξυζ

English to Greek.

FOREIGN TEXT. RUSSIAN.

```
10 REM change type font
20 REM program name RUSSIAN
30 REM copyright A.L.Mackay
40 REM Birkbeck College, London
50 REM Microsoft Basic for Nascom II micro
60 REM and EPSON FX-80 metrix printer
70 REM set infinite line width
80 WIDTH LPRINT 255
90 REM initialise printer
100 LPRINT CHR$(27);"@";
110 REM type style condensed enlarged
120 LPRINT CHR$(27);"!";CHR$(52);
130 REM set left margin
140 LPRINT CHR$(27);"l";CHR$(8);
150 REM copy original characters
160 LPRINT CHR$(27);":";CHR$(0);CHR$(0);
170 REM select download set
180 LPRINT CHR$(27);"%";CHR$(1);CHR$(0);
190 DEFINT I-N
200 DIM L(11)
210 REM number of characters to be re-defined
220 N=51
230 DIM A$(N)
240 REM N characters to be replaced
250 DATA W,w,\,[,C,c,X,x,?,/
260 DATA Q,q,D,d,Y,L,l,Y,=,-
270 DATA _,],U,u,B,b,G,g,H,h
280 DATA I,i,J,k,N,n,P,p,R,r
290 DATA S,s,T,V,v,Z,z,*,F,f
300 DATA m
310 FOR I= 1 TO N
320 READ A$(I)
330 NEXT I
340 LPRINT
350 REM if there are descenders in new chars.
360 REM then attribute is 11, otherwise 139
370 REM list of attribute chars.
380 DIM M(N)
390 FOR I=1 TO N
400 READ M(I)
410 NEXT I
420 DATA 139,139,11,11,11,11,139,139,139,139
430 DATA 139,139,139,139,139,139,139,139,139,139
440 DATA 139,139,139,11,139,139,139,139,139,139
450 DATA 139,139,139,139,139,139,139,139,139,139
460 DATA 139,139,139,139,139,139,139,139,139
470 DATA 139,139
480 REM redefine characters
490 FOR I=1 TO N
500 LPRINT CHR$(27);"&";CHR$(0);
510 LPRINT CHR$(ABC(A$(I)));CHR$(ABC(A$(I)));
520 LPRINT CHR$(M(I));
530 FOR J=1 TO 11
540 READ L(J)
550 LPRINT CHR$(L(J));
560 NEXT J
570 NEXT I
580 REM data for N characters
590 REM 11 items for each
600 REM data for RUSSIAN
610 LPRINT
620 DATA 0,254,0,2,0,254,0,2,0,254,0
630 DATA 0,62,0,2,0,62,0,2,0,62,0
640 DATA 0,252,0,4,0,252,0,4,0,252,3
650 DATA 0,124,0,4,0,124,0,4,0,124,3
660 DATA 0,0,252,0,4,0,4,0,252,3,0
670 DATA 0,0,124,0,4,0,4,0,124,3,0
680 DATA 0,130,108,16,0,254,0,16,108,130,0
690 DATA 0,34,20,8,0,62,0,8,20,34,0
700 DATA 0,68,0,130,0,146,0,146,68,56,0
710 DATA 0,36,0,66,16,66,16,66,36,24,0
720 REM
730 DATA 0,254,0,16,0,124,130,0,130,124,0
740 DATA 0,62,0,8,0,28,34,0,34,28,0
750 DATA 0,3,4,250, 0,130,0,130,0,255,0
760 DATA 0,3,0,62,0,34,0,34,0,63,0
770 DATA 0,62,0,18,12,0,0,62,0,0,0
780 DATA 0,4,0,194,60,128,0,128,0,254,0
790 DATA 0,0,50,12,32,0,32,0,62,0,0
800 DATA 0,48,0,32,0,62,0,18,0,12,0
810 DATA 0,240,0,8,0,8,0,8,0,254,0
820 DATA 0,0,56,0,4,0,4,0,63,0,0
830 REM
840 DATA 0,98,4,152,0,144,0,144,254,0,0
850 DATA 0,0,27,0,36,0,36,0,63,0,0
860 DATA 0,129,64,33,18,12,16,32,64,128,0
870 DATA 0,1,64,33,18,12,16,32,64,0,0
880 DATA 0,254,0,146,0,146,0,146,12,0,0
890 DATA 0,0,108,18,128,18,128,18,140,0,0
900 DATA 0,254,0,128,0,128,0,128,0,128,0
910 DATA 0,0,62,0,32,0,32,0,32,0,0
920 DATA 0,0,130,68,40,16,40,68,130,0,0
930 DATA 0,0,34,20,0,8,0,20,34,0,0
940 REM
950 DATA 0,254,0,4,8,16,32,64,0,254,0
960 DATA 0,0,62,0,4,8,16,0,62,0,0
970 DATA 0,0,62,128,4,72,16,128,62,0,0
980 DATA 0,0,62,0,8,0,20,0,34,0,0
990 DATA 0,254,0,16,0,16,0,16,0,254,0
1000 DATA 0,0,62,0,8,0,8,0,62,0,0
1010 DATA 0,254,0,128,0,128,0,128,0,254,0
1020 DATA 0,0,62,0,32,0,32,0,62,0,0
1030 DATA 0,254,0,144,0,144,0,144,0,96,0
1040 DATA 0,0,63,0,36,0,36,0,24,0,0
1050 REM
1060 DATA 0,124,130,0,130,0,130,0,130,68,0
1070 DATA 0,28,34,0,34,0,34,0,34,0,0
1080 DATA 0,32,0,32,0,62,0,32,0,32,0
1090 DATA 0,130,124,130,16,130,16,130,16,108,0
1100 DATA 0,0,62,0,42,0,42,16,6,0,0
1110 DATA 0,0,68,130,0,146,0,146,108,0,0
1120 DATA 0,0,20,34,0,34,0,42,20,0,0
1130 DATA 0,0,62,0,18,0,18,12,0,0,0
1140 DATA 0,130,16,170,0,124,0,170,16,130,0
1150 DATA 0,28,34,0,34,93,34,0,34,28,0
1160 REM
1170 DATA 0,62,0,16,8,4,8,16,0,62,0
1180 REM test data
1190 LPRINT
1200 LPRINT CHR$(27);"4";
1210 LPRINT "English to Russian"
1220 LPRINT
1230 LPRINT CHR$(27);"5";
1240 LPRINT CHR$(27);"4";
1250 LPRINT "ABCDEFGHIJKLMNOPQRSTUV
  WXYZ\[?/=- ]*"
1260 LPRINT CHR$(27);"5";
1270 LPRINT "ABCDEFGHIJKLMNOPQRSTUV
  WXYZ\[?/=- ]*"
1280 LPRINT CHR$(27);"4";
1290 LPRINT "abcdefghijklmnopqrstuvwxyz"
1300 LPRINT CHR$(27);"5";
1310 LPRINT "abcdefghijklmnopqrstuvwxyz"
1320 LPRINT
1330 LPRINT CHR$(27);"4";
1340 LPRINT "Russian to English:"
1350 LPRINT CHR$(27);"5";
1360 LPRINT
1370 LPRINT "ABVGDEXZIKLMNOPSTUFHC=W\Y*?Q_"
```

(continued on page 118)



24 pin impact dot matrix, 200 cps, 67 cps NLQ mode, 101–406 mm paper width, up to 272 characters per line.
Options: single or double sheet feeder, tractor, parallel and serial 2K or 32K, IEEE 2K.

EPSON

FOREIGN TEXT. RUSSIAN.

(continued from page 116)

```
1380 LPRINT CHR$(27);"4";
1390 LPRINT "ABVGDEXZIKLMNOPSTUFHC=W\Y*?Q_"
1400 LPRINT CHR$(27);"5";
1410 LPRINT "abvgdexziklmnopstufhc-w[y*/q]"
1420 LPRINT CHR$(27);"4";
1430 LPRINT "abvgdexziklmnopstufhc-w[y*/q]"
1440 LPRINT CHR$(27);"5";
```

GREEK

```
10 REM change type font
20 REM program name GREEK
30 REM copyright A.L.Mackay,
40 REM Birkbeck College, London
50 REM Microsoft Basic for Nascom II micro
60 REM and Epson FX-80 matrix printer
70 REM set infinite line width
80 WIDTH LPRINT 255
90 REM put Greek characters into Italic set
100 REM initialise printer
110 LPRINT CHR$(27);"@";
120 REM type style condensed enlarged
130 LPRINT CHR$(27);"!";CHR$(52);
140 REM set left margin
150 LPRINT CHR$(27);"l";CHR$(8);
160 REM copy original characters
170 LPRINT CHR$(27);":";CHR$(0);CHR$(0);
  CHR$(0);
180 REM select download set
190 LPRINT CHR$(27);"%";CHR$(1);CHR$(0);
200 DEFINT I-N
210 DIM L(11)
220 REM number of characters to be re-defined
230 N=37
240 DIM A$(N)
250 DATA a,L,X,F,g,G,l,x,f,D
260 DATA d,m,P,h,e,z,n,p,W,j
270 DATA Q,q,r,w,i,k,y,t,u,U
280 DATA c,b,J,R,8,H,s
290 FOR I= 1 TO N
300 READ A$(I)
310 NEXT I
320 LPRINT
330 REM if there are descenders in new chars.
340 REM then attribute is 11, otherwise 139
350 REM list of attribute chars.
360 DIM M(N)
370 FOR I=1 TO N
380 READ M(I)
390 NEXT I
400 DATA 139,139,139,139,11,139,139,139,11,139
410 DATA 139,11,139,139,139,11,139,139,139,11
420 DATA 139,139,11,11,139,139,139,139,139,139
430 DATA 11,11,139,139,139,139,139
440 REM redefine characters
450 FOR I=1 TO N
460 LPRINT CHR$(27);"&";CHR$(0);
470 LPRINT CHR$(128+ASC(A$(I)));CHR$(128+
. ASC(A$(I)));
480 LPRINT CHR$(M(I));
490 FOR J=1 TO 11
500 READ L(J)
510 NEXT J
520 FOR J=1 TO 11:LPRINT CHR$(L(J));:NEXT J
530 NEXT I
540 REM data for N characters
550 REM 11 items for each
560 REM data for GREEK
570 LPRINT
580 DATA 0,28,0,34,0,34,20,8,20,34,0
590 DATA 0,2,4,8,16,32,64,128,112,14,0
600 DATA 0,2,0,146,0,146,0,146,0,128,0
610 DATA 0,24,36,2,76,16,100,128,72,48,0
620 DATA 0,32,64,135,0,138,84,40,64,128,0
630 DATA 0,6,24,96,128,0,128,0,128,0,128
640 DATA 0,130,0,132,64,40,16,8,4,2,0
650 DATA 0,40,85,128,85,0,85,34,64,32,0
660 DATA 0,16,41,2,86,16,100,128,40,16,0
670 DATA 0,2,4,10,16,34,64,130,112,14,0
680 REM
690 DATA 0,0,76,162,16,130,16,130,76,0,0
700 DATA 0,3,12,48,68,0,4,8,52,64,0
710 DATA 0,6,24,96,128,0,128,6,152,96,128
720 DATA 0,34,0,34,20,8,20,34,64,2,0
730 DATA 0,0,20,42,0,42,0,34,20,0,0
740 DATA 0,1,0,177,8,66,136,66,140,64,0
750 DATA 0,32,18,12,2,0,4,8,16,48,0
760 DATA 0,34,4,56,0,32,0,32,28,34,0
770 DATA 0,128,120,5,128,127,128,5,120,128,0
780 DATA 0,0,64,60,0,64,0,64,63,0,0
790 REM
800 DATA 0,28,34,80,130,16,130,20,136,112,0
810 DATA 0,12,18,8,34,8,34,8,36,24,0
820 DATA 0,7,24,32,4,64,4,64,8,48,0
830 DATA 0,96,16,0,11,20,104,128,16,96,0
840 DATA 0,0,0,0,0,60,2,0,2,0,0
850 DATA 0,0,62,0,8,16,36,0,2,0,0
860 DATA 0,32,12,48,2,0,2,4,56,0,0
870 DATA 0,32,0,60,2,32,2,32,0,32,0
880 DATA 0,28,34,0,2,28,2,0,34,28,0
890 DATA 0,50,72,2,132,0,132,2,72,50,0
900 REM
910 DATA 0,48,72,1,68,1,68,1,70,32,0
920 DATA 0,127,128,4,160,4,160,4,88,0,0
930 DATA 0,6,56,192,16,0,16,6,56,192,0
940 DATA 0,6,24,96,144,0,144,0,144,96,0
950 DATA 0,2,0,134,64,170,0,146,0,128,0
960 DATA 0,2,132,72,32,24,36,2,64,128,0
970 DATA 0,12,16,34,0,34,0,52,8,32,0
980 LPRINT "English to Greek:"
990 LPRINT
1000 LPRINT "ABCDEFGHIJKLMNOPQRSTUVWXYZ"
1010 LPRINT CHR$(27);"4";
1020 LPRINT "ABCDEFGHIJKLMNOPQRSTUVWXYZ"
1030 LPRINT CHR$(27);"5";
1040 LPRINT "abcdefghijklmnopqrstuvwxyz"
1050 LPRINT CHR$(27);"4";
1060 LPRINT "abcdefghijklmnopqrstuvwxyz"
1070 LPRINT CHR$(27);"5";
1080 LPRINT
1090 LPRINT "Greek to English:"
1100 LPRINT
1110 LPRINT CHR$(27);"4";
1120 LPRINT "ABGDEZJQIKLMNXOPRSTYFHWU"
1130 LPRINT CHR$(27);"5";
1140 LPRINT;"ABGDEZJQIKLMNXOPRSTYFHWU"
1150 LPRINT CHR$(27);"4";
1160 LPRINT "abgdezjqiklmnxoprstyfhwuc"
1170 LPRINT CHR$(27);"5";
1180 LPRINT "abgdezjqiklmnxoprstyfhwuc"
```

TURKISH

```
10 REM change type font
20 REM initialise printer
30 LPRINT CHR$(27);"@";
32 REM type style condensed enlarged
34 LPRINT CHR$(27);"!";CHR$(52);
40 REM copy original characters
50 LPRINT CHR$(27);":";CHR$(0);CHR$(0);CHR$(0);
60 REM select download set
70 LPRINT CHR$(27);"%";CHR$(1);CHR$(0);
80 DEFINT I-N
90 DIM L(11)
100 REM number of characters to be re-defined
110 N=10
120 DIM A$(N)
130 REM N characters to be replaced
140 DATA I,w,/,!,W,q,J,x,X,0
150 FOR I= 1 TO N
160 READ A$(I)
170 LPRINT A$(I);
180 NEXT I
190 LPRINT
200 REM if there are descenders in new chars.
210 REM then attribute is 11, otherwise 139
220 REM list of attribute chars.
230 DIM M(N)
240 FOR I=1 TO N
250 READ M(I)
260 NEXT I
270 DATA 139,139,139,139,139,11,11,11,11,11
280 REM redefine characters
290 FOR I=1 TO N
300 LPRINT CHR$(27);"&";CHR$(0);
310 LPRINT CHR$(ASC(A$(I)));CHR$(ASC(A$(I)));
320 REM attribute "a"
330 LPRINT CHR$(M(I));
340 FOR J=1 TO 11
350 READ L(J)
360 LPRINT CHR$(L(J));
370 NEXT J
380 NEXT I
390 REM data for N characters
400 REM 11 items for each
410 REM data for TURKISH
420 LPRINT "TURKISH"
430 DATA 0,0,28,162,0,34,0,162,28,0,0
440 DATA 0,0,60,128,2,0,2,128,60,2,0
450 DATA 0,0,34,0,62,0,2,0,0,0,0
460 DATA 0,0,0,66,0,254,0,66,0,0,0
470 DATA 0,60,64,130,64,2,64,130,64,60,0
480 DATA 0,56,68,1,68,1,70,0,36,0,0
490 DATA 0,25,128,37,64,37,64,37,128,30,0
500 DATA 0,32,84,1,84,1,86,0,84,8,0
510 DATA 0,72,132,33,132,33,134,32,132,24,0
520 DATA 0,120,132,1,132,1,134,0,132,72,0
530 REM test characters
540 FOR I=1 TO N
550 LPRINT A$(I);
560 NEXT I
```

PC

BABBLING BOOKS

With the machine itself settling into maturity, Simon Beesley finds that books on the BBC Micro are waning in number but improving in quality.

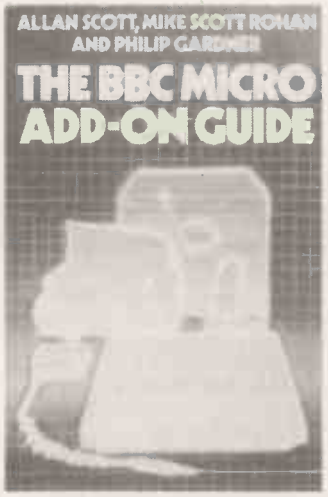
BBC OWNERS who fear that the machine will soon pass into obsolescence can take heart from the continuing flow of new BBC books. Admittedly it is not as great as it was: no longer the raging torrent of yesteryear, more a babbling brook. But the quality of these books is generally much higher now. Instead of being directed at an imaginary beginner who is perpetually baffled, most of them take a more practical and detailed stance.

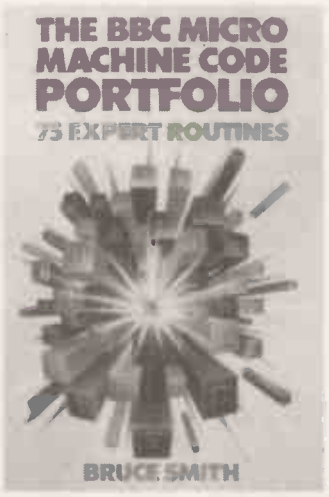
The BBC Micro Add-On Guide is a good example. Without assiduously reading four or five computer magazines every month it is impossible to keep up with the range of new BBC products. This guide does it for you.

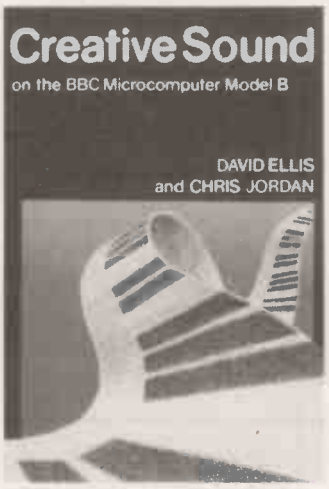
Naturally books of this sort soon become outdated. The prices given are already too high, particularly for disc drives which a few months later are almost 25 percent cheaper. There is also no mention of Acorn's Music 500 or the excellent AMX mouse and its icon-based software. Both products were released after publication. But the book manages to cover most of the add-ons currently available and, more importantly, gives a fair appraisal of each.

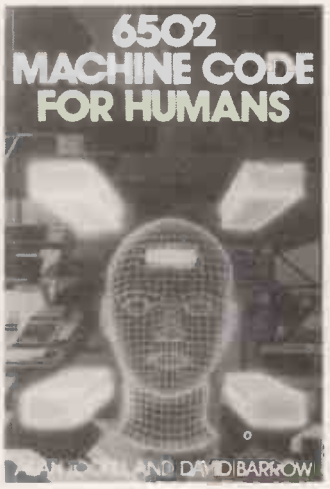
On the software front, *Business Applications on the BBC Micro* by Susan Curran and Margaret Norman provides a similar service. First the authors give a good account of what to expect from the various types of business programs — including specialised applications such as accounting and stock control. Then they supply reviews of most of the leading products. A pity, though, they they could not get hold of a copy of View to round off their survey of word processors.

Hardware buffs who are prepared to wield a soldering iron are catered for by *Interfacing the BBC Microcomputer* by Colin Opie and *BBC Hardware Projects* by Don Thomasson. Of the two, Colin Opie's book is stronger on explaining the principles involved in interfacing. It gives more detail on how to program the hardware, including a useful section on programming the VIA. *Hardware Projects* is more for those who want ready-made projects to go to work on. Along with construction details it provides diagrams of circuits, boards, and connectors for a variety of devices — light pens, hex keypads, 255-way controllers, and such like.









Disk Programming Techniques for the BBC Microcomputer by Michael Coleman is one of a series of personal computer books published by Prentice-Hall International. In common with the rest of the series it is attractively produced and has the look of a high-quality textbook. But although it includes a very useful section on creating serial and random access files its treatment of the subject is not quite as advanced as one might hope.

A rather curious feature of the book is the author's practice of heading each chapter with irrelevant quotes — a bad habit probably caught from Boris Allan. His intention is humorous and after quoting Hamlet, "in form, in moving, how express and admirable", he comments: "Hamlet . . . had probably just succeded in formatting his first ever disc".

Another book in the Prentice-Hall series is *Applied Assembly Language on the BBC Microcomputer* by Edward Ball. He says in the preface that books on assembly language are often dry texts on computer science: this one is meant to be more attractive to beginners. In fact almost every book on BBC assembly language makes the same claim. So, as you might expect, there is not much new material here. The two most interesting chapters are on animation and writing a word processor in machine code.

People who submit machine-code programs to magazines often apologise for the quality of their programming. What they need is not another course on assembly language but advice on how to write more efficient code. I have only seen one book that sets out to do this: *6502 Machine Code for Humans* by Alan Tootill and David Barrow. It tries to find the most effective code for a number of common tasks. While not specifically aimed at the BBC Micro its routines are easily modified.

However, you do not have to be fluent in machine code to write adequate programs. Rather you can simply cobble together routines that are already available. Bruce Smith's *The BBC Micro Machine Code Portfolio* is designed for just that purpose, and supplies 75 procedures ready to be incorporated in your own programs.

Creative Assembler can also be treated in the same spirit, as a library of routines, hints and tips. But coming from Jonathan Griffiths — the author of Acornsoft's superb Pacman game, Snapper — the book is something of a disappointment. There is too much on an elementary level, and not enough on the art of designing an arcade game.

The Advanced User Guide has become an essential reference work for BBC owners. Adder Publishing has followed it up with the *Basic ROM User Guide* by Mark Plumbley, which gives a comprehensive description of the workings of the Basic interpreter. Although it contains a number of handy example programs and a section on adding new commands it has less practical application

(continued on next page)

BOOK REVIEWS

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than the ealier book; but it is of considerable interest nonetheless. The two books stand as a model for how to produce a microcomputer reference guide: they are clearly written, well presented, and are largely free of padding.

Computer book titles often bear only a tenuous relation to their contents. Jeremy Ruston's *Advanced Programming Guide to the BBC Micro* is a case in point. Inside the cover it calls itself the BBC Micro Compendium and this is a better description for it. The author hops about from topic to topic — from recursive programming to floating-point arithmetic — until he finally settles down and hatches out listings for two compilers, Froth and Slug. Froth is a threaded language similar to Forth, while Slug is a structured language which generates assembly language statements. Since Jeremy Ruston is a talented programmer this approach is quite fruitful. The book has some interesting snippets of information and a number of entertaining diversions such as a program for writing text on a tube.

Of all the books under review by far the best buy is *Creative Sound* by David Ellis and Chris Jordan. The authors are particularly well qualified for their subject matter: David Ellis is a musician, composer and programmer, while Chris Jordan designed the BBC's Sound and Envelope commands. Their approach is to talk about the field of computer music in general and then show what is possible on the BBC Micro. The result, over 300 pages, is a book that is full of fascinating digressions and jam-packed with information. It ranges over such topics as the history of synthesisers, psychoacoustics, computer assisted composition, sound effects, and using micros as musical trainers. Equally impressive is the accompanying software — over 200K's worth of Basic and machine-code programs given as listings and also available on tape or disc.

Creative Sound is probably not for the complete beginner, who may find it a little heavy going in places. Anyone else with just a smattering of musical or programming knowledge will certainly enjoy it. Indeed I can think of few computing books that I have read with as much interest as this one. PC

BABBLING BOOKS

The BBC Micro Add-On Guide by Allan Scott, Mike Rohan and Philip Gardner. Published by Collins, £6.95. ISBN 0 00 383008 8

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LAST WORD

By Boris Allan

INVESTIGATING MS-DOS

Should comparative benchmarks for disc operating systems be treated with suspicion?

More than any other facet of computers, the various forms of disc operating systems DOS do not lend themselves to simple comparisons. At a very simple level, how can I compare an MS-DOS implementation which provides 360K discs, with an Acorn DFS which gives a possible 400K per disc, but which splits the storage into two separate sides, each of 200K? Is the 400K of the Acorn DFS worth more or less than an MS-DOS 360K? Can the MS-DOS 360K store more information than the Acorn 400K?

In general, 360K for MS-DOS is worth more than a 400K for some other DOS versions because of the way in which the information is stored on the disc. For many versions of DOS, disc files are stored in contiguous sectors on the disc so if a file is erased, unfillable gaps may appear on the disc. Some DOS versions have commands such as Compact or Crunch which can be used to reorganise disc storage by moving files to fill empty sectors. If there is a good deal of disc file creation and manipulation within an application, compacting is a frequent necessity, as in UCSD Pascal.

MS-DOS uses a more sophisticated method of storing files, based on the idea of linked lists. Each section of a file in MS-DOS has a pointer to the next section, and so a particular file does not have to be stored in contiguous sectors. Therefore, with MS-DOS there is no need to Compact or Crunch — although it does help if files are tidied every so often, by use of Copy *.* from one disc to another.

So when investigating benchmarks for disc systems you need different kinds of benchmarks for different types of DOS. My first benchmarks were designed to compare the performance of the same version of DOS across several computers. Because of the increasing importance of 16-bit systems, I chose to start with PC-DOS/MS-DOS.

MS-DOS — in which I include PC-DOS — claims to be a fairly sophisticated system, and I decided that one of the features I would investigate would be the effects of different MS-DOS configurations. I decided to investigate only a few facilities at first and then examine the facilities over a fair number of different MS-DOS configurations — by which I mean different ways of setting up MS-DOS for the same computer.

As the storage of files in MS-DOS is by the linked-list system, I produced a special disc with files having many non-contiguous sectors. The example disc was produced by running a short Basic program which produces a disc with 30 files.

The way in which the first 15 files — those with extension .1 — are created means that consecutive elements of the files are very widespread. These first 15 files are produced a portion at a time, in 10 distinct sections. The next 15 files — with extension .2 — are created in a similar manner, and finally the first 15 files are extended even further with another 10 sections.

Each of the files with extension .1 occupied 13,312 bytes, and the files with the .2 extension occupied 6,656 bytes. But there were many non-contiguous sectors for both types of file. There were 55,296 bytes free on a 360K disc.

The configuration of MS-DOS is altered by use of a Config.Sys file. The first element of the configuration to be altered was the number of disc buffers by forming a Config.Sys file with varying Buffers= commands. In MS-DOS, a disc buffer is 0.5K of memory set aside for intermediate storage of disc files. The default number of buffers is two, and thus the total disc buffer area is 1K. The number of buffers can be set to 98 — that is 49K — and so I wanted

(continued on next page)

BASIC FILE CREATION PROGRAM

```
10 FOR I=1 TO 15:OPEN"o",I,CHR$(64+I)+".1":NEXT I
20 FOR M=1 TO 10
30 FOR I=1 TO 15
40 FOR J=1 TO 60: PRINT# I,"rstuvwxyz":NEXT J
50 NEXT I
60 NEXT M
70 FOR I=1 TO 15:CLOSE I:NEXT I
80 FOR I=1 TO 15:OPEN"o",I,CHR$(64+I)+".2":NEXT I
90 FOR M=1 TO 10
100 FOR I=1 TO 15
110 FOR J=1 TO 60: PRINT# I,"rstuvwxyz":NEXT J
120 NEXT I
130 NEXT M
140 FOR I=1 TO 15:CLOSE I:NEXT I
150 FOR I=1 TO 15:OPEN"a",I,CHR$(64+I)+".1":NEXT I
160 FOR M=1 TO 10
170 FOR I=1 TO 15
180 FOR J=1 TO 60: PRINT# I,"rstuvwxyz":NEXT J
190 NEXT I
200 NEXT M
210 FOR I=1 TO 15:CLOSE I:NEXT I
```

ADVANCE 86B RESULTS

Buffers	Format	Mixed copy	Clean copy
2	41.4	100.3	99.4
10	41.5	97.8	93.0
20	41.4	98.0	93.7
30	41.7	98.0	94.3
40	41.6	98.4	93.4
50	41.6	98.4	93.4
60	41.5	129.1	105.2
70	—	138.8	118.0
80	41.7	124.0	94.7
90	41.4	122.7	93.1

Timings in seconds.

(continued from previous page)

to investigate performance with varying numbers of buffers. Later I was going to examine the effects of other parameters.

The investigation used three tasks: formatting a disc; copying the standard mixed disc files by use of Copy *.* B:; and taking the new, clean arrangement of files on the second disc, and copying those to a new disc.

The first task was introduced because essentially it is independent of the buffers, and thus should not alter in time taken. The copying of the mixed files was set as a worst-case scenario, which could then be compared to the third task. The intention was to investigate the extent to which non-contiguous files slowed down copying.

The results for the Advance 86B are shown in the table. They indicate that special attention should be paid to the results for 70 buffers. The time taken to format a disc is effectively constant, except for the case of 70 buffers. In the case of 70 buffers it was impossible to format, and bad disc sectors were reported. Both types of copying worked for 70 buffers, but there was a degradation in performance, tailing off either side of 70 buffers.

As MS-DOS takes up 29K, and 70 buffers is equivalent to 35K, the DOS and buffers were taking up 64K of memory. The Intel 8086/88 processor divides memory into 64K segments, and to move from one segment to another requires a modification of the segment register. Unlike, for example, the Motorola 68000 series, there is no simple address register which can point to anywhere in memory. An address register for the 8086 can only point to 64K, and which 64K is determined by the segment register.

All MS-DOS buffers behave badly when 70 buffers are set, not just the Advance.

The problem with MS-DOS on the Advance 86B seems to be tied into the use of segments, and it seems as if the handling of inter-segment addressing is not as clean as it should be. The next question was to establish whether the possible inter-segment confusion was a specific Advance 86B problem, or a general MS-DOS design fault. Chris Williams examined the effect of setting buffers to 70 on other MS-DOS machines, including the IBM PC.

All the MS-DOS/PC-DOS machines examined so far were found to have problems with 70 buffers. For an Apricot with 256K the system claims to have run out of memory, and the machine is completely paralysed. The extra problems for the Apricot may be due to the lack of a DMA chip, but I do not have any real explanation. The unreality of specifying 70 buffers is immaterial, because there should not be strange results for a standard facility. This particular MS-DOS fault for all machines examined is indicative of a basic design flaw which may have other, less obvious, consequences. What this has shown is that benchmarks designed to really test a DOS can have a far wider utility than merely comparing speeds. PC

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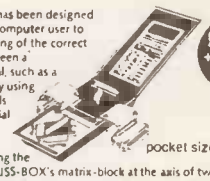

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COMPUTER WEEK. 9-14 year olds, 27-31 August, daytime, Berkshire. Write: Avion Leisure Care, 62 Elder Road, Bisley, Surrey. 187M

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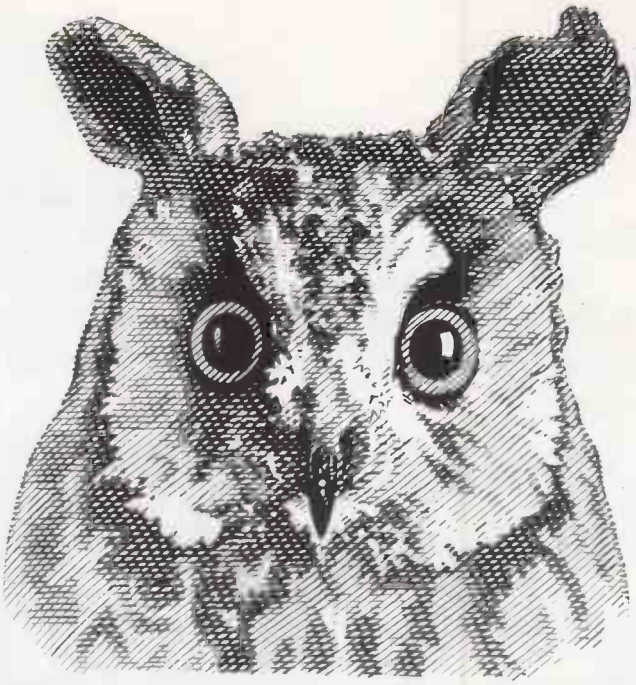

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