Practical Computing

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Volume 7 Issue 12

HOT 100

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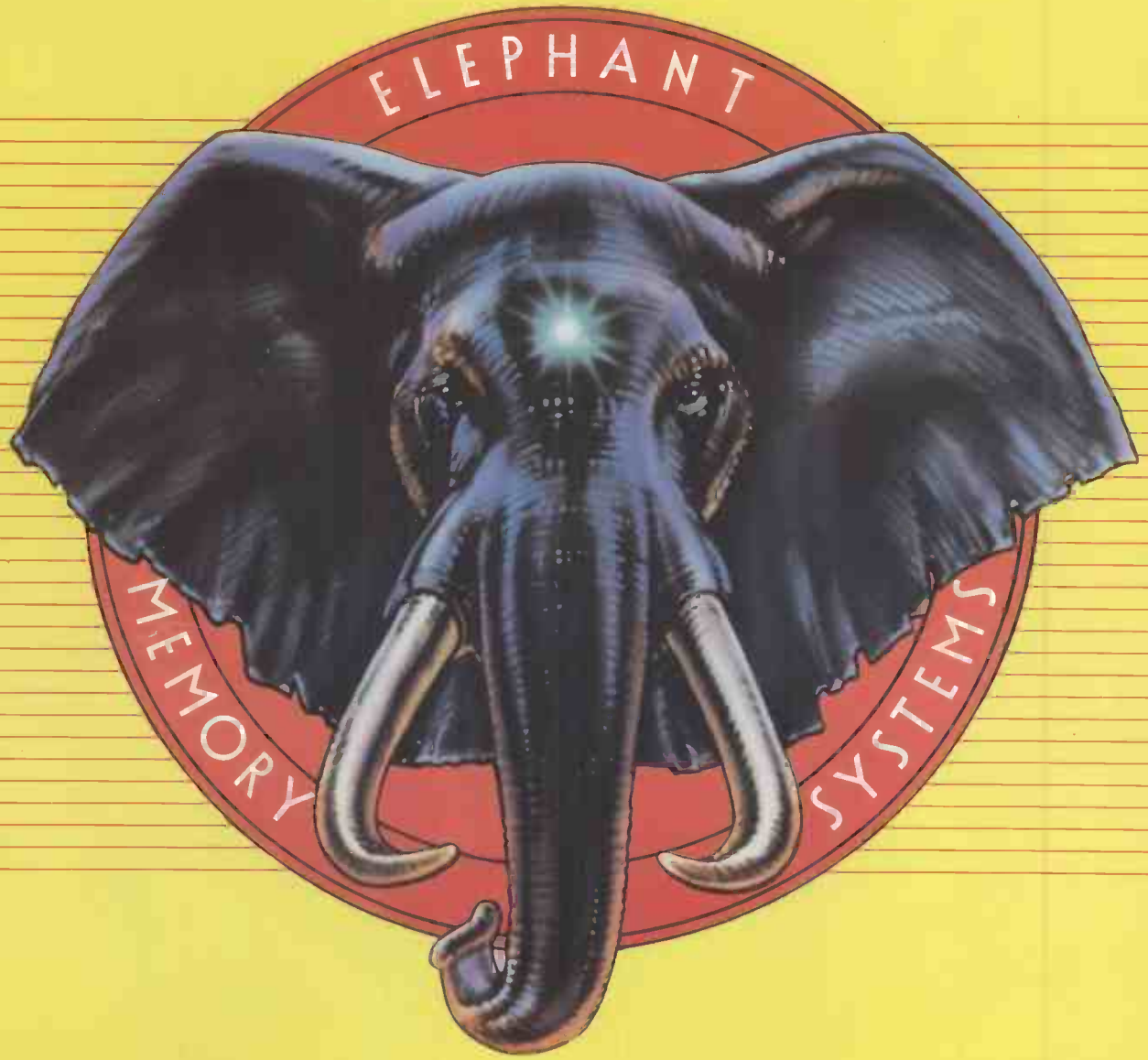

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Every effort is made to check articles and listings but *PC* cannot guarantee that programs will run and can accept no responsibility for any errors.

Christmas rush

CHRISTMAS comes but once a year, though if micro manufacturers had their way it would come every month, for the weeks leading up to Christmas are the home-computing world's silly season. Machines, along with Cabbage Patch dolls, or whatever this year's craze is, sell like hot cakes.

Some of this is desperation buying by parents who have run out of ideas. Others probably believe that they are buying their children a passport to success in the techno-world to come. The sad fact is that the nearest many of them will get to realising their starry-eyed vision is blasting a few alien life forms off their TV screens.

For whatever reason, hundreds of thousands of machines will be bought this Christmas by people who would not know a byte if it bit them in the leg. Even though the machines are the same Spectrums, Commodores and BBC model Bs that readers of *Practical Computing* have bought and spent so much time on, the attitude of their users could not be more different. This is because the machines are consumer goods, bought as a result of purely seasonal variations in buying patterns.

There is nothing inherently immoral with micros being bought for such reasons. The money that will flow into the micro world — one estimate puts it at £340 million for U.K. pre-Christmas hardware sales alone — will help keep firms and products bubbling along in 1985.

But, of course, things are not that simple. Last year, many people sensibly decided that since they were going to spend money on a micro, they might as well lash out on a BBC model B. Unfortunately, so many people decided to do this that a lot came away from Acorn empty handed. Even Sinclair was unable to meet the unprecedented demand for its machines.

The result was a lot of people buying less than the best, simply because it was there. Thousands of micros were sold by manufacturers that went into receivership when the Christmas rush abated, and this reinforced some people's misconception that micros are a fashion that will pass.

Many more thousands opted for the remaining big name of Commodore, whose market share took a huge leap last Christmas not through any inherent virtue of the Vic-20 or Commodore 64, but because the machines were available when people wanted them. But once that user base had been created, software houses naturally catered for it. So pre-Christmas aberrations have resulted in long-term and dubious shifts in the state of the micro market.

To be fair to Commodore, it has largely redeemed itself with its latest releases, the 16 and Plus-4, which deserve any success they get this Christmas. The irony is that it could be the last chance they have to do so. Recently Sinclair, Acorn and Commodore declared their belief that this Christmas's home-computer bonanza may well be the biggest, but also the last. Sales of micros have shifted from the professional classes to the lower socio-economic groups and consequently over half the market for cheap home micros has been mined out.

After this year the manufacturers believe people will start buying computers because they want them for a purpose, not in response to a Christmas reflex. As a result, micros will have to become more practical: tools, not toys.

Practical Computing readers will have been largely immune to Santa insanity but the withering away of the spurious annual micro boom can only be for the long-term good of the industry and end-users. Let us hope it happens. The coming of age of the microcomputer market would be the best Christmas present we could have. µ

5 Years ago...

So far, if anything, computers have been a nuisance. Now, the microchip revolution promises to make them a menace. The immunity the computing profession has enjoyed for 20 years from serious public criticism may well be about to end.

Some industries are so mechanised already that they cannot be automated — for instance, farming. Yet there is little doubt that the ASTMS predictions of 3.8 million people unemployed in Britain by 1985 and 5.2 million by 1991 are of the right sort of magnitude.

What compounds our problem is that we are competing with societies which take a much tougher line about social disruption. In some countries, if a factory automates half its workers out of a job, they are invited to leave, and if they try to return with sabots in their hands, intending to deal with the offending machinery in the time-honoured way, the army will stop them — dead, if necessary.

In Britain we are used to a much gentler level of industrial strife. We opt almost automatically for the soft solution, for industrial inefficiency rather than para-military riot police and barbed wire in the streets.

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MSX

I FIND the MSX standard restrictive and already outdated, as do others I have spoken to. However, having used a lot of different MSX machines I can't help feeling that anyone who buys one will have a machine which will work perfectly the instant it is plugged in, will continue to work faultlessly, and will give years of pleasure. They are geared to giving buyers reliability and value for money, and treat them as consumers with rights.

Some micro owners seem to think that part of the fun of buying a machine is the waiting, the duff operating systems, the bugs which must have been there when the thing was stuck in its box at the factory, and so on. Yet they would not buy stereos if they had to keep touching them to make sure they were not getting too hot, or if the rewind button had to be pressed 10 times or in just the right place to get it to work.

A number of companies are going to get a shock when Joe Public stops buying grotty little bits of unreliable black plastic and refuses to play Spot the Delivery Date.

Paul Hardy,
Bingley,
West Yorkshire.

Compute! books

IN YOUR October feature on books for the Atari, you make mention of *Mapping the Atari* by Ian Chadwick and published by Compute! books. Holt Saunders has now been appointed exclusive distributors for Compute! publications in the United Kingdom and throughout Europe, the Middle East and most of Africa, and from now on any difficulties in finding Compute! books in the shops should disappear.

One further point: you quote the price of *Mapping the Atari* as £14.95. The correct retail price is in fact £11.95.

Robin J Dunn,
Holt Saunders,
Eastbourne,
East Sussex.

Commodore disc danger

I AM SURPRISED that Mr Morgan — Feedback October issue — should expect Commodore to provide protection against inadvertant overwrite of other files on disc when the @ is used. To do so would be a contradiction in terms: Commodore has provided experienced programmers with a means of overriding the system's file-protection features — but at their own risk.

The first rule of good computer practice is to retain one or more previous generations of each file or program. This can only be done by giving each a different name, in which case the @ is irrelevant. I cannot imagine any circumstances, in which the generation rule should be ignored when saving progams. On the other hand, the @ is safe for saving successive generations of a constant-length data file — a risk justified on occasion.

The designers of the Commodore 64 made a powerful budget-priced micro available to anyone willing to take the time to explore its depths. I regularly read adverse comments on the 64's version of Basic, but the experienced programmer soon learns that Basic is no more than a framework on which to build a system. For instance, I prefer my programs to branch to labels, which few Basics cater for. By placing labels in Data statements, a Read and a few judicious Peeks and Pokes are all that is needed to Goto a label.

It would be a pity if any readers were put off the Commodore 64 by ill-founded criticism. Here is one well satisfied user.

J R Stillingfleet,
Amersham,
Buckinghamshire.

Fewer screen headaches

I AGREE with Mike Lewis's idea of standardising the layout of configuration files — *PC* October issue, page 51 — but feel that Mike Lewis has made a fundamental error in his proposed standard.

Terminals which use a five-part code to directly position the cursor tend to follow the new ISO standard for terminals. They include the IBM PC, Wang, Hewlett-Packard HP 150, etc. In addition to the lead-in characters, intermediate characters and final characters, the code requires that the row and column numbers are sent as a series of ASCII decimal digits and not, as indicated in the article, a single byte.

It is due to this strange decision by ISO to use ASCII strings instead of binary values that delimiting characters are needed at all: the terminal cannot predict whether the number it is expecting will be sent as one byte or two. The code required by the IBM PC to position the cursor at row 9 column 19 is in the form

ESC[£;£H

and is as shown in the table.

It is therefore necessary to send between six and eight bytes to the IBM PC to position the cursor anywhere on the screen, which is one of the reasons why this procedure is so slow on this machine. The other reason is the need for the application program to convert row and column numbers to a printable form before transmitting the command, and for the system program to convert that printable form back to binary before executing the command.

The proposed standard therefore needs an additional question as to whether the row and column numbers are sent as a single binary byte or as a string of decimal ASCII digits. In addition, I feel that it would be worthwhile to go beyond just highlighting text and include the codes to display

Code	ASCII for
27 91	Escape and [
57	9
59	;
49 57	1 and 9
72	H

reverse video, high- and low-intensity text, and flashing text, which are available on most modern terminals. Perhaps even one or more alternative display founts and protected display fields should be provided to cope with next year's terminals.

It is difficult to amend the program listing to deal with the ISO method of addressing the cursor and retain the command as a function call. Although

STR$(c% + coff%)

can be used in place of

CHR$(c% + coff%)

the logic which places the row and column number in the string according to flag% will no longer work. In view of the market share enjoyed by the ISO-standard machines, any proposed standard which ignores them cannot really be called a standard.

Colin Neville,
Welling,
Kent.

Screen hazards

IN HIS LETTER published in the October issue of *PC* Paul Backhouse has raised a number of questions which seem to require practical suggestions rather than theorising.

First: What can he do straightaway? Taking the EG-101 monitor out of commision is the safest, if inconvenient, first step. If there is a significant X-ray emission, which seems questionable, glass plates will offer no practical shielding.

Contractual obligations under U.K. consumer safety legislation rest primarily with the supplier, but it may be simpler and quicker to write directly to the manufacturer asking for the fullest

(continued on next page)

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

(continued from previous page)
clarification of the X-ray warning notice. Consultation with the local-authority trading standards department should help Mr Backhouse clarify his situation.

The second question is whether there is any X-radiation emitted from his EG-101 monitor and, if so, whether the emission rate is less than the permitted maximum exposure rate for domestic electronic equipment set out in BS415:1979. This requires special measuring equipment operated by specialists, and expert interpretation. Possible sources of help include once again, the local trading standards department; the National Radiological Protection Board, Harwell, Didcot, Berkshire, telephone (023 583) 600; or consultants such as HUSAT Research Centre, The Elms, Elm Grove, Loughborough, Leicestershire LE11 1RG, telephone (0509) 2640833. Some of these organisations may make a charge for their services.

A E Waring,
Office Technology Unit,
Polytechnic of the South Bank,
London SW4.

The editor adds: We have not been able to find any evidence that there is any health risk from radiation emitted by normally constructed visual display screens. There have been numerous investigations, and a report was made to the U.S. Health and Safety subcommittee this summer. Experts from DEC and Bell Labs said "VDTs don't present a radiation hazard to employees at or near a terminal, as emissions are well below any existing national and international standards." These witnesses also said there was no correlation between VDT radiation and birth defects, and advised that protective clothing such as lead aprons represented a greater health hazard than the VDTs themselves.

The fact that VDTs are, in general, safe does not mean a particular sample of a particular monitor is necessarily safe, so the matter may be worth taking further.

There is a way the ordinary user can try to record any X-rays emitted. Seal a piece of photographic film inside a light-tight bag and tape it to the surface of the screen. Switch on the computer, print something on the screen, and leave for a week. If there are any emissions the film should record them, and they should show up after processing. We have not tried this, but would be interested to hear from anyone who does.

AI research

THE AI and fifth-generation feature in the October issues of *Practical Computing* made topical and interesting reading. However, I would like to make two points.

First, Tony Durham, in his overview, states that induction approaches to expert-system building are only appropriate to small problem domains. But with the method of structured induction the limitations can be convincingly overcome. Alen Shapiro successfully used an induction tool similar to Expert-Ease to generate, using the structured style, a complete expert system for a chess endgame. The problem consisted of 41 attributes, nine levels of sub-problem and covered a total decision space of over 200,00 legal positions, which it was able to classify correctly and justify at each level of the game.

More recently the inductively driven Rulemaster system has generated expert systems for substantially larger domains. Michie *et al* have described a weather-forecasting system called Willard, which currently outperforms existing methods for predicting severe storms. The system currently covers a problem space of over 9,000,000 possible weather conditions and so represents one of the largest expert systems yet devised.

My second point in the same article concerns the "business as usual" remark about AI research centres. If we are to learn any lessons from recent history then the first should be that what we lack in Britain is the interface between research ideas and applied practice. For a country that in the early days stoked so substantially the fires of AI research, our position in terms of fifth-generation realisation is feeble.

The recent Butcher report showing a British trade deficit of over £1 billion in IT exemplifies our problem. The formation of the Turing Institute represents a step in an attempted reversal of this disastrous state of affairs.

One part of our work concerns the devleopment of our industrial affiliates scheme, engineered precisely at the academic/industrial bottleneck of technology transfer. The Institute also runs a variety of courses which include logic programming, inference systems, computer vision, robot planning and expert systems.

Peter Mowforth,
The Turing Institute,
University of Strathclyde,
Glasgow.

Tony Durham replies:
Of induction, my actual words were that "the technique must be refined before it is suitable for building large expert systems". Structured induction was one of the refinements I had in mind. I think it is a great idea and I am glad to see that software support for structured induction is now becoming available commercially.

My "business as usual" comment was not meant to imply that all artificial intelligence people live in ivory towers. Researchers like Professor Michie have been seeking industrial collaboration for years. The founding of the Turing Institute was made possible by the warmer commercial climate that now exists for AI.

The good old days

I MUST AGREE with John Billingsley that the old Pet was in many ways easier to use than most of the latest 16-bit business machines. However, the 16-bit machines do offer a number of significant improvements over the Pet, and many Pets in business use are reaching the end of their useful lives.

I have recently been involved with a company which wanted to convert a large amount of data from its old Pet system to a replacement IBM PC system. Consequently, I have developed hardware and software with which I can convert data on Pet 4040 or 8050 disc format to IBM PC disc formats 160K, 180K, 320K or 360K and I would be pleased to give further details to any interested readers who write to me or phone me on Leicester (0533) 704676.

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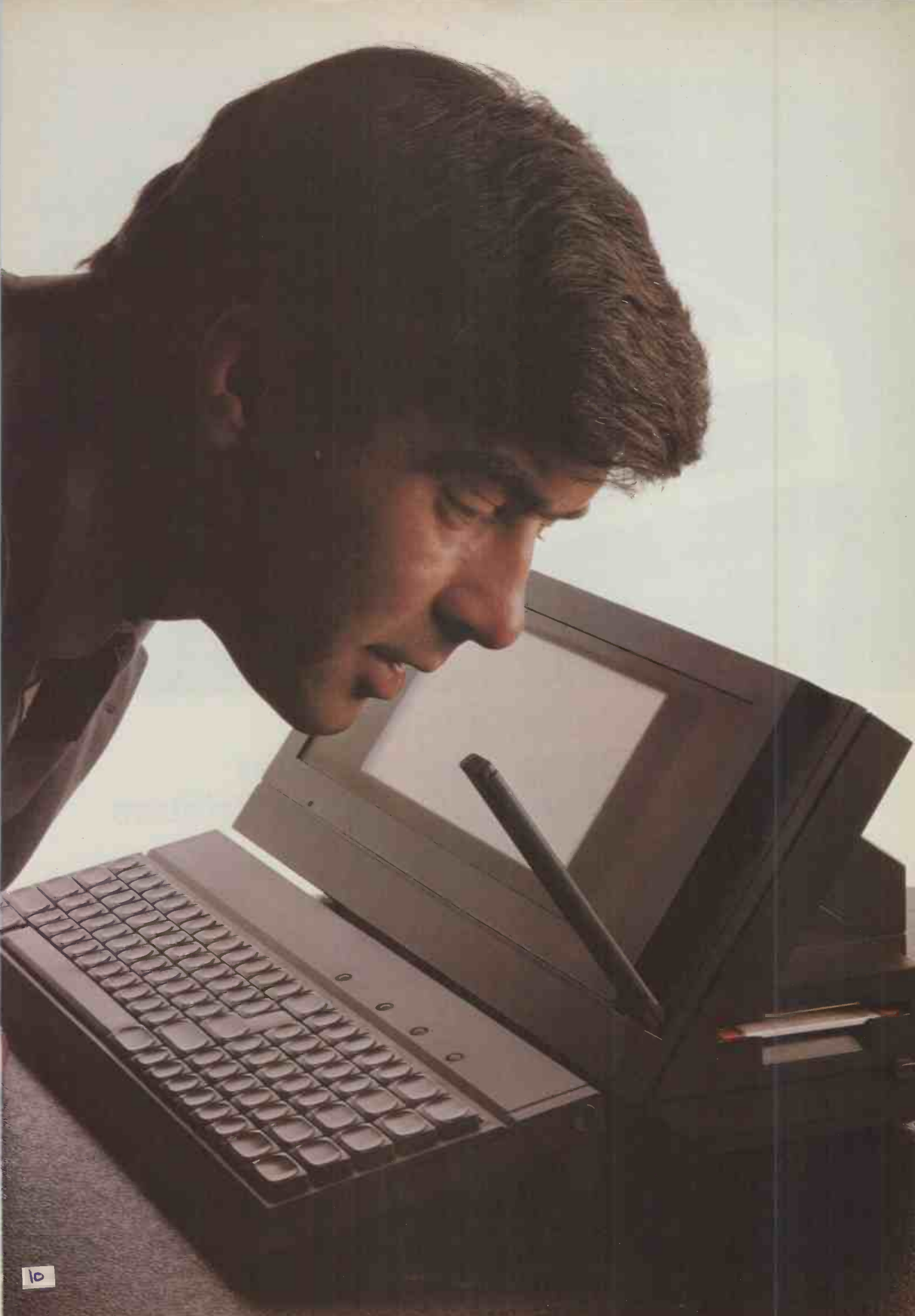

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One of the reasons I'm so trim is my full sized flat screen. It's a bit like looking at a big digital watch.

My cordless keyboard and mouse work by infra red signals, the way you probably operate your TV set at home.

What's a mouse?

It's a piece of gadgetry that lets you use the computer by simply pointing the mouse at the machine and moving around the ball control with your thumb.

Or you can use the desk to roll the ball if it's more comfortable for you.

Want to know more?

TUTORIAL DISK

With every machine you get a free tutorial disk that demonstrates all my features.

It shows how words and pictures are cleverly mixed on screen and explains everything you haven't gathered already.

You will also get a powerful bundle of free software which, among other things, gives you a word processor, spreadsheet and diary.

Then when you've mastered those, you can choose from two thousand packages specially developed for Apricot, which will include Lotus 1-2-3.

That'll make me do almost anything except sugar your tea.

Give them time. They're working on it.

Please send me details of the Apricot Portable. To: ACT (UK) Ltd., FREEPOST, Halesowen, West Midlands B63 1BR.
Or Freefone Apricot via Operator.

PC/12/84

Name

Position

Company

Address

Tel

THE ANSWER IS AN

Apricot Portable

ACT

APRICOT PORTABLE FROM £1695 PLUS VAT NOT INCLUDING MOUSE.

• Circle No. 140

ACT (UK) LTD., FREEPOST, HALESOWEN, WEST MIDLANDS B63 1BR.

STOP PRESS

IMPOS now supports genuine multi-user MS-DOS as well as Concurrent CP/M 3.1, CP/M 2.2. and CP/M 86 simultaneously in any combination for up to 16 users

Mini's too expensive

For a multi-user business system expandable to 16 screens you used to need a sizeable mini, say from **DEC** or **Burroughs,** with a hefty price-tag for hardware and software, with long time-scales.

Micro's too small

Micros, like **Altos, Sage** and **Rair,** 8-bit or 16-bit, are doomed by CPU degradation, being based on the time-sharing principle. PCs, like **IBM** and **Apricot/Sirius,** just aren't in this league at all, networked or otherwise.

SuperStar multi-user system... ...is just right

SuperStar is a multi-processor system in which up to sixteen 16-bit processors, each with up to 1Mb RAM, are integrated in an attractive desk-top unit. All users can work at full speed in genuine multi-user, multi-tasking mode with full file/record locking and spooling.

At half the price of a mini and a give-away price for the world's largest selection of software, **SuperStar** is just right for any multi-user application.

£5975 buys a complete 2-user high-performance system, with 10Mb winchester and VDUs. Additional users for £995 each, including VDU and processor.

Supports all **CP/M** and **MS-DOS** programs as well as the wide range of **BROMCOM** genuine multi-user software.

BROMCOM

417-421 Bromley Road, Bromley, Kent BR1 4PJ
Tel: 01-697 8933 Telex 896691 TLX1RG

OEM, Dealer and Overseas enquiries are welcomed.

● **Circle No. 205**

SuperStar is a trade mark of Bromley Computer Consultancy. CP/M is a trade mark of Digital Research. MS-DOS is a trade mark of MICROSOFT.

SuperStar-16 has a 16-bit Master Processor which runs IMPOS (BROMCOM designed true 16-bit controlling operating system). IMPOS supports CP/M, MS-DOS and shortly Xenix in slave processors in any combination and it is fully upward compatible with ACTION OPC/OS, Televideo MmmOST and TurboDOS.

ADVERTISEMENT

NEW GENERATION MULTI-PROCESSING SYSTEM

IMPOS® (Intermixed Multi-processing Operating System) is upwards compatible with TurboDOS, Televideo MmmOST, Action DPC/OS and MP/M + CP/NET software but with a difference. It is written in the highly transportable language C which runs in 16-bit and 32-bit master processors with a much higher degree of performance and sophistication.

Further, while others offer only CP/M80 or CP/M86 compatibility, IMPOS® supports a much wider choice of the most popular operating systems for the slave processors i.e. CP/M80, CP/M Plus, CP/M86, Concurrent CP/M86, MS-DOS and XENIX all working simultaneously sharing common resources.

GENUINE MULTI-USER ENVIRONMENT

Same generic operating system (i.e. Digital Research vs MicroSoft) within the same system have full genuine multi-user facilities e.g. record / file locking.

The fact that all previous generation multi-processing software written with the constraint of 8-bit instruction sets and, of course, a memory size of 64Kbyte of RAM makes them rate very poorly against IMPOS® which has been implemented with 16-bit and 32-bit instruction sets and 1Mbyte of memory space. Of course higher processing power is an added bonus. Wide ara networking over Ethernet is also supported.

SUPERSTAR 16™

BROMCOM® SuperStar 16™ is the first implementation of IMPOS®. Superstar ™ is a desk top system with integral winchester of up to 80Mbyte and a tape streamer of 40Mbyte. Slave processors are Z80A with up to 128Kbytes or iAPX186 with up to 1Mbyte RAM. A total of 16 Slave processors can be accommodated in any combination while the current Master processor is an 8086 with up to 1Mbyte of RAM.

For more information ring 01-697 8933 and ask for Tony

MSXers emerge

THE FIRST spate of MSX micros has hit the streets. Sony, Mitsubishi, Spectravideo, JVC and Sanyo have all announced their own look-alike versions of the Microsoft-agreed standard. Kyocera Yashica is currently distributing from Germany only.

Since practically all the machines are identical, the main criteria for choice have to be price and colour. Most machines are kitted out in Samurai blacks and greys; the Spectravideo opts for a cream colour.

Prices tend to be rather steep at £299; the Sony Hit Bit, Mitsubishi ML-F80 and Sanyo MPC-100 are at this level. The JVC HC-7GB costs £279, and the Spectravideo SV1-728 £250. All machines have a Z-80 processor, 64K RAM, common video and sound chips, plus ports and cassette slots.

The Sony Hit bit comes with some software in ROM.

The honourable exception to this wall of uniformity is Sony. Its Hit Bit offers a 16K ROM with a simple address book and memo pad, as well as the option of a battery-powered 4K CMOS RAM data cartridge.

More information from Sony on (81) 61688, Mitsubishi on (0923) 770000, Spectravideo on 01-330 0101, JVC on 01-450 2621 and Sanyo on (0923) 46363.

WCW work station

THE MG-1 Personal Workstation from London-based Whitechapel Computer uses a National Semiconductor 32016, and comes with 512K of RAM an 800K floppy, a 10Mbyte Winchester and a floating-point unit as standard.

The system is designed mainly for advanced graphics applications, and offers a 1,024-by-800 bit-mapped display, with a high-resolution screen. A mouse and keyboard are included in the entry-level price of £5,495, as well as the operating system Genix.

Upgrades available include 22Mbyte and 45Mbyte Winchester versions, a 512K RAM expansion board, IBM PC bus adaptor and Ethernet. More information available from WCW Ltd, 75 Whitechapel Road, London E1 1DU. Telephone: 01-377 8680.

The Hitachi MBE-16002 — on offer at Dixons.

Half-price Hitachi

DIXONS is offering the Hitachi MBE-16002 for £1,295 instead of the normal £2,595. This includes two 320K disc drives, colour monitor, keyboard and bundled WordStar and Calcmaster. There is a two year on-site warranty.

The price is "while stocks last" but Dixons offers other cut-price deals on the Apricot PC and the Sanyo 555, where £1,000 of software and a monitor is bundled in the price. Details on 01-952 2345.

Robot club

A LABORATORY ROBOTICS CLUB has been launched to foster the use of small robots in labs. The main aim of the club is to encourage the development of robot-based automated laboratory systems.

The club has been formed by representatives from the Laboratory of the Government Chemist, industrial laboratories, universities and polytechnics. It will provide newsletters, meetings, access to consultancy services and sponsorship of projects. Further information from D G Porter, Laboratory of the Government Chemist on 01-928 7900 ext. 691.

Quorum Multi-PC

QUORUM COMPUTERS of Southampton has launched its Multi-PC micro. Built around an 80186, and available with a variety of operating systems, the machine is designed to support up to four virtual screens per user on a four-terminal network. The entry-level machine comes with 128K RAM, expandable to 512K, and one or two 360K floppies.

(continued on page 15)

Software for the IBM PC/XT
A Buyer's Guide

START HERE

First, ask yourself a few simple questions:

1. Do you want one of the best selections of software for the IBM at your disposal?
2. Do you wish to take advantage of some of the lowest prices available?
3. Do you want to deal with friendly, down to earth, sales people?
4. Do you need help, advice or technical support?

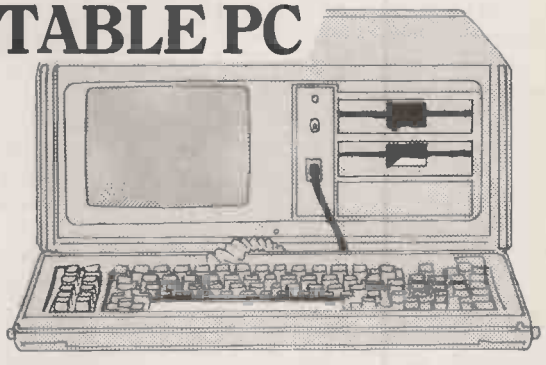
If you answer YES to any of the above, then move on.

SUPPORT

We've been helping companies for over seven years now. We'll offer advice and help in choosing the right software for your application. We also provide training, installation and maintenance.

Authorised IBM Dealer

THE NEW IBM PORTABLE PC



Now you can take your PC with you! The Portable gives you the same power, versatility and function as an equivalent IBM PC. Standard features include:

* 256K RAM
* Integral 9″ amber screen
* Slimline D/S drives
* Colour graphics adapter
* Five extra expansion slots
* DOS 2.1
* Lightweight 83-key keyboard
* Fitted bag for easy transport.

The inclusion of the colour graphics card is a really smart move on IBM's part. In the field where you will likely just be entering data the 9″ screen is fine. Then back in the office you can plug in an IBM colour monitor for large easy to read characters with the added highlighting colour gives.

All this power for only £2,195 (excludes colour monitor) plus VAT.

FRAMEWORK SPECIAL OFFER

We are including Ashton Tate's excellent new, software package, Framework with every Portable PC or 256K PC/XT sold by September 30th 84. Just add a printer and your up and running one of the most powerful software/hardware combinations available.

CHOICE

We stock one of the widest selections of software for the PC including the best of the latest releases, such as the exciting integrated systems from Lotus and Ashton Tate.

Look at a few of the many software packages available for the IBM PC:

Ashton Tate — Framework: Powerful integrated system comprising outlining, spreadsheet, database (fully compatible with dBase), DOS access, word processing and graphics.

MicroPro — WordStar Professional: WordStar, the no. 1 word processing program for micros, packaged complete with MailMerge, StarIndex and CorrectStar (MicroPro's new, phonetic spelling checker).

Lotus — Smyphony: All-in-one integrated package incorporating graphics, communications, spreadsheet (1-2-3 compatible), word processing and database system.

Peachtree — PBMS Ledgers: Interactive suite of Business Management Systems. Comprising Nominal, Purchase, Sales and Costing ledgers, inventory management and payroll.

Sorcim — SuperCalc 2: Probably the most popular spreadsheet package. Comprehensive, easy to use, and very well documented.

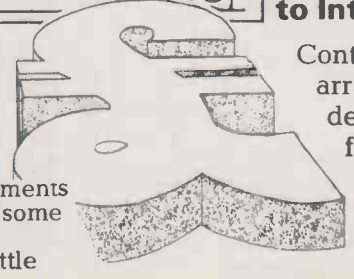
IUS — EasyWriter: Easywriter I is IBM's choice for quick efficient word processing, for more sophisticated text processing choose Easywriter II.

SPI — Open Access: A six-in-one package combining spreadsheet, 3-D graphics, word processor, scheduler, telecommunications and information manager.

THE NEXT MOVE

Dial 01-675 5325 and speak to Interam Computer Systems Ltd.

Contact us for further details or to arrange for a free product demonstration. We'll also send you a free catalogue and price list.



PRICE

You may know exactly what your requirements are and simply wish to take advantage of some of the lowest prices around, making that already over-stretched budget go just a little further.

INTERAM COMPUTER STORE

INTERAM COMPUTER STORE 46 BALHAM HIGH ROAD LONDON SW12 9AQ TEL:01-675 5325 TELEX:8954072

● Circle No. 161

(continued from page 13)

Upgrades include 20Mbyte and 40Mbyte Winchesters. A number of multi-user software packages are available. Further details on (0702) 30721.

More modems

THE MODEM FLOOD continues with two more systems approved by British Telecom. The Miracle Modem can cope with both the European CCITT and U.S. Bell standards, and can run at 75 baud, 300 baud, 600 baud and 1,200 baud. It costs £150. More on (0473) 50304.

The MS-21/23 from master Systems Ltd operates at 300 baud full-duplex, 1,200 baud half-duplex and 1,200/75 baud full-duplex. It costs £299. Ring (0734) 791619.

Multi-standard Miracle.

Master Systems: MS-21/23.

School price cuts

APPLE AND RML have reduced prices on equipment bought by schools. Until December 31 Apple will sell an Apple IIe with two disc drives for £749 instead of £1,102, an Apple IIc for £599 instead of £865, and a 128K Macintosh for £1,349 rather than £1,795. There are also price reductions on Lisas and various peripherals. Details on (0442) 60244.

RML's offer is to primary schools, but has no time limit. An RML 480Z can be bought for £499, which is £200 less than the old list price. A twin-drive quad-density disc unit costs £649. RML is on (0865) 249866.

HM Systems' S-100 based multi-processor Minstrel 2.

Hotel Micro

HOTEL MICRO SYSTEMS has unveiled its Minstrel 2 multi-processor micro. Like the previous model, it is based on the S-100 bus, and uses the same master and slave processor technique. A central Z-80 acts as the main processor, and additional users are added by slotting in slave cards with Z-80s or 8086s. A maximum of 12 users can be accommodated.

There is a Winchester and floppy controller board, capable of supporting two 5.25in. floppies, two 8in. floppies and two 5.25in. hard discs. The entry-level price is about £6,265. More information from HM Systems on 01-328 8737.

Mobile Sanyo

THE MBC-775 is an 8088-based transportable from Sanyo. The standard model comes with 256K RAM, expandable to 512K, and two 5.25in. 360K floppies. Unusually, there is a 9in. colour screen with 640-by 200-pixels monochrome resolution, and an eight-colour resolution of 160 by 200. The 83-key keyboard is detachable from the main unit.

For further information ring Sanyo on (0923)46363.

Win a Compaq at Compec!

WHEN YOU visit the *Practical Computing* stand at the Compec exhibition, bring your business card and you could win a Compaq transportable with two floppy-disc drives and built-in screen, worth over £2,000.

Compec will be held at Olympia 13-16 November. Opening times are 10 a.m. to 6 p.m. on the first three days, and 10 a.m. to 4.30 p.m. on the final day.

Hardware shorts

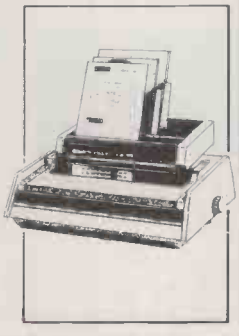
- The Universal Card from P&P Micro Distributors allows an Epson printer to emulate an Apple Image Writer as well as operate with a wide range of computers. The cost is £99.95 from (0902) 43913.
- Jarogate has launched an 80286-based micro which can cope with up to 18 users. Unix V and Concurrent DOS will be available for it next year. The entry cost is about £5,000. More on 01-671 6321.
- Tandy's Color Computer 2 has been reduced in price for all its models. The 16K version costs £99.95, a reduction of £20. Further information on (0922) 648181.
- A national schools computer competition is being sponsored by Microvitec, the monitor manufacturers. Children will be required to complete a series of computational tasks. The first prize is a trip to Florida. Details on (0274) 309930.
- A Winchester disc has been produced for the M-24 by Alloy. The PC-Stor comes in 20 Mbyte, 52Mbyte and 85Mbyte sizes. Prices start at £3,540. More on (0285) 68709.
- Image III allows pictures to be captured and displayed from any 625-line video source on a BBC Micro. The cost is under £2,000. More information on (0621) 59500
- More than a million Commodore 64s have rolled off the production line at Corby since it was opened 15 months ago. The 16 and Plus- 4 machines are also produced there.
- BBC Micros can use the Mator Shark range of Winchesters via the Syscon 6 interface from Intelligent Interface. Cost is about £180. Details on (0789) 296879.
- Sinclair profits were practically stationary over the last year: moving from £14.03 to £14.28 million. Sir Clive noted that the QL "added to costs in the year but little to sales".

Xerox telecopier

Send a document across the world in just two minutes with a Xerox facsimile terminal. It speeds up business and means important decisions can be made immediately. And there's a model to suit your exact need. The Xerox Telecopier 455 sits conveniently by your telephone. The 485 can handle up to 30 originals and receive up to 300 pages at a time. For bulk transmission the 495 can transmit an A4 letter in under a minute; its auto dial facility can make calls and transmit documents 24 hours a day. British Telecom Approved. I have full details. Just circle this number.

378 on enquiry card

The Trend 930 printer means business



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

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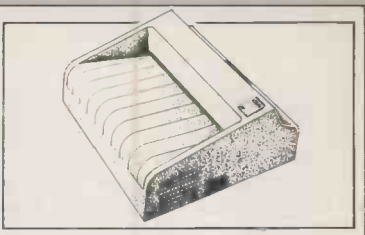
PAGE PLUS Computers

COMPILED BY–

Ursula Hewitt

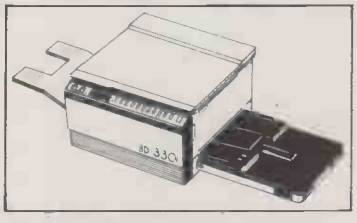
Maple House, Heath Drive,
Walton-on-the-Hill, Surrey. KT20 7QJ
Tadworth (073781) 4139



Little Big Mouth — the print-out protector

Specially designed for computers, printers and word processors, the Scimitar Data 3801 from BABS is the first desk-top datashredder with a full 15in wide mouth. It shreds six streams of full width print-out at once, and will also double as a general office shredder. Truly portable, this marvellous little machine is as quiet as a whisper — less than 60 dB(A) — and features a flush fitting dust-free shred container which tells you audibly when it's full, an auto switch off, plus a full 4-year guarantee. I have full details.

384 on enquiry card



Zoom into new copying convenience

The new Toshiba zoom copiers, the BD-8811 and BD-8812, give you a free choice of reduction or enlargement ratios, from 65% to 141%. You can make copies anything from half to double the size of your original. But that can be hit or miss. So the Toshiba zoom copiers will take account of the size of copy paper you are using, relate that to the copy size you select and show you — clearly on the platen — what selection of your original will be produced. A host of other features including document feed make these copiers a pleasure to use. Just circle this number.

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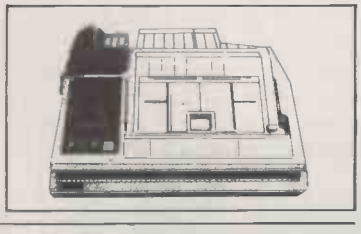
Now — worldwide Fax in only 15 seconds

The very latest Mufax facsimile transceiver can send A4 sized drawings, typed or handwritten sheets around the globe in just 15 seconds — and all for a matter of pence. Advanced features on the Mufax 7850 such as full report facilities, and A4/B4 scanning and recording combine with outstanding reliability to give you the best in table-top Fax. The 7850 is BT approved and is compatible with Groups 2 and 3. Just part of a complete range of transceivers that can be bought or leased from Muirhead. Contact me now for full details.

381 on enquiry card



New customer consultancy service

Microwriter now offers a unique free service to potential users. A professional team is at hand to help you choose the best system to suit your individual needs — interfacing to your existing equipment, helping you choose suitable peripherals, matching your budget requirements. The first step to becoming master of the written word is to contact me now for your information pack and FREE MICROWRITING COURSE. After you've discovered how simple it is, phone Microwriter to find out how to revolutionise your professional life with this portable word processor.

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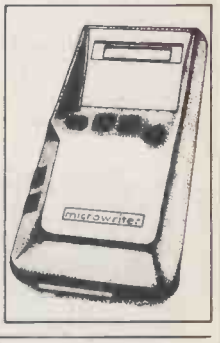
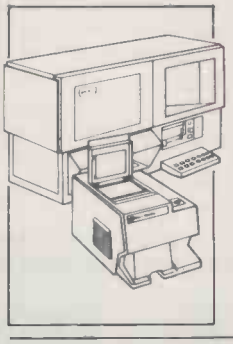
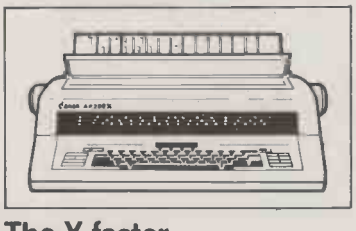




Updatable information system

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

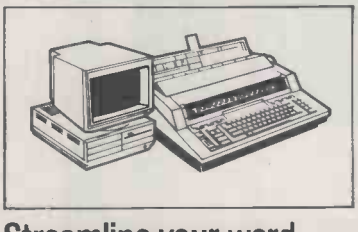
386 on enquiry card



The X factor

Canon have brought to the market a new concept in electronic typewriters by introducing the AP200X. When you purchase the AP200X you also invest in the X Factor — Xpandability. The AP200X has all the features of a modern electronic typewriter including RS232 interface capability. However as your needs grow by adding a package you can turn your AP200X into an AP300X which gives you the benefit of a 15 character screen, decimal tabulation and justified printout. A further package gives you the AP350X which will give you the advantage of a 2K memory expandable to 16K and the link to the VP2000 W.P.

382 on enquiry card



Streamline your word work

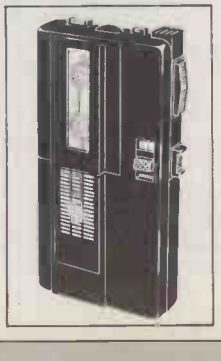
The Canon VP2000 is an add-on screen editor that works with an electronic typewriter to give you powerful word processing that's very easy to use. The system gives versatile editing commands such as block move, insert and delete. Word wrap, search and replace, special print enhancements and more. It even makes short work of form letters by a powerful data and text merging tool that lets you produce personalised letters. A complete help menu ensures that even a first time operator can use the system right away without wasteful errors. I have full details on both these Canon products.

383 on enquiry card

Complete mobile trolley range from Twinlock

Twinlock have introduced the first Mobile Trolley Range in the UK with an aesthetically pleasing, co-ordinated look. A multi-purpose range of 7 trolleys, fulfilling every mobile furniture need. These unique, 'look-alike' office trolleys will be your mobile desk companion, post carrier or even an easily-movable piece of office furniture. Today's office is becoming more design and colour co-ordinated with desking and storage bought to match. The new Twinlock Media-Stor Trolley Range complements these surroundings perfectly. Illustrated is the Cabinet Trolley (for a photocopier or guillotine on top, with related lockable storage below).

387 on enquiry card



Dictation: let's talk

One of Dictaphone's most advanced portables, the 324 gives you a full two hours' recording on a cassette one-third the size of the standard C-type. So it's a handy and convenient way to catch up with that backlog of correspondence when you're out of the office. You can even use the 324 as a note-taker at meetings. Press the conference button and you've got an instant record of the main speaker's voice. All this in a machine that measures a mere 4½ × 2¼in. I have full details.

388 on enquiry card

RELEASE THE TRUE POWER OF THE QL!

Write programs to unlock the multi-tasking power of your QL!

Metacomco now offers you three languages for the QL:

> Use **ASSEMBLER** for its speed, and for complete access to the QL's many features.

> Use **BCPL** for systems programming: writing games, utilities, and applications packages.

> Use **LISP** for manipulating data structures, and for exploring the world of artificial intelligence.

Each language comes as a complete development kit with a screen editor and documentation, for only £59.95.

THE ASSEMBLER

> Standard Motorola 68000 mnemonics.
> English error messages.
> Produces code which can be EXECed, and run as a concurrent job.
> External references allow linkage to high level languages and other assembler modules.
> Macro expansions.
> Position independent, absolute or relocatable code can be produced.
> Conditional assembly.
> Large range of directives.
> Fully formatted listings.
> 30 character variable names and 32-bit values.

BCPL

> True compiler.
> Multiple BCPL programs can run concurrently.
> Full runtime library includes interfaces to QDOS graphics, window handling, file operations, etc.
> Exception handling provides diagnostics for debugging.
> Link loader allows linkage of separately compiled segments.
> Assembler and BCPL modules can be linked together.
> 32-bit variables use the full QL address space.

LISP

> Full support of QL features including windows, graphics, and screen handling.
> Compatible with Acornsoft Lisp for the BBC micro.
> Interpreter.
> Structure editor allows alteration of data structures.
> Prettyprinter displays programs in structured format.
> Tracer to aid in debugging.
> Garbage collector automatically recovers spare memory space.
> 28-bit integers and 250-character names.

THE SCREEN EDITOR

> Full screen editor within a user defined window.
> Edits any ASCII file including SuperBASIC source.
> Comprehensive range of commands.

The Development Kits are available **now** from HMV, Menzies and other leading retailers, or direct from Metacomco.

QL, QDOS, and SuperBASIC are the trade marks of Sinclair Research Limited.

METACOMCO

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Tel: Bristol (0272) 428781

PC2

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- Microdrive demonstration cartridge
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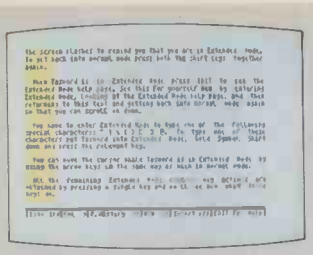
The new ZX Spectrum +
Fully compatible with all Spectrum software and peripherals, including this Expansion System

Tasword Two word processor

Turns your ZX Spectrum into a high-quality word processor!

Tasword Two has all the essential features of professional word processing packages – move and copy, insert, margin settings, 'help' pages, find and replace, and much more.

Written by Tasman Software Ltd.
Usual price (RRP): £13.90.



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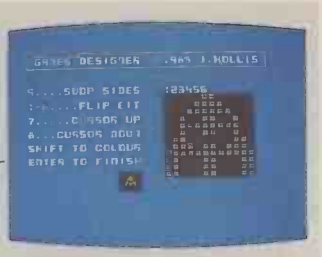
Now, all you need to create original games are original ideas – and Games Designer! It has eight, very different, pre-programmed games for you to play as they are – or modify out of all recognition!

There's never before been an easier, more enjoyable, way into games design.

Written by Quicksilva Ltd.
Usual price (RRP): £14.95.



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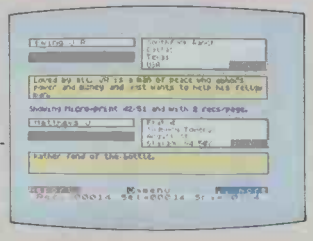
Address lists... personal files... stock inventories... stamp or album collections... club records... recipes ...if you can file it, you can Masterfile it!

Masterfile is a menu-driven filing and retrieval system of immense power. Display formats are user-defined, so the range of applications is enormous.

Written by Campbell Systems Ltd.
Usual price (RRP): £16.95.



Ant Attack

The all-time classic 3D strategy game. Ant Attack combines stunning Escher-like graphics with fast-moving action and a real tactical challenge.

Your task is to enter the walled city, seek out your captured partner, and escape. At all times you can choose from four angles of view. But beware: the city is patrolled by giant ants...

Written by Quicksilva Ltd. Usual price (RRP): £6.95.

All programs run on a 48K Spectrum or Spectrum +. Recommended retail prices are for each program on cassette.

...includes this great set of Microdrive programs!

The unique ZX Microdrive system sets the Spectrum apart from all other home computers.

It gives you all the advantages of floppy disc drives – at a fraction of the cost. And tests show the Microdrives are faster than some disc drives.

Now, the complete Microdrive system comes in one package – together with four of the best-ever Spectrum programs, on Microdrive cartridges.

This software alone would normally cost you over £50. Yet the Sinclair price for the complete ZX Spectrum Expansion Pack is just £99.95!

You'll find full details of its contents in the panel opposite.

ZX Microdrives – another Sinclair first!

The ZX Microdrive is a revolutionary fast access / mass storage device. And it's the only truly affordable alternative to disc drives ...

- Loads or saves up to 85K of program or data from Microdrive cartridges.
- Just 3.5 seconds to access a typical file.
- Only 9 seconds to load a typical 48K program.

The ZX Microdrive cartridge – a unique storage medium.

Smaller than a matchbox, the ZX Microdrive cartridge packs in a massive amount of data and programs.

Each Microdrive cartridge holds at least 85K bytes of data or programs (that's 30 pages of A4 text). And you can store up to 50 different data files per cartridge, identified by titles of your choice.

Every cartridge comes in its own protective case. Simply remove the cartridge, slot it into the Microdrive, and it's ready to use.

ZX Interface 1 – adds powerful new capabilities to your Spectrum.

ZX Interface 1 connects to the back of your Spectrum and controls up to 8 Microdrives. (Additional Microdrives are available for £49.95 each.)

It also gives you:

- An RS 232 interface – to link your Spectrum with full-size printers, other computers using RS 232 (the industry-standard interface) and provide data transmission over telephone lines, via modems.
- ZX Net – lets you set up a local area network of up to 64 Spectrums, for high-speed data communications between you and Spectrum-owning friends.

At your local Sinclair stockist – today!

The ZX Spectrum Expansion System adds an exciting new dimension to Spectrum and Spectrum + computing. At £99.95 it's superb value too.

To find out more, call in at your local Sinclair stockist now!

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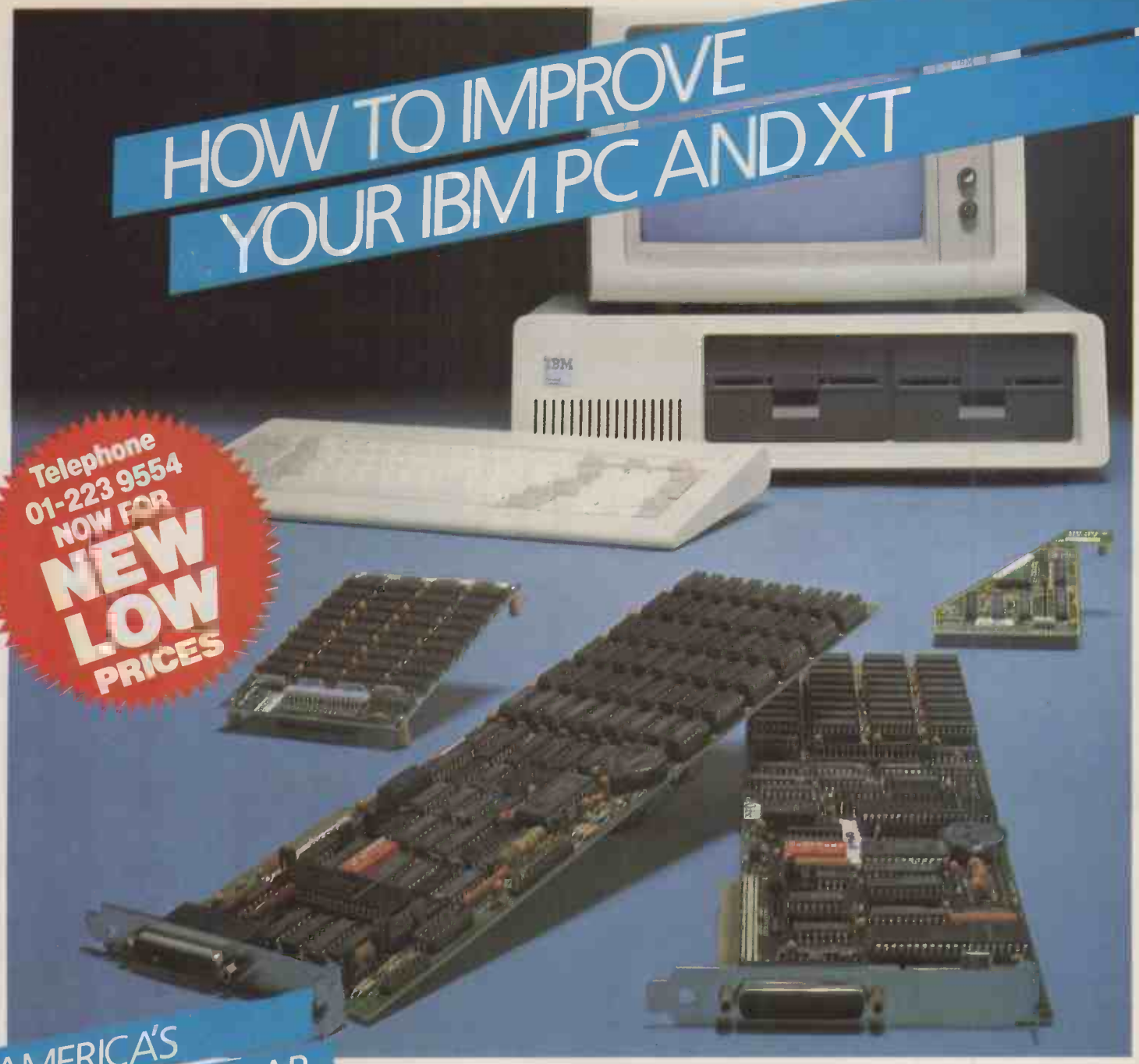
● Circle No. 163

HOW TO IMPROVE YOUR IBM PC AND XT



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SIXSHOOTER – IDEAL FOR PC OR XT

For most customers the SixShooter offers all that you require from a multifunction board. 64K of Ram (socketed up to 384K), a serial port, a parallel port, automatic clock/calendar with battery back up are all standard. An IBM compatible games port adaptor is optional.

Q PLUS II – MORE OPTIONS

Corporate customers and those with special needs will appreciate the ability of the Q plus II. Ram is expandable from 64K all the way to 512K. Add two serial ports, a parallel port clock/calendar and a games port to give 4 I/O connections from one slot.

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Free with each board are the custom-made Qubie' drive™ and Qubie' spool™ programmes.

Qubie' drive™ disk emulation software allows you to create up to three "electronic disk drives" in memory which access your programmes at the speed of RAM memory.

Qubie' spool™ is a programme which allows you to assign a portion of memory to act as a print spooler.

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● Circle No. 110

Compaq's desk-tops

THE COMPANY formed to launch an IBM PC compatible portable has followed up its success with a desk-top range. The Compaq Deskpro family includes four models which use the 8086 chip rather than the 8088 used in the portable.

The Model 1 has 128K of RAM and a single 5.25in. disc drive, and costs £2,195. The Model 2 has 256K of RAM and two floppies, and costs £2,595. The Model 3 has 256K of RAM, one floppy and one 10Mbyte hard disc, plus an asynch communications/clock card; the price is £3,995. The Model 4 has 640K of RAM, a half-height floppy disc, a 10Mbyte disc drive, plus a 10Mbyte backup tape for £5,595.

All the models come with an IBM-type 83-key keyboard, and 12in. dual-mode monitor which can display both text and graphics. The keyboard offers a key combination that knocks the 8086's clock speed back from 8MHz to the more leisurely 4.77MHz of the IBM PC.

Compaq claims the Deskpro models are "the first on the market to run the 16-bit 8086 microprocessor while maintaining true compatibility with the IBM PC and PC/XT". The correctness of this claim is open to dispute. The Advance 86B, Olivetti M-24 and Eagle are among the 8086-based IBMulators already on the market.

More of a problem for Compaq is likely to be the discovery that its prices are too high. The Olivetti M-24, which is about equivalent to the Model 2 Deskpro, costs £517 less at £2,078. The ITT Xtra 130, which is about equivalent to the Model 3, is £932 less at £3,063. Anyone with £6,000 to spend will surely go for the IBM PC/AT instead.

Further, Compaq will find that rises in the U.S. dollar tend to make its micros more expensive. The M-24, made in Italy, and the Xtra, which is made in Korea, face fewer currency problems.

Contact Compaq Computer Ltd at Ambassador House, Paradise Road, Richmond, Surrey TW9 1SQ. Telephone: 01-940 8860.

IBM shorts

- Accent computers has announced its own HD-10 10Mbyte hard disc for PCs, XTs and compatibles. The price is only £995 plus VAT. Telephone: (0444) 451324.
- Vaser and Sipher can turn your PC into a telex machine with Volkswriter de Luxe and the Streamline interface. The cost is £1,900. Contact Vaser on (02404) 5434.
- Wave Mate, from California, has launched an 80286 board for the IBM PC and PC/XT. It is claimed to be more PC compatible than the new IBM PC/AT. Prices start at around $2,000. Contact Wave Mate in Belgium at (03) 239 62 91.
- Superdraft is a computer-aided design package from a British company, Data-Graphic. It includes a graphics processor with up to 832- by 630-pixel resolution, digitising tablet and colour monitor for under £6,000. Telephone: (06333) 72741.
- Cameron Communications has an interactive video-disc package with Interact touch screen which combines a Philips player with an IBM PC. IBM is using it for dealer training. Telephone: 041-633 0077.
- ADDS, Applied Digital Data Systems Inc., has launched floppy- and hard-disc IBM compatibles the PC/I and PC/II. ADDS is a subsidiary of NCR and has more than 50 distributors worldwide, including Data Dynamics in the U.K. Telephone: 01-848 9781.
- Three American companies have set up U.K. operations: Columbia Data Products, whose Columbia MPCs were previously imported by Icarus, now has an office at Greenco House, 36-40 High Street, Slough SL1 1EL. Telephone: (0753) 821991/2/3. Palantir Software Inc. has set up at Columbia House, Aldwych, London WC2. Telephone: 01-242 6248. Harvard Software is now at Fairfield House, South Luffenham, Leicestershire LE15 8NT. Telephone: (0780) 721433.

Televideo's Personal Mini

TELEVIDEO has launched what it calls a "personal mini", but which is really intended as an intelligent file-server. The PM-16 is a processor box with an 8MHz Intel 80186, 256K of RAM, a 5.25in. floppy-disc drive and a 46Mbyte hard disc. This is somewhat expensive at £9,995. However, the PM-16 also has eight RS-422 serial ports, so the idea is to hang IBM PCs or terminals on the end. Under the PM-16's operating system, Infoshare, they can run PC-DOS applications, share files and exchange electronic mail.

What Televideo would like users to attach to the ports is the PM disc-less work station. This looks like the standard Televideo IBM-compatible micro with an Intel 8088 CPU, 256K of RAM and a built-in 14in. monochrome screen. Unfortunately the PM costs £1,995 — and for less than that you could get a complete micro.

Contact Thorn EMI Computeraid (Televideo), The Business Centre, Molly Millars Lane, Wokingham, Berkshire RG11 2EY. Telephone: Freephone Televideo.

Spotlight

SOFTWARE ARTS, developer of VisiCalc and TK!Solver, has launched a desk-top management program called Spotlight. It offers a DOS filer, appointments diary, telephone directory, card index, note pad and calculator.

Spotlight runs concurrently with application programs. You call up the facilities as and when needed. The program requires 128K of RAM and DOS 2.

Spotlight is being distributed by Softsel, P&P and Tamsys. For further details contact Software Arts International at 43 Buttermarket, Ipswich, Suffolk. Telephone: (0473) 221551.

R:Base gets Clout

A FRIENDLY front end is now available for the mainframe-derived R:Base database from Microrim. Clout has a vocabulary of 300 enquiry phrases; you can add up to 500 of your own and Clout translates them into database commands. This permits interrogation of the database using more natural English.

Clout costs £136.50 plus VAT, and is distributed by Softsel Computer Products, Softsel House, Central Way, Feltham, Middlesex TW14 0XD. Telephone: 01-844 2040.

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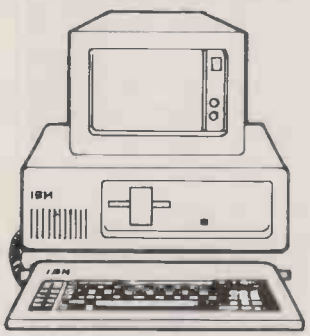

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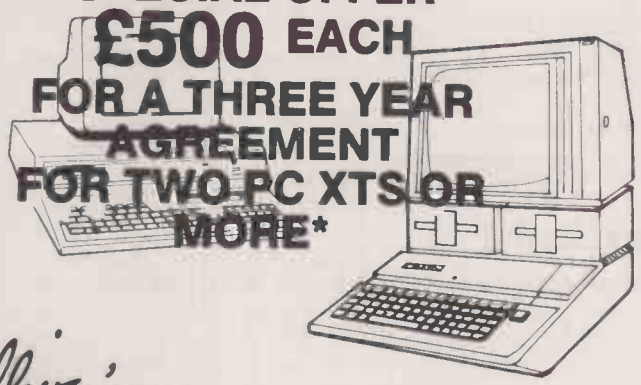

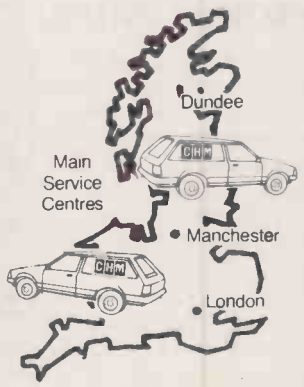

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View spreadsheet

THREE NEW PROGAMS from Acornsoft complement the best-selling View word-processor for the BBC Micro. Viewsheet is a spreadsheet package on ROM which is data compatible with View, so you can produce word-processed documents with spreadsheet-derived figures in them. It costs £59.80 including VAT.

Viewindex is an automatic index generator, price £14.95. You first mark the relevant words in the text, then Viewindex goes to work automatically amending the index when you edit or reformat the document.

Printer Driver Generator, price £9.95, extends the range of printers View will work with. At the same time Acornsoft has announced Hi-View, £59.80, which is a special high-performance version of View optimised for the use with the BBC 6502 second processor.

These programs should all be available now from Acornsoft dealers, or by mail order from Vector Marketing, London Road, Dennington Estate, Wellingborough, Northamptonshire NN8 2RL.

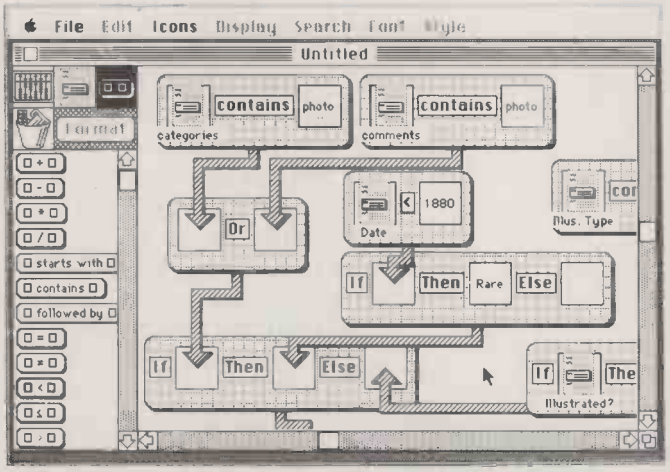
Helix for the Mac

HELIX is a innovative package for the Macintosh which combines the functions of a database package like dBase II with those of a spreadsheet, report writer and programming language.

One unusual feature is the extensive use of icons to represent the structure of the data itself, not just the tools for manipulating it. Each field in your data is given an icon and you then manipulate the data by dragging field icons around the screen, putting them into templates and report-generating forms, and so on.

The screen dump shows the Helix equivalent of a programming language, which uses graphic symbols called abacus tiles. Each tile specifies a relationship and contains one or more blanks. You drag out tiles from the list in the window at the left and then drop field icons into the blanks, or other abacus tiles to build up more complicated nested operations.

Helix should be available in December from Softsel dealers for around £232 plus VAT. Contact Softsel Computer Products Ltd. Telephone: 01-844 2040.



Helix gives you a visual programming language.

Information services for ACT Apricot

ACT is offering free membership of 11 business-orientated on-line information services to Apricot owners buying its new Communique communications package. They include Extel, Datastream, Pergamon Infoline, Prestel and Telecom Gold.

Communique costs £395 and includes a BT-approved direct-connect modem and menu-driven software which handles the details of logging into each service. You have to pay normal access charges for the services you use, but by going through ACT you avoid subscription fees and a lot of paperwork.

The package gives access to many of the best-known on-line business information services. Extel holds share prices, while Datastream also provides financial information and can do real-time portfolio valuation. Dun and Bradstreet, Pergamon Infoline and Jordan's Online provide company information, while Eurolex is a legal database.

Textline and Datastar index thousands of newspaper and magazine articles, and Datastar gives access to the Dow Jones News Service and Financial Times Company Information Service. Communique also offers Apricot users access to the Telecom Gold electronic mail and telex service, and to Prestel.

For further details contact ACT Computer Services Ltd. Telephone: (0272) 211733.

Rare bird protection

THE EDUCATIONAL simulation game called Osprey has been produced in conjunction with the Royal Society for the Protection of Birds. You protect breeding pairs of the rare birds from marauding tourists and egg stealers. The program, available for the Amstrad, BBC, Commodore 64 and Electron, comes with a 32-page booklet about Ospreys.

The price is £9.95 on cassette, £11.95 on disc. Details from Bourne Educational Software Ltd. Telephone: (0794) 523301.

Software shorts

- Logo Software's version of Logo for the BBC Micro is now available, price £59 plus VAT. Brochure from Logo Software Ltd, Freepost, Twickenham TW1 1BR. Schools can contact E J Arnold's School Computer Service on (0532) 772112.
- Wordtech System's dB Compiler, costing £675 plus VAT, lets you produce compact compiled programs which run independently of dBase II and without Run Time. The CP/M version requires a clear 54K to run, the MS-DOS version 128K. Details from Pete & Pam on (0706) 217744.
- Games Creator comes on a £12.95 cassette and lets you design and play different arcade-style games on the Commodore 64. It is well documented and much simpler to use than similar packages. Contact Mirrorsoft for stockists on 01-353 0246.
- TDI has brought out versions of the UCSD p-System Pascal environment for both the Macintosh and the expanded BBC Micro with 800K dual disc unit and 6502 second processor. Prices are £495 on the Mac, £299 on the BBC Micro. Details from TDI on (0272) 742796, or from Acornsoft on (0223) 316039 for information on the BBC version.
- Welsh XBasic is a new version of Xitan's semi-compiled Basic in which all the keywords and error messages are in Welsh — Llwyth instead of Load, Rhedeg for Run, etc. It is available for most Z-80 based CP/M systems and costs £185. Details from Xitan Ltd on (0703) 871211.
- APES, which stands for augmented Prolog for expert systems, is a set of pre-programmmed Prolog modules intended for expert-system building. It is available for popular MS-DOS machines and costs £495 plus VAT. Details from Logic Programming Associates Ltd, on 01-874 0350.

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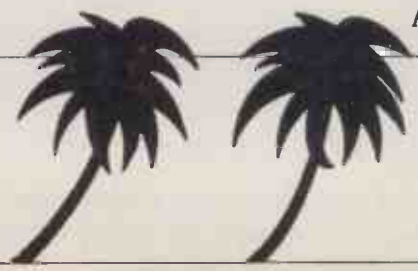

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Taking flight

THE UNCHALLENGED leader among flight-simulation programs for micros, Bruce Artwick's Flight Simulator II, is now available to everyone with an Apple, Atari or Commodore 64. The program is already familiar in its Microsoft incarnation for the IBM PC. The new versions contain almost as much detail — which has to be seen to be believed — and superior sound.

The program is an accurate simulation of flight in a Piper 181 Cherokee Archer. Over 40 controls and indicators are shown on screen, along with a colourful three-dimensional view out of the cockpit in the direction of your choice — front, back, either side and down.

The instrument panel includes two navigation radios, a clock, a magneto switch position indicator, gauges for the right and left fuel tanks, mixture and throttle-control indicators, and aileron- elevator- and rudder-control indicators. These instruments help you to fly day or night using both VOR and ADF navigation.

The flying area covers all of North America, with detailed landscapes for four separate areas: Chicago, New York, Seattle and Los Angeles. These areas include about 80 airports, and some may be held on a separate disc. Other areas are now being coded using maps, charts and aerial photographs.

Of course, as this is a real-time simulator, flying from New York to LA could take days. But the simulation provides a 24-hour clock, day and night, choice of four seasons, cloud layers, surface wind and wind at three levels with turbulence factor — as much nasty weather as you could want, and more. Naturally you can land to refuel or, if you want to make a long flight, save and load your position from disc.

All of this is explained in great detail in a 90-page manual. There is a second 92-page manual of *Flight Physics and Aircraft Control*, with an introduction to aerobatics which ends with the advice "please do not attempt these maneuvers in actual flight with a real airplane unless accompanied by a qualified flight instructor experienced in aerobatics". The warning is appropriate: you really believe that if you can fly this simulator you can fly anything.

If you get tired of aerobatics there is also a World War 1 Fighter Ace mode. And if you want to fly without all the fuss there is an Easy mode as well as Reality mode. Some details are missing from certain versions, and the 48K ones lack several. However, there is more than enough to cope with in even the simplest.

Bruce Artwick is obviously a keen pilot; he used to work for Hughes Aircraft. After writing several versions of this flight simulator he also wrote Night Mission Pinball, which recreates a pinball table.

The Sublogic Flight Simulator II is our Game of the Year — see page 88. It is distributed by Softsel and costs around £40, depending on the version. It is available via most dealers, who can contact Softsel at 01-844 2040.

Flight Simulator II — now widely available.

Commodore 64 owners can take a fresh look at Macbeth.

Activision's River Raid (left) and Enduro — see page 29.

Adventurers brought to book

THE HOBBIT has been such a massive success that more and more adventure writers are turning to books for inspiration. A good book provides more in the way of plot and characterisation than is usual in adventure games. And if the book is a worthy one, the result can have educational value.

Sherlock is the direct descendant of The Hobbit, written by the same author, Philip Mitchell, for Melbourne House. It uses the same language, Inglish, with over 800 words. The graphics are by Russell Comte, who did the graphics for Mugsy.

In Sherlock you play Sherlock Holmes and try to solve a murder mystery in the midst of a re-creation of Victorian London. The game is available on tape for the 48K Spectrum and Commodore 64, and costs £14.95.

An even older murder mystery is Macbeth. In Shakespeare's play the story starts with witches and ends with the hero beheaded — which is standard stuff for hardened adventurers. But in the version by Oxford Digital Enterprises you can rewrite Shakespeare and survive.

Macbeth the Computer Adventure has four parts. In part 2 you play Lady Macbeth, and in part 3 you collect the ingredients for the witches' brew. To survive you need to consult the facsimile of the 1623 edition of the play — so this game must have educational value. Finally there are four psychoanalytical programs where Sigmund questions you, Macbeth, to analyse your motives, providing another educational aspect to the game.

Macbeth is a graphics adventure for the Commodore 64, and costs £14.95. It is distributed by Creative Sparks/ Thorn EMI.

(continued on page 29)

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(continued from page 27)

Pilgrim's Progress, similarly, is not only a book, it's also an adventure game for the 48K Spectrum, with BBC and Commodore 64 versions due next year. In it you play Pilgrim on your way through up to 100 locations to the Heavenly City. It works like a normal text adventure, with hints given in the form of Bible references.

The instructions warn that "just because a particular course of action didn't work the first time doesn't necessarily mean it won't work if you try it again. But if you do make a mistake it expects you to be honest and truly sorry about it and . . . to repent".

Pilgrim's Progress comes with an extra cassette for saving games and costs £10.95 from the Sound and Vision Unit of the Scripture Union, 130 City Road, London EC1V 2NJ.

Other book spin-offs include two £9.95 titles from Mosaic publishing. The Unorthodox Engineers: The Pen and The Dark is based on Colin Kapp's science-fiction novel. It is available for the BBC model B and the 48K Spectrum. The Width of the World is a graphics adventure sequel to Ian Watson's SF story of the same name, which is included with the package. It is available for the 48K Spectrum. Both adventures are marketed by John Wiley & Sons.

Join the Elite

ACORNSOFT has just launched a new game, Elite, which it says will sell more than double the number of copies of any of its previous games.

Elite is a combination of the old space-trader game with arcade elements. The trading takes place in a large universe of eight galaxies, with over 250 recognised planets in each galaxy. The trick is to fly around shipping, say, food to industrial planets and technology to agricultural ones.

On your travels you may meet bounty hunters, pirates, generation ships and space dredgers, which may involve you in missile and laser battles. If you want an alternative lifestyle, you can always become a bounty hunter, pirate or asteroid miner yourself.

While doing all this you aim to gradually increase your rating, starting from Harmless and progressing through Competent and Dangerous until you eventually become Elite.

The action takes place in a mixture of text and graphics. In the graphics screens you have a spaceship control panel with colour, but the high-resolution part of the screen is black and white, like Acornsoft's Aviator.

The intergalactic empire/trader type of game can get pretty boring, but Elite is sufficiently complex to be a real challenge. In fact, it's amazing how much has been fitted into a BBC B.

Elite should be widely available from dealers at a cost of £14.95 on cassette or £17.65 on disc. Acornsoft is at Betjeman House, 104 Hills Road, Cambridge CB2 1LQ. Telephone: (0223) 316039.

Activision's disappointing conversions for the Spectrum.

Spectrum Activision

ACTIVISION — like Koala Technologies, Amiga and Mindset, a spin-off from Atari — published a series of smash-hit games for the Atari video games machine and home micros. But the original authors of great games like River Raid and Enduro will probably weep if they ever see the Spectrum versions which have just been released by Activision in the U.K.

The first eight for the Spectrum are Beamrider, Enduro, Hero, Pitfall II, River Raid, Space Shuttle, Zenji and The Designer's Pencil. Activision says "When we develop software for each new system . . . the original concept is reprogrammed and enhanced to maximise on every nuance and advantage the hardware has to offer. Spectrum owners will be pleasantly surprised at the sophistication. . ." etc., etc.

Compare the Atari versions of Pole Position for the Atari and Spectrum — both excellent — with Activision's Atari and Spectrum versions of the similar Enduro race game and this claim collapses. The Spectrum Enduro is rubbish. The Spectrum River Raid is a travesty compared to the Atari version reviewed last month. What the others are like we can't bear to find out.

Scott's 13th

MANY YEARS AGO Scott Adams practically invented adventure games on micros when he embarked on his famous series of witty and challenging adventures. The first of the 12, Adventureland, was released for the Tandy micro in 1978, and they were soon available for the Apple and Atari machines. They are currently being converted in the U.K. for machines such as the BBC, which should give them the new generation of adherents they richly deserve.

Recent games from Adventure International — such as The Incredible Hulk and C'est la Vie — have been arcade adventures or in the series of Scott Adams Graphics Adventures, Saga. Now a Saga story has been added to the original series, and the fact that it is the 13th is significant. The adventure is called the Sorceror of Claymorgue Castle. The aim is to find the 13 Stars of Power concealed in the castle. You have spells to help you.

The game is available with graphics for the Apple II, Atari, Commodore 64 and Sinclair Spectrum. Text-only versions are available for the BBC, Dragon, Electron and Tandy computers. Contact Adventure International (U.K.), 119 John Bright Street, Birmingham B1 1BE.

Game watch

Look out for the new Electronic Arts game **Seven Cities of Gold** for the Atari and Commodore 64. . . . Another Atari/Commodore game, **Beach Head,** is out for the Spectrum from U.S. Gold — but nothing like as good. . . . Can you stand yet another Track and Field-type game? Quicksilva has launched Epyx's **Summer Games** for the Commodore 64, Hesware has launched **Hesgames** for the Commodore 64, and Melbourne House has **Sports Hero** for the 48K Spectrum . . . . Quicksilva's new version of **Battlezone,** for the Atari and Spectrum micros, is not as good as Novagen's **Encounter,** for the Atari and Commodore 64 — see review last month . . . . 3D specialist Micromega has three more games for the 48K Spectrum: **Braxx Bluff,** which is good; **Kentilla,** an adventure; and **Jasper,** where you get killed by a rabbit . . . . Still no sign of the most wonderful games ever written, **Ballblazer** and **Rescue on Fractalus,** for the Atari micros. Both have been produced by Lucas Films, the company that brought you *Star Wars* and *Indiana Jones* . . . . Meanwhile Infocom, of Zork fame, has a new game called **Seastalker,** available for most American micros, including Apple, Atari, Commodore and IBM . . . . Parker Brothers, covering the same machines, has three new games: **Frogger II, Threedeep** and **Montezuma's Revenge** . . . . No more curried eggs for you!

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ASK PC

Q I am considering an upgrade from my present eight-bit Z-80 machine to one of the 16-bit machines. I am attracted by the Sanyo 16-bit computer, which appears to be an IBM at a fraction of the price. Are there some hidden snags, and is this a good buy? My work involves a lot of heavy arithmetic calculations.

D Preuss

A The Sanyo 550 computer is an eight/16-bit computer with an Intel 8088 processor. It runs MS-DOS version 1.25, not the latest version 2. It looks similar to the IBM PC, but is much cheaper, starting at £749 plus VAT for a single-drive system with a keyboard but without a monitor. Look carefully at the specification before buying.

The clock speed of the 8088 CPU on the Sanyo is a pitiful 3.6MHz, compared with 4.77MHz on the IBM PC and most of the clones, and 8MHz on the NEC and Olivetti M-24. The Sanyo will probably run Basic more slowly than an old-fashioned 4MHz Z-80 based eight-bit machine will run MBasic.

The Sanyo has 128K RAM standard, compared with 64K standard on an IBM. The Sanyo can be expanded internally to 256K on the motherboard but there are no expansion slots, so you cannot plug in extra memory boards or extra boards for any other function. The IBM PC has five expansion slots for extra boards, while the hard-disc XT version has eight, and both can be expanded to 640K of memory.

The IBM is sold with a monochrome video board and colour is extra, whereas the Sanyo has colour and monochrome built in. Sanyo charges extra for a serial port if you need one for a printer. On the machine I have seen so far the discs hold a meagre 160K, though 320K and 700K disc drives are advertised at an increased price.

Software compatibility with the IBM is not very good, so there could be problems there, and the user manual is poor. On the other hand, Sanyo gives some very useful software free, including Basic, WordStar and Calcstar.

The IBM has an unexciting specification, is fairly slow and is overpriced, but it does have reliability and the backing of a major firm going for it. Sales in the U.S. were claimed to be 600,000 last year, and it is expected to sell three times that number this year. There are a number of IBM clones, IBM look-alikes and IBM pretenders with diminishing degrees of IBM compatibility.

The price of the Sanyo is exceptionally low. Whether it is a good buy depends on whether it does the jobs you bought it for reliably and at a reasonable speed. You mention heavy arithmetic, which will be processor bound: the Sanyo's low clock speed means that it will not run Basic very fast.

If you really want to do heavy calculations any 8086-based machine would do better than an 8088, and one running at 8MHz or 10 MHz would be even better. A compiler rather than an interpreter or an 8087 co-processor might also help.

You are advised not to buy this or any other machine without actually trying it. Advice on the Sanyo can be obtained from Icarus Computer Systems Ltd, 39-51 Highgate Road, London NW5.

J&TL

Transferring disc files

Q I recently ordered a CP/M program from the U.S. for the Newbrain, and the supplier was unable to provide the disc in the Newbrain disc format. It was suggested that I should buy it in another machine format — say Osborne — and borrow such a machine, and then transfer the program to the Newbrain.

Unfortunately the manuals supplied with the Newbrain are very uninformative about how this can be done, and most of the other manuals one can buy are just as uninformative. Would it be possible to simply connect the Osborne RS-232 interface to that of the Newbrain, or does one need a couple of modems?

S T W Hayes

A It is in theory possible to directly connect the RS-232 connectors on both machines together, but a non-standard cable is required. Connect pin 2 on one plug to pin 3 on the other, pin 3 to pin 2, and pin 7 to pin 7. Provided that the baud rates are the same, the number of start and stop bits match, and the Printer Busy line is not wired, then transfer of text files can usually be accomplished with Pip. This will not work with machine code, and may not work with large text files. Modems are only required if you cannot get the two machines close enough together to connect them with wires.

It is possible to buy commercial communications programs such as BSTAM or Move-It for transferring files. The program must be mounted on both computers. Alternatively the British CP/M Users Group has a public-domain program called Dump which is available free to members.

Unfortunately all such transfers are a messy business. *Practical Computing* will publish a detailed technical article on the subject in a future edition.

J&TL

Q My daughter is 11 and learning computing in school. If I buy a computer for home use, which one should I get?

Clare Saville

A It is tempting to find out which micro your daughter is using in school, and buy the same one. Unfortunately this is likely to be an expensive model such as the Acorn BBC Model B or the Research Machines 480Z. They cost far more than is worth spending on a child unless he or she is really keen on computing. Anyway, the really keen child will probably have a good idea which micro to buy.

However, I recommend the Sinclair Spectrum, even though this may not be used in her school, and even though it is no longer particularly good value.

The Spectrum is the best choice because:

- It works with a TV and ordinary tape recorder and so probably requires no extra spending.
- It has the largest range of really cheap cassette tape software available.
- Its small size makes it readily portable.
- Most other kids who have a micro already seem to have a Spectrum.

Also, far from being a disadvantage, it is probably an advantage for a child to be exposed to two non-standard versions of Basic rather than one.

JS

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To be considered, letters should contain one question only, and must include your name and address, together with a stamped addressed envelope. Because *Practical Computing* receives hundreds of letters each month, we cannot guarantee that personal replies will be given, but we will do our best. This month the replies are provided by Jack Schofield and John and Timothy Lee.

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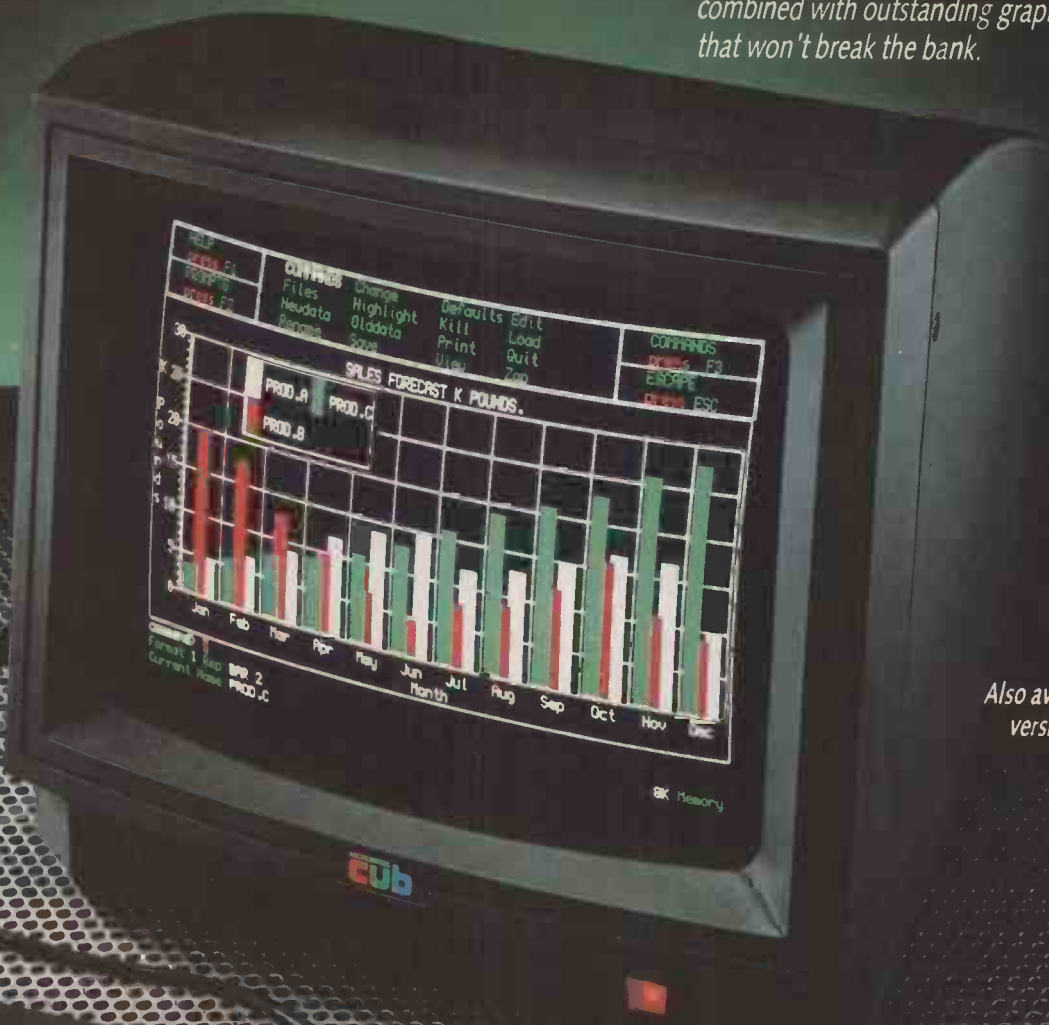

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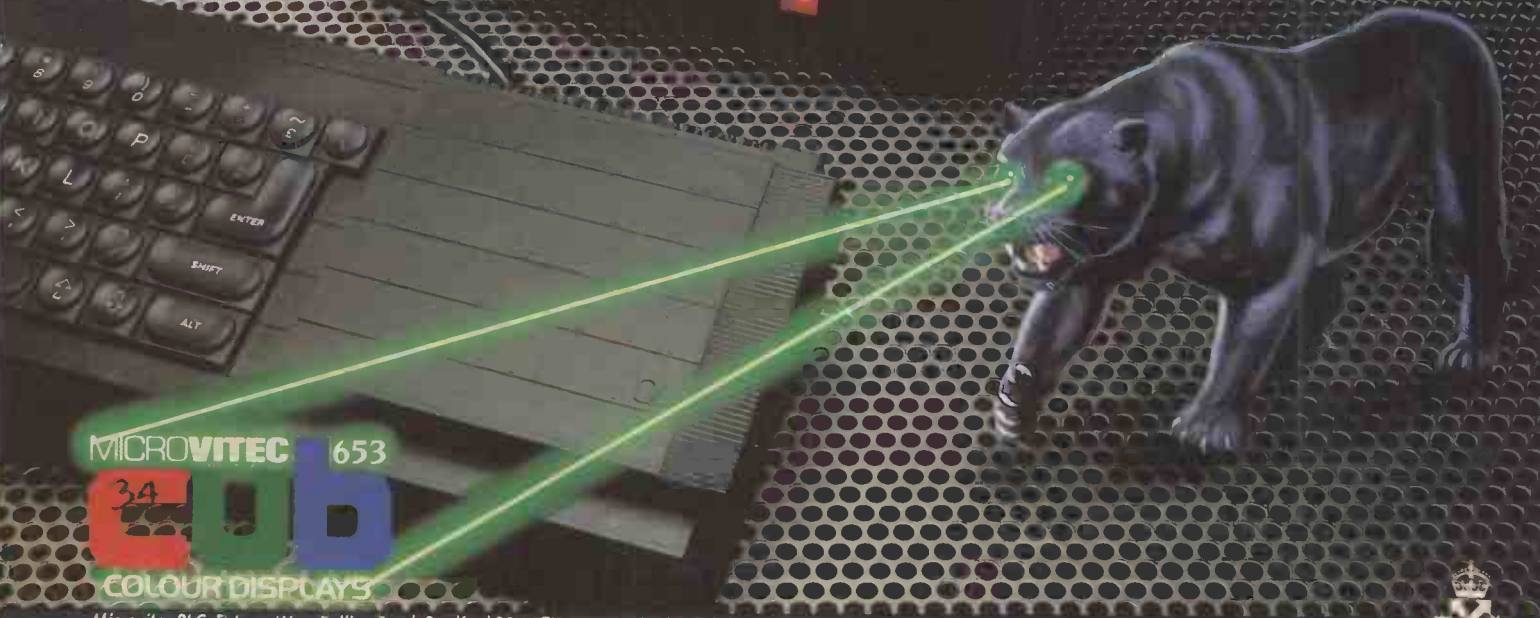

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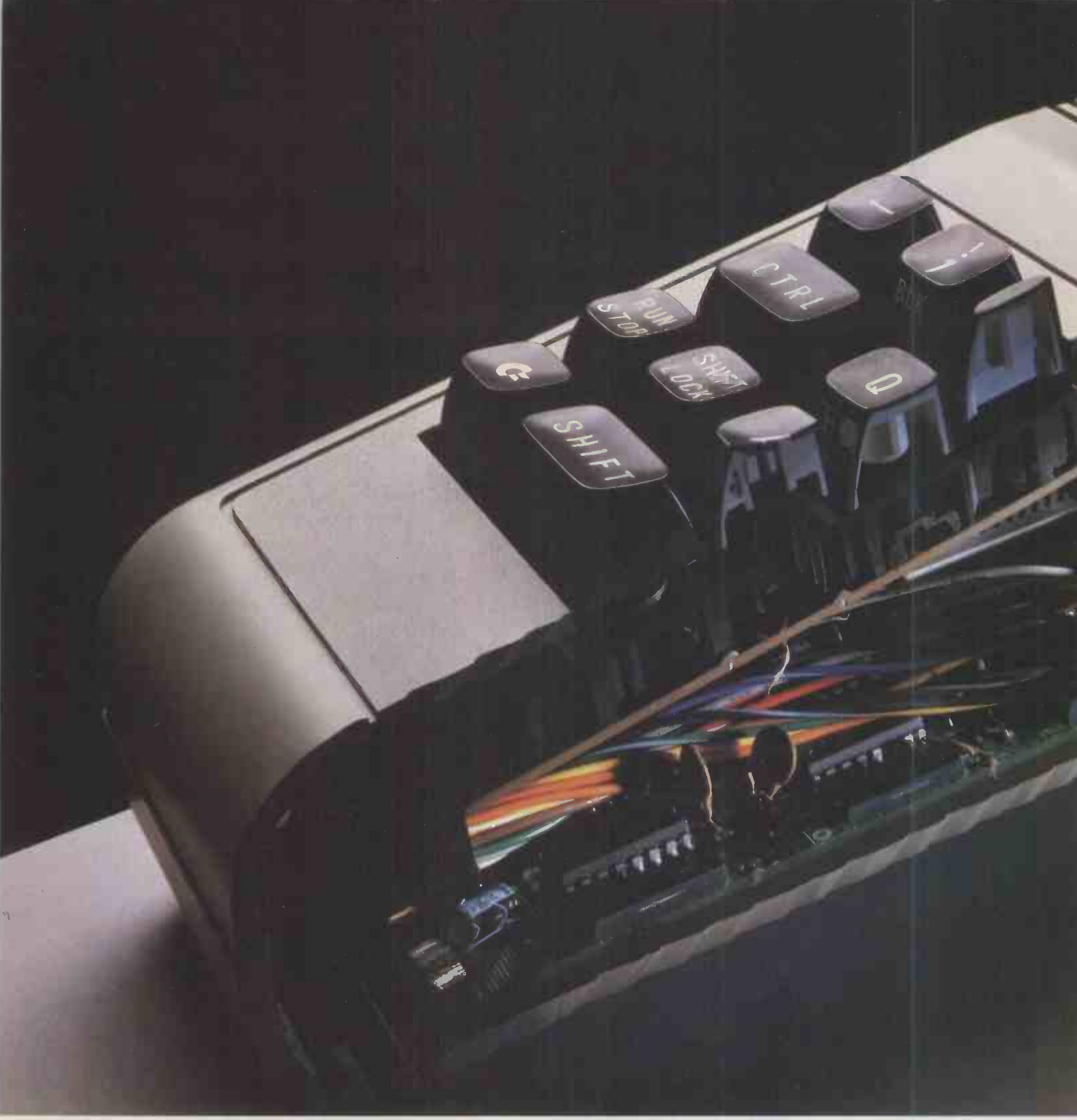

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paper. Print speed:
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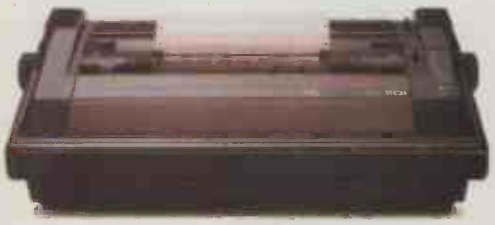

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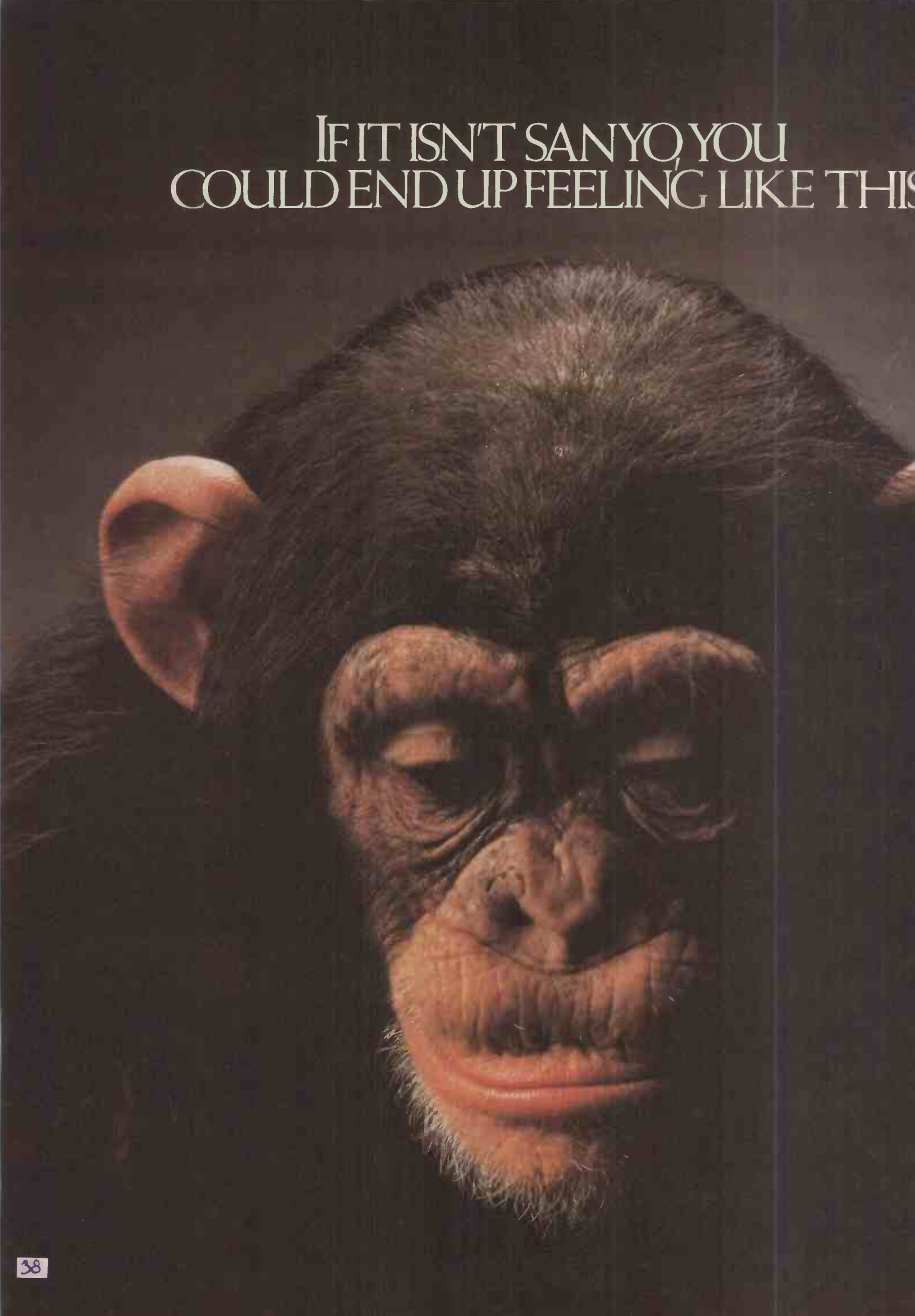

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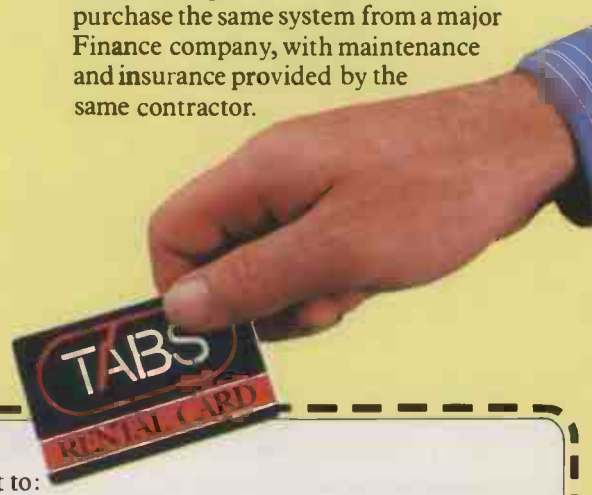

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The discs can be used for storage under the Acorn DFS system or for CP/M® programs and data.

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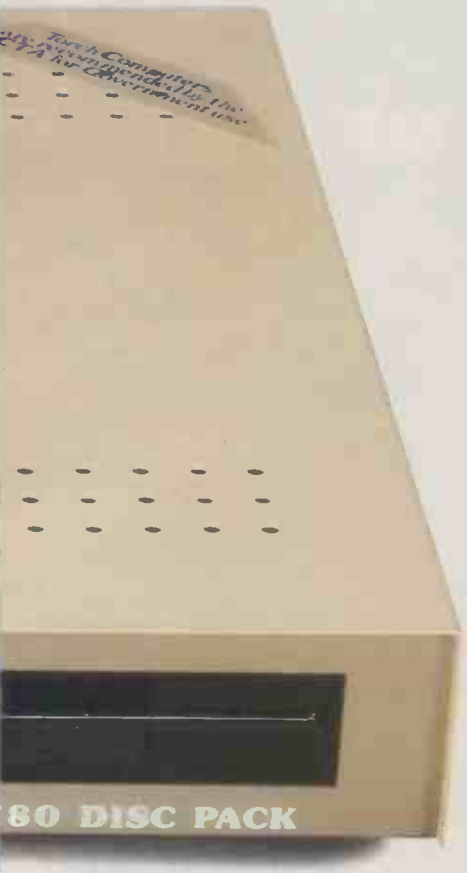

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by Mike Lewis

Divide and conquer

Recursive algorithms can provide neater code than the iterative alternatives.

A WELL-KNOWN computer academic was once asked to suggest a dictionary entry for "recursion". After a moment's thought, the story goes, he offered: "Recursion: see Recursion". A more serious definition might describe a recursive procedure as one whose execution involves a call to a smaller version of itself. Recursion can be thought of as a divide and conquer approach to problem solving.

In his book *Algorithms* Robert Sedgewick demonstrates recursion with a procedure for finding the highest common factor, or HCF, of two integers, u and v. The obvious way of doing this would be to set a temporary value, t, equal to the lower of u and v, then to continually decrement it by 1 until it divides without a remainder into both u and v. Listing 1 shows this straightforward routine in Microsoft Basic. The Mod function computes a remainder, so if $u_{(Mod\ t)}$ is zero, t divides exactly into u.

Sedgewick's method of finding an HCF is less obvious but much faster. He uses an algorithm put forward by Euclid, who showed that the HCF of u and v is also the HCF of v and $u_{(Mod\ v)}$. You can apply this rule successively until $u_{(Mod\ v)}$ reaches zero, at which point the latest value of u is the HCF of the original pair of integers.

Listing 2 shows a Pascal implementation of Euclid's algorithm. One of the statements within the function is a call to the function itself, albeit with smaller arguments. When one of the arguments eventually reaches zero, each called function will exit, ultimately returning the required value to the highest level. This is recursion.

Recursion is made possible by the use of stack-dwelling variables. In certain languages when a function or procedure is invoked, all the variables that are local to the caller are pushed on to a stack. The called routine can then create its own local variables without conflict. When the called routine exits, its own local variables are lost, and those of the caller are restored from the stack. Of course, this will work just as well if the called procedure happens to be the same as the caller.

Languages that support stack-dwelling variables and therefore recursion include Pascal, C, Lisp, Logo and Modula-2. Recursion is not possible in standard Basic or Fortran, where all variables are global.

When writing recursive procedures it is easy to overlook the fact that there must always be some condition that terminates the process. In the HCF example, it is the test for where v is equal to zero. Without it the procedure would keep calling itself until the stack grows to the point at which it fills available memory and then the program crashes.

The use of the stack means that recursive programs will normally require more memory than their non-recursive counterparts. While some recursive routines like the HCF program will run much faster, others will not. The main advantage of recursion is not efficiency but rather the means of writing highly compact and easy-to-follow programs. In certain applications, such as the analysis of tree structures, programming can get very sticky without recursion.

Saving space

In theory, you can reduce the stack space by using tail-end recursion. If the call to the lower-level procedure is the last action of the caller before exiting, the caller no longer requires its local variables and these do not need to be pushed on to the stack. This is fine in theory but I wonder just how many compilers are intelligent enough to detect tail-end recursion and to act accordingly.

Another example of recursion can be found in C A R Hoare's Quicksort algorithm, first published in 1960. Not only is this one of the most popular of the general-purpose sorts, it is also a demonstration of recursive techniques. The first step in Quicksort is to pick an arbitrary member of the list to be sorted and to place it in such a position that it has a higher value than all elements to its left, and a lower one than all those to its right. This entry is called the pivot.

To find and place the pivot, you start with an element v. Hoare suggests selecting v at random, while Sedgewick uses the right-most member of the list. You then scan from the left of the list until you reach an element that is greater than or equal to v, and scan from the right looking for one that is less than or equal to it. You swap these two elements and continue scanning from the points where you left off. The position at which the pointers meet is the destination of the pivot, so you swap the element there with v.

The original list may now be thought of as two sub-lists, one on either side of the pivot. Although they are not yet in sequence, all members of each sub-list will remain on their respective sides of the pivot. Therefore the last step is to sort each of the sub-lists separately, which you do with a recursive call to Quicksort.

Listing 3 shows Sedgewick's implementation of Quicksort for an integer array

a[l..r]

The routine is slightly different from the earlier example in that it includes not one but two calls to itself, one for each of the two sub-lists.

A final example of recursion is provided in Kernighan and Ritchie's *The C*

(continued on next page)

```
100     'Routine to find the HCF of 2 positive integers, U% and V%
110     IF U%<V% THEN
                T%=U%
        ELSE
                T%=V%                   'T% is lower of U% and V%
120     WHILE (U% MOD T%<>0) OR (V% MOD T%<>0)
                T%=T%-1:
        WEND
130     RETURN '                        'T% is now HCF of U% and V%
```

Listing 1. Non-recursive method of finding HCF, in Basic.

```
function hcf(u,v:integer): integer;
        begin
        if v=0 then hcf:=u
                else hcf:=hcf(v,u mod v)
        end;
```

Listing 2. Faster HCF routine, using recursion in Pascal.

(continued from previous page)

Programming Langauge, where it is used in a C routine printing a decimal representation of a binary integer. The problem with binary-to-decimal conversions is that they are based on successive divisions by 10, and therefore produce the low-order digits first, which is the opposite of the way in which decimal numbers are printed.

The recursive solution shown in listing 4 is for the routine to call itself to handle all higher-order digits — higher, that is, than the digits being converted in the current invocation — then to print the current digit. The printing takes place as the stack of procedures is exiting, and so is in the reverse sequence to the one in which the digits were generated.

This routine highlights the potential inefficiency of recursion. The first action of the function is to test for a negative argument so that it can output a minus sign and convert the number to a postive one. Unfortunately, this test has to be repeated in every call to the function, despite the fact that it can only ever succeed in the first call.

The opposite of recursion is called iteration, this being the familiar method of repeating certain actions by using For-Next and While-Wend loops. With iteration it is much easier to avoid inefficiencies like the one illustrated in the binary-to-decimal conversion, but the overall coding is nearly always bulkier and more convoluted. Try programming Quicksort without using recursion and you will see what I mean.

```
procedure quicksort(l,r:integer);
        var v,t,i,j:integer;
        begin
        if r>l then
                begin
                v:=a[r]; i:=l-1; j:=r;
                repeat
                        repeat i:=i+1 until a[i]>=v;
                        repeat j:=j-1 until a[j]<=v;
                        t:=a[i]; a[i]:=a[j]; a[j]:=t;
                until j<=i;
                a[j]:=a[i]; a[i]:=a[r]; a[r]:=t;
                quicksort(l,i-1);
                quicksort (i+1,r)
                end
        end;
```

Listing 3. Pascal implementation of Quicksort.

```
printd(n)                       /*print n in decimal*/
int n;
{
        int i;
        if (n<0)  {
                putchar('-');
                n=-n;
        }

        if ((i=n/10)!=0)
                printd(i);

        putchar(n % 10+'0');
}
```

Listing 4. Recursive binary-to-decimal conversion, written in C.

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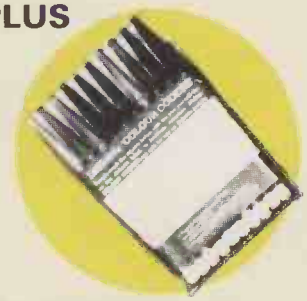

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by Ray Coles

Virtually infinite memory capacity

If you are thinking of installing ever-larger banks of RAM chips you should think again; virtual memory management chips are on the way.

THERE WAS a time when the possession of 48K of RAM memory on your eight-bit personal computer was just about the ultimate social accolade, with only a new Roller or an invitation to a Buckingham Palace garden party capable of inflicting a total eclipse. Sadly, now that this humble columnist has reach such dizzying heights, any such size comparison carried out in public brings forth only guffaws and sniggers from today's social elite, who now seem to be universally endowed with 256K IBM PCs or 512K Apple Lisas.

Pub chat

However, being a hardware man does have some advantages, even on a tight budget. Right now, deep in the bowels of Microchip Mansion, I am hard at work designing the ultimate pub-chat exterminator: a personal computer with virtually infinite memory. The ploy is simple, I shall wait until the assembled company have all indicated the precise size of theirs, then look the person with 4Mbyte straight between the eyes and say: "Er, well mine's virtually infinite actually. . . ."

My secret is based on the use of the relatively simple virtual memory concept. It does not require a second mortgage and the purchase of a tipper lorry full of reject 256K RAM chips.

The virtual memory concept was first introduced in the early seventies for use on mainframe computers. In those antediluvian days even mainframes could not store more than a few dozen Kbyte. In the multi-user time-sharing applications so popular then this lack of memory space could really put a damper on things. So somebody thought that it would be a good idea to apparently magnify the store size and make each user believe they had unlimited memory by using fast disc storage as an overspill area.

By itself, the concept was not so smart because people had been using overlays and other techniques which achieved a similar result in their programs for years. What made the virtual memory concept special was the fact that with this system the user was blissfully unaware that chunks of program were constantly whistling backwards and forwards between store and disc. It appeared that each user had a very large store to themselves.

Graceful recovery

A number of ingredients were necessary to make the virtual memory concept work. A fast-access hard disc was necessary — not a floppy. The CPU had to be designed so that it was able to recover gracefully when it attempted to fetch part of an instruction or data and found that it was not currently resident in store. A hardware system called a memory-management unit was needed to translate the logical addresses used by the program code into the physical address allocated to the user in the store. Finally, special virtual memory operating system software was needed so that when memory faults occurred, the new sections of code could be loaded in from disc and the program restarted with the minimum of fuss.

Don't despair

From this shopping list, you can now see why your Spectrum and other eight-bit micros are not similarly endowed. But do not despair, because the chances are that you will have a virtual memory machine before long, thanks to the giant strides being made by the chip designers.

At the moment the smallest machines commonly available which use the virtual memory concept are in DEC's ubiquitous Vax minicomputer family — at prices which nothing less than a successful bank-job could bring within reach. But the era of the 32-bit microprocessor has dawned and all the contenders announced support virtual memory. Winchester discs which can provide the necessary hard-disc backing store are also here, and prices are starting to fall as disc capacities soar.

Memory-management chips are being made available with all the new processors, and the only thing which seems to be missing is the necessary software in the form of a capable virtual memory operating systems. Such operating systems are certainly available for earlier machines. DEC's excellent Vax/VMS sets the standard here and will be used, albeit in a reduced form, on the microprocessor version of the Vax already announced.

Missing is a virtual memory successor to MS-DOS and 16-bit CP/M, something which can be ported to all the popular microprocessor chips and sold at High Street prices. Perhaps one of the many Unix offspring will come to the rescue, but apart from the great following among the inmates of university computing departments — who are less than objective judges since it is usually made available to them at very low cost — there seems to be little general enthusiasm for Unix.

When the proper combination of ingredients has been assembled in a few years' time, the resulting low-cost machines will represent a leap in capability. The combination of a Motorola 68020 32-bit, CPU and one of the Signetics memory-management chips, known as the Memory Access Controllers, will provide a performance capability equal to, for example, one of the larger Vax machines. So offering the lucky user a virtual address space of up to 4Gbyte.

Multi-user

The problem of who gets to use the family computer first will undoubtedly disappear. Each member will be able to run their own terminal without ever having to worry about who else is logged in. But don't throw your Spectrum or BBC away yet, because they may be just the thing to use as dumb terminals to that virtual memory, multi-user, multi-tasking, super machine.

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by Ben Knox

The quiet revolution

OVER THE PAST YEAR there have been a number of changes in the computing and telecommunications industries which have brought about a revolution in computer communications. The most important change is the liberalisation of British Telecom's policies toward the connection of electronic equipment to the telephone system. For example, transatlantic communications have been made cheaper since BT and other telecommunications companies have set up networks designed specifically for computers to use.

The setting up of the independent British Approvals Board for Telecommunications, BABT, has shown manufacturers that the communications market is not just for the dedicated hacker, and has encouraged them to produce cheaper equipment designed for general use.

Modems at home

Since modems are now appearing in more homes, a number of databases and information systems have been set up. They have features for business as well as home users, including news and share prices, weather reports and teleshopping.

On the amateur side, about 20 bulletin-board systems have been started up by computer enthusiasts. These free systems enable people with the right equipment to send messages to other users, play games and swap programs.

Other than the computer itself, the most important piece of equipment you require when setting up your communications systems is the modem, which enables you to connect your computer to the telephone network. It converts the digital signals from your computer to analogue signals which it sends down the phone line as tones, and converts incoming tones into digital signals which it feeds into your computer. In fact, its name is derived from its function: to modulate and demodulate signals.

There are two types of modem available: hard-wired modems and acoustic couplers. Hard-wired modems connect directly to the telephone system, whereas acoustic couplers connect to a telephone handset. Each type has its advantages and disadvantages: hard-wired modems are more reliable, as they do not suffer from the effects of background noise, and acoustic couplers cannot be used on special telephones such as Trimphones. However, they are often available with rechargeable batteries, allowing them to be used from public telephone boxes, which you may want to do if you have a portable computer.

There are two factors to be taken into account before you choose a modem. First is the speed at which it sends and receives data. A common rating is 300 baud, equal to 300 bits or roughly 30 alphanumeric characters each second.

The speed of modem you require will depend on which systems you intend to use. Bulletin boards usually run at 300 baud, while information systems such as Prestel run at different speeds for transmitting and receiving data. Prestel sends to you at 1,200 baud and receives from you at 75 baud. Modems cannot communicate with each other unless they are running at the same speed. A number of hard-wired modems can run at a number of different speeds, but acoustic couplers can only manage one speed.

The second factor to consider is the mode of the modem. There are two modes available: Answer and Originate. Two modems of the same mode cannot communicate with each other. All systems which you call use Answer mode, because they are answering your call, so it makes sense to get an Originate modem. Many hard-wired modems and acoustic couplers can be switched between the two modes.

Connection

Before buying a modem you must ensure that you can connect it to your computer. Unless designed for use with a particular machine, all modems use an RS-232 serial interface. If your computer does not have an RS-232 then you will need an expansion which provides this facility. You may be able to get a modem which connects to your computer directly through its expansion port, such as the Commodore modem for the Commodore 64 or the VTX-5000 modem for the Sinclair Spectrum.

With one exception, communications software is fairly standard. The main differences between programs are that the more expensive ones provide more convenience features and/or gimmicks. The exception to the rule is the Prestel feature. Prestel systems use special control characters intermingled with the transmitted data to control colour and screen layout. Some software cannot translate these characters into instructions which your computer will understand, so you end up with a mess. If you intend to use both Prestel and bulletin board systems, make sure that the program you choose can handle both.

You will also need an error-free file-transfer facility which allows you to receive programs with none of the errors often caused by crackles on the telephone lines. The most common transfer system is known variously as the Christiansen protocol, X-Modem, Modem 7 and CP/M transfer. Software which uses this transfer system is available for most of the popular micros.

What to look for

Other features to look for are: the ability to send and receive ASCII files to and from the host system which you are calling; the facility to print out what you are receiving as you receive it; and the ability to change the baud rate at which your computer is running.

Finally, before starting to communicate, you need to tell your system which word format to use. ASCII code is used to transfer data passed between computers. In ASCII each alphanumeric character is made up of seven bits, but in communications extra bits are added so the point at which the data of one character stops and another begins can be found, and error checking can take place.

You need to know three parameters to set the word format: whether the number of data bits is seven or eight; whether the number of stop bits for differentiation between characters is one or two; and whether the parity bit is used.

There are two types of parity, odd and even. The computer checks how many 1s there are in each character before it is sent. In odd parity it sets the parity bit to make the total number of 1s an odd number. With even parity, the parity bit is set to make an even number of 1s.

The standard word-format settings for bulletin boards are: seven data bits, one stop bit and even parity. If you use error-free file transfer the settings are eight data bits, one stop bit and no parity.

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>NEXT MONTH

>GAMES

In our annual look at the world of computer games Richard Bartle — who runs the original multi-user Dungeon at the University of Essex — explains why MUDs will replace SUDs, Tony Harrington reports on developments in chess, John Dallman provides an overview of the whole games field, and you get the chance to argue over our list of the top 50 games of all time.

>REVIEWS

Among the hardware on the stocks for next month is the Fujitsu 16 from Japan's biggest computer manufacturer, and the TDI Pinnacle, a super-fast 68000-based machine. Plus, Chris Bidmead reviews Sycero, an interesting new program generator, while Glyn Moody unwraps a package of Sinclair QL books.

>AND MUCH MORE..

Next month, Ben Knox continues his series on communications for beginners, while David Levy provides more insights for the games programmer. In Software Workshop, Mike Lewis explains binary trees and how to grow them.
And there will be the usual news, regular columns, your letters, and lots of free software in Open File.

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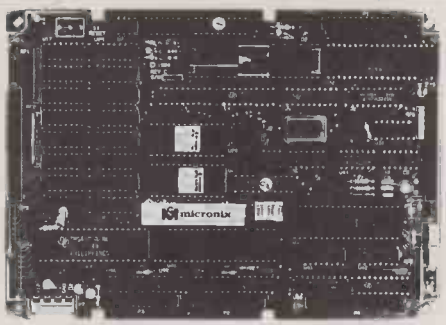

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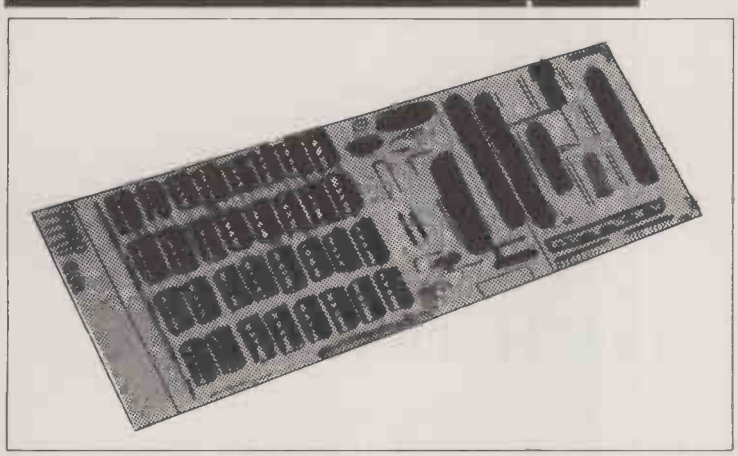

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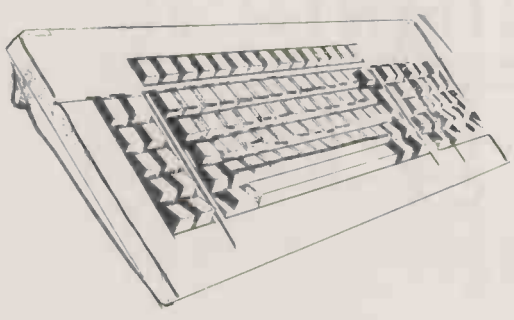

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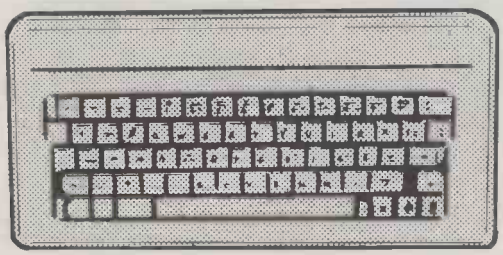

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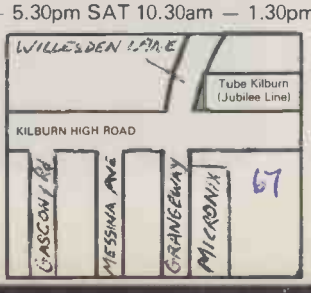

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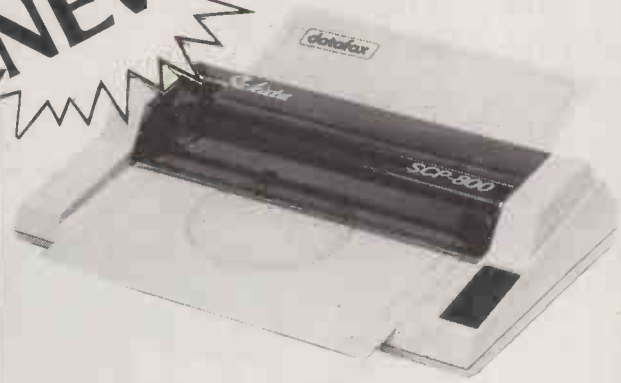

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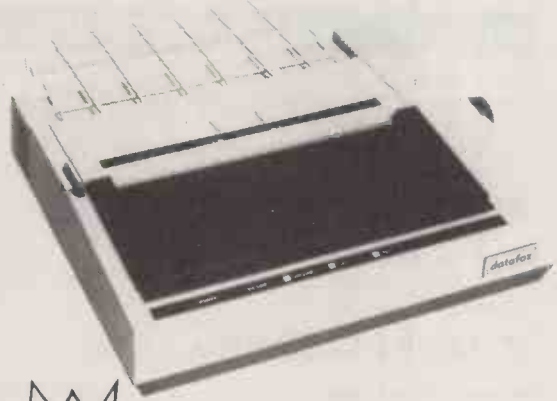

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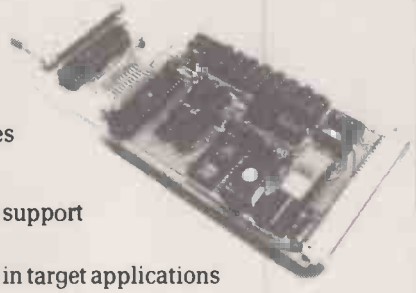

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IBM PC/AT

Jack Schofield reports on his first experiences with IBM's top-of-the-range micro — the one they will all be following a couple of years from now.

Specification

CPU: Intel 80286 running at 6MHz
RAM: 256K, expandable to 3Mbyte
ROM: 64K, including Basic
Discs: 1.2Mbyte 5.25in. floppy-disc drive. Optional disc drives are 320/360K floppies and 20Mbyte hard discs
Operating system: PC-DOS 3
Display: not included; choice of monochrome and colour displays plus adaptor cards as per IBM PC; resolution up to 640 by 200 pixels with up to 16 colours
Keyboard: detached 84-key QWERTY with 10ft. coiled extension and three LED indicators
Sound: single programmable sound channel
Expansion: eight slots on motherboard
Prices: Basic model £2,951; enhanced model with 512K of RAM, 20Mbyte hard disc and serial/parallel adaptor £4,281; prices do not include the display, operating system or VAT
Extras: 320K disc drive £299; 20Mbyte hard disc £1,179; 128K memory expansion £289; serial/parallel adaptor £112; PC-DOS 3 £58; PC Basic 3.0 manual £38
Contact: IBM United Kingdom Ltd, PO Box 41, North Harbour (Baltic House), Portsmouth PO6 3AU

IT DOESN'T seem too long long since a micro was something put together out of a polythene bag full of bits. The screen was an LED display, and anything over 2K of RAM was luxury. Three years ago, the most basic IBM PC itself had 16K of RAM, no disc drives and a cassette port; that was the entry-level system on the U.S. market.

Now here we are with this monster: Intel 80286 CPU with 16-bit data bus, 24-bit address bus and a virtual-memory management system that lets it address a gigabyte — 1,000Mbyte! — of virtual RAM. The PC/AT embodies speed, power, memory and storage beyond the dreams of avarice.

Any minute now some fool is going to say that under PC-DOS it can only access 640K of RAM. Well, the floppy-disc drives only store 1.2Mbyte, the dinky little hard disc only offers 20Mbyte, and so on. The fact is that the PC/AT offers more power to the single user than any single user currently needs. The AT is today's Rolls-Royce of microcomputing.

But the AT also has a quite separate importance in the world of micro-computing. It establishes the IBM standard for the next three to six years, which many other companies are bound to follow. It provides data-processing departments with another neatly designed piece to fit into the jigsaw of corporate computing, between the existing PC and the small minicomputers like the System 34. It provides software writers with a target: they must now transfer their existing packages to the new machine, and write new ones to fit.

The AT thumbnails the future for the rest of us. Remember, a couple of years

ago a 64K CP/M micro cost £2,000 to £3,000 and only businesses could afford them. Now Amstrad is about to put £500 systems of similar power into a large number of homes. Machines with a computing power similar to that of the AT will be widely available, and affordable, within the next five years. And by then there will be the software to exploit them.

The IBM PC/AT is a full 16-bit micro which uses the Intel 80286 chip running at 6MHz. It comes in two versions. The basic model has 256K of RAM and one or two 5.25in. floppy-disc drives. The enhanced model has 512K of RAM, a 20Mbyte hard disc and one or two floppies.

Both versions of the AT comprise only two parts: a substantial system box and a superb keyboard. The screen display is something you need to add, along with the appropriate expansion card. The AT offers the same choice as the PC: a monchrome card to drive the green screen, and/or a colour- graphics adaptor to drive the colour screen.

In spite of rumours to the contrary, IBM (U.K.) has not launched an improved colour-graphics adaptor for the AT. The maximum resolution is still 640 by 200 pixels instead of 640 by 400 or even 1,024 by 1,024. The colour monitor still flickers on scrolling.

Up to date

The system box is even bigger than the standard PC, so many people will take IBM's hint and buy the special enclosure to stand it on the floor. However, the AT looks a lot more up to date than the PC. Floppy discs are now half-height and positioned on the far right. There is a key on the front to lock the system on or off, and two indicator lights: green for power on and red to show hard-disc access.

The system will not boot if the key is locked. When a program is being run — a long calculation, for example — locking the system disables the keyboard so it cannot be interrupted, except by turning off the power, though on the sample reviewed the key did not disable the On/Off switch.

The sound channel has been improved enormously from the thin beeper on the PC. The AT plays a very reasonable tune. A further nice touch is that the fan now has a thermostat, so it does not blast away if your office is air-conditioned.

A look inside the box reveals a huge power supply and a generally well engineered system. In current models all the RAM chips are installed on the motherboard up to a maximum of 512K. As 64Kbit chips have been used, this means two have had to be piggybacked into each socket. In the future, when the price drops, it seems likely that 256Kbit chips will be used instead.

The RAM can now be expanded to 3Mbyte, the physical limit attainable by adding five 512K RAM cards. Under PC-DOS, however, the 80286 chip runs in a mode that simulates the 8086. The maximum real memory that can be directly addressed under PC-DOS is 640K. Any extra RAM can, of course, be used as a silicon disc or RAM disc; DOS 3 provides a new Device command, which allows up to 24 of these to be installed.

The motherboard has eight expansion slots, of which two are eight-bit and six 16-bit. A disc controller is fitted in one, and an input/output board in another. This provides a serial and a parallel port. A display driver card has to be added, so that leaves five slots free.

All the slots are available for 16-bit cards, and have an extra connector for the extra address and data lines. Many existing expansion cards are said not to be compatible with the new system, so do not count on swapping cards over if you are upgrading from a PC.

The standard disc drive is a 5.25in. floppy which holds 1.2Mbyte of data. It does this by spinning faster and writing 96 tracks per inch, instead of 48, on both sides of the disc. Where the first 160/320K drive wrote eight sectors per track under DOS 1, and the 360K drives wrote nine sectors under DOS 2, the 1.2Mbyte disc writes 15 sectors per track under DOS 3.

Obviously the 320/360K drives cannot read or write to the new high-density discs. The new drive can read existing 320K and 360K discs, and it can write to them. Unfortunately it cannot write to them in such a way that a 320/360K drive can read the result. In fact, if you do write to a 360K disc using the high-capacity drive, your 360K drive probably will not be able to read it afterwards either.

(continued on next page)

Keyboard

The AT keyboard is just about perfect. It has the same superb touch and positive action as the existing PC ones, but different key placings. The two Shift keys and the Enter key are now enormous, which makes touch-typing a lot easier. The spurious backslash key has been moved from between the Z and left Shift, and now sits at the top left-hand corner where the Esc key used to be. The Print Screen key has also been moved out of the way.

A new metal ridge now clearly separates the main keyboard from the numeric pad and function keys on the right. This pad is also now clearly laid out for entering numbers. Note how the + key has grown at the expense of Del. The AT keyboard has 84 keys — one more than the PC version. The extra key is marked Sys Req, for System Request. So far it doesn't do anything, but it will probably summon help or be used in mainframe terminal applications to switch from local processing to the host.

IBM has added a panel above the keypad with three green LEDs which light up to show when Caps Lock, Numb Lock and Scroll Lock have been selected. The keyboard now has a 10ft. cable, which may be needed if the system box is stood on the floor. The AT has back legs like the PC keyboard but is thicker and deeper. Like the rest of the AT it is beautifully made. If IBM made a version compatible with the standard PC it would sell.

(continued from previous page)

Anyone who wants to buy an AT and already has PCs should install a half-height 360K disc drive alongside the 1.2Mbyte one to allow for program and data transfer. The review machine was so specified, and this sidestepped the software problems that might otherwise have arisen.

The hard disc is a very fast 20Mbyte model which can be partitioned and divided up into Unix-like directories and sub-directories under PC-DOS. A hard-disc system will normally be set up to boot from the hard disc; this was done with the review machine, and left 21,237,760 bytes of the original 21,309,440 free for use. Start-up is much quicker than with the PC and PC/XT models. It helps, of course, that there is a clock/calendar built into the motherboard so that it already knows the date and time.

There is room inside the system box for a second hard disc, taking the total storage capacity up to 41.2Mbyte. Since the AT can only handle three physical drives this would mean using only one floppy-disc drive. It would have to be the 1.2Mbyte drive; backing up 20Mbyte of hard disc on to 360K floppies would drive you batty.

The new version 3.0 of PC-DOS is required for the AT. DOS 3 will run on other PCs but is not intended to replace DOS 2.1. It adds a number of new features to the operating system: Attrib, Label, Select, Share, Country, FCBS and Lastdrive. In addition, Format, Backup/Restore, Date and Graphics have been enhanced.

Nationality

Attrib enables a file to be made read-only. Select and Country are used when configuring the system for the format of time and date and the keyboard nationality, etc. FCBS enables you to set the number of file control blocks that can be open at the same time.

Country is pretty neat. It uses the three-digit international telephone code, with the default of 001 for the U.S.

```
Country = 044
```

sets the U.K.

```
Country = 972
```

selects Israel, and so on. It sets the date and time format, the decimal separator . or , and the currency symbol. You get a £ sign on both the keyboard and the screen in the appropriate mode.

The documentation has been improved. To the burgeoning dwarf-format manual and reference card, two separate blue books have been added. One, the Users' Guide, provides a much-needed instant guide to DOS, with cartoons. The other, the Application Setup Guide, explains how to set up and use various IBM applications programs. Of course, none of the programs are supplied on high-capacity discs and you may want to copy them across, if possible. There can be up to 16 steps to follow to install, say, VisiCalc in its own directory on the hard disc, so the help is welcome.

Benchmarks

The standard Benchmarks were run under Basica version 3.00, as updated with the AT. All times are in seconds.

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Av.
IBM PC/AT — 80286	0.5	1.9	4.6	4.7	5.2	9.1	14.6	13.5	6.76
IBM PC — 8088	1.3	4.8	11.8	12.2	13.4	23.6	37.6	36.6	17.7
Olivetti M-24 — 8086	0.5	2.0	4.6	4.7	5.2	9.4	14.8	16.1	7.2

The power supply is huge, and there is space for add-on cards running the full depth of the system box.

In other respects DOS 3 seems to be the same as before. There is getting to be a lot of it, though — 34 user files and two hidden files, taking up 253K if you keep it all hanging around. It actually takes up about 14K more RAM. Next year DOS 3.1 will arrive to support networking, though it seems it will be the same in other respects. IBM plans to offer a 3 to 3.1 upgrade kit.

Theoretically the new PC/AT has one of the largest software bases in the world, but it will be some time before most of the packages have been thoroughly tested on the new machine. IBM has already published its own first list of what will run and what will not. Most packages will, though quite a number cannot be on 1.2Mbyte discs and several require small patches. Among the things that are said not to run are CP/M-86 version 1, and the UCSD p-system. No doubt most packages will be fixed quickly, though I hold out less hope for the Microsoft Flight Simulator, which will not even taxi.

The power of the AT makes it a tempting candidate for multi-user operation. However, the 80286 is hobbled by having to run in its 8086 mode, by the 640K limit imposed by PC-DOS, and by PC-DOS's fundamentally single-user nature. If the AT is to become a multi-user machine, it will need another operating system, such as Unix.

IBM has two versions of Unix already, while Microsoft has a third, and they all seem to be incompatible. IBM PC Xenix is a multi-user multi-tasking System III implementation by Microsoft, and it runs only on the AT. IBM PC/IX is a single-user multi-tasking implementation of System III which runs on the XT but not on the AT. In the U.K., Logica also supplies a version of Microsoft's Xenix for the XT. Meanwhile, there seems to be very little applications software about, except for Berkeley Unix 4.2 and similar, while AT&T is busy trying to standardise everyone on System V.

Considering the confusion, the shortage of software and the high prices of what Unix software there is, any end-user who buys the PC/AT as a multi-user machine is crazy. There are many simpler, cheaper and more reliable ways to the same result: a bunch of Z-80 cards in an S-100 crate is but one example. The IBM System 34 will not find the AT denting its sales either.

This is not to say that one day the PC/AT will not be an extremely useful and economical way to buy a three-user system to run applications software. But that day is not now, not this year, probably not next year, and maybe not the year after.

To that extent the real future of the AT depends on software writers starting to exploit the chip and its facilities, such as the virtual-memory management. This was also the case with the original IBM PC, of course. Rapidly converted eight-bit CP/M software often ran slower on the PC than it did under CP/M-80. It is only after three years work by thousands of software writers that we have come to wallow in the volume of PC packages now available. The PC/AT starts off better than that, thanks to its existing compatibility with the IBM PC. It is such a luscious machine that software writers will probably be only too keen to perform the same miracle again.

Conclusions

- **The PC/AT is a delight — it's wonderful, it's bliss. It's even cheap. The extra speed it has over the PC and PC/XT may make your time more productive, but you'll probably spend the few seconds saved drooling over the damn thing.**
- **The AT's best features are the keyboard and the super-fast hard disc. They should be made available for the full IBM range.**
- **The colour-graphics adaptor lets it down. The colour is lovely but the text is not sharp enough and it should not flicker when scrolling.**
- **IBM may claim to have "advanced technology" but the AT is not really all that advanced. It has an 80286, but at the moment it is effectively hobbled. The AT is, however, well thought out single-user technology beautifully applied.**

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SPECTRUM PLUS

The 48K Spectrum has been joined by a restyled model with solid, moving keys, but Jack Schofield wonders if the improvements are worth £50 extra.

DID THE ORIC ATMOS impress Clive Sinclair? Was he amazed by the rejuvenation of the Atari 400 when it became the 600XL? Whether there was any influence or not, the Sinclair Spectrum's face-lift is of the same type.

With the Spectrum, the improvements are less pronounced. The most obvious and most important one is the substitution of a QL-type moving-key keyboard for the rubber pads of the original. The new keyboard even includes a space bar.

Another improvement is that hinged legs have been provided at the rear of the case to tilt the Spectrum Plus to a good typing angle. They are nicely made — and even have pads on the bottom — and represent a vast improvement on the useless feet supplied with the QL.

There is one enhancement: a tiny Reset switch has been added just under the rim of the keyboard. It is just like the one on the QL, except that it is on the other side of the casing. There are also a few improvements that only become evident when the Spectrum Plus is used.

The sad fact is, however, that the new machine is not a revamped Spectrum. It is basically the same Spectrum, the same old single-board Z-80 micro, in a new box. Where Atari redesigned the board and Oric debugged the Basic ROM, and where both transformed their keyboards, Sinclair seems to have spent most effort on redesigning the casing.

This represents a missed opportunity. It would have improved the machine a lot to have the option of putting the sound out through a TV set. It would have been nice to have a Basic smart enough to recognise a typed keyword, to have an On/Off switch, or a built-in joystick port.

Is it worth it?

Sinclair will continue selling the old-style 16K and 48K machines, so the arrival of the Spectrum Plus poses only two questions. First, what is the new keyboard and casing like? Second, is the change enough to make the Spectrum Plus worth £180?

The new QL-like keys cover the entire area of the keyboard, so they cannot be labelled on the casing, as they are with the old Spectrum. This means each key cap has to carry up to five legends. They are all marked in white — the colour coding has gone — so it is difficult to tell what's going on. It took me about five minutes to type in the one-line program

```
10 Beep 1,1: GO TO 10
```

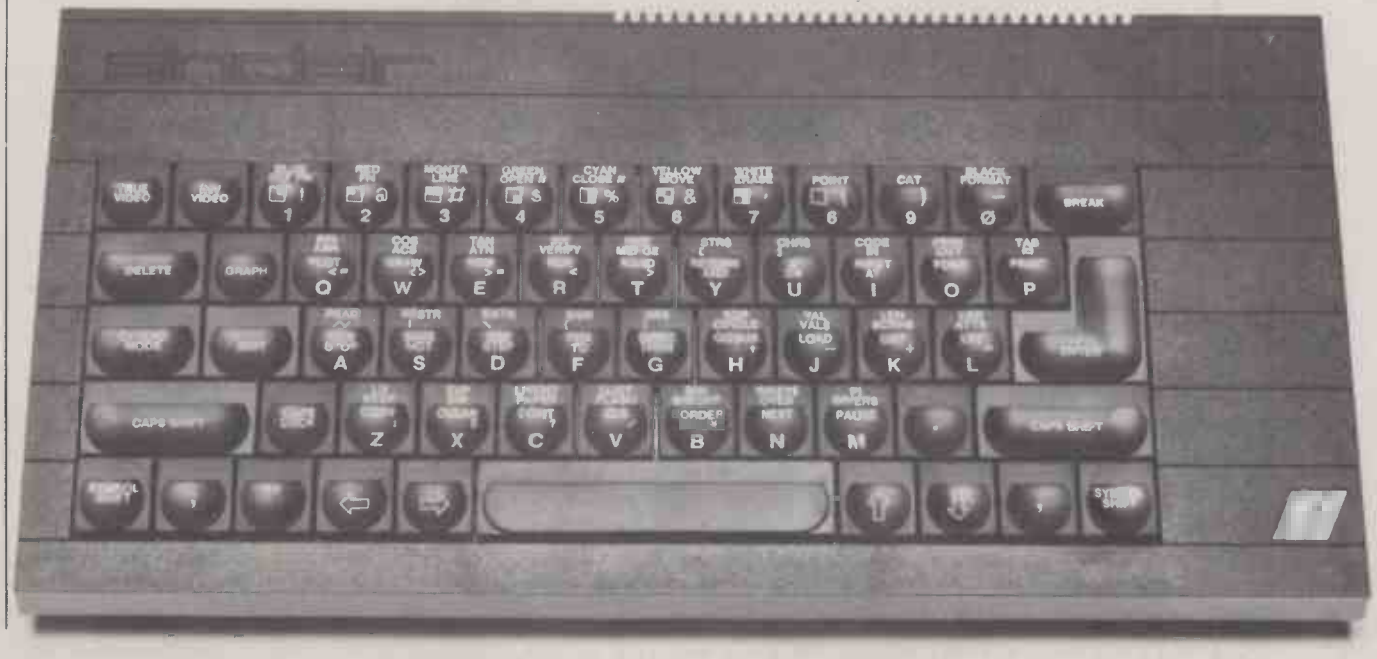
I hope it gets quicker with practice.

Where the old 48K Spectrum had 40 rubber keys, the new Plus has an amazing 58. Break and Space are now separate keys, with Break in the top right. The Plus has a space bar fully 3.3in. long. There are two Caps Shift keys, instead of one, and a new Caps Lock key. There are two Symbol Shift keys instead of one. True video, Inverse video, Delete, Graph, Extend Mode, Edit and the four cursor-control arrows all now have their own keys. Finally, four punctuation marks have been given keys: the full stop, comma, semicolon and quotation marks. Keys may have unmarked functions: for example, you can still delete using Caps Shift-0 instead of the Delete key.

The placing of some of the keys is bizarre to say the least. Typists will be driven crazy by the semicolon that appears near the bottom left-hand corner of the keyboard instead of under the little finger of the right hand. The key that does fall under that little finger is the huge Enter key.

This key placing makes a complete nonsense of the whole arrangement. It destroys any pretence that the Spectrum Plus can seriously be considered as a useful micro like the Acorn BBC, Atari 800XL and Commodore machines.

I do not believe that anyone with anything like a full set of marbles could



possibly have designed this keyboard layout deliberately. Perhaps the review sample's layout is intended to be a gigantic practical joke. Perhaps the physical design of the keyboard was fixed, and they had to fit the letters on as best they could. Perhaps the layout is designed for nine-finger typists.

It must be stated clearly: the Spectrum Plus keyboard represents a massive physical improvement on the original. Having said that, anyone who launched a new machine with this keyboard and its layout would be laughed off the streets.

The new casing is extremely rigid, well made and well finished. The rubber pads on the bottom are now securely anchored, not feebly glued. There are ventilation slots at the back and front to help dissipate heat. On the bottom of the case, more plastic has been cut out around the built-in speaker, and this provides a noticeably louder sound — though still not a really loud one.

When you power-on, improvements to the video display of the Spectrum Plus are immediately obvious. The screen background is white rather than creamy yellow. The whole display is more stable, and this makes the characters look sharper. And when you start using colour, everything looks brighter, cleaner and better. The same is true when using commercial software.

With general programming, and running the standard Benchmarks, it emerged that the Spectrum Plus, issue 4, is slightly faster than the 48K Spectrum, issue 2. The Plus seems to have no problems running standard Spectrum software. It was also attached without difficulty to add-ons such as the Prism VTX-5000 modem and Protek joystick interface. The Plus ran cooler than the standard 48K model.

However, the keyboard again let the rest of the machine down. For a start, a couple of keys fell off, though they were easily replaced. Worse, there was "bounce", especially on the top row. Press a key once and the desired character sometimes appeared twice. Press a number and the number would appear followed by a 4: for example, if you typed 123 it came out 142434.

The price of the Spectrum Plus includes six programs. They are like the six that are currently being given away with the old 48K Spectrum. The Plus programs are Scrabble, Make a Chip, Chequered Flag, Chess, Vu-3D and the word-processing program Tasword 2. The value of the software is over £50, though you would be unlikely to buy it all if you had to pay for it separately.

The Spectrum Plus comes with an introductory tape and a colourful new handbook. However, anyone interested in programming would be better off with the boring old Vickers/Bradbeer manual from the original Spectrum.

Specification

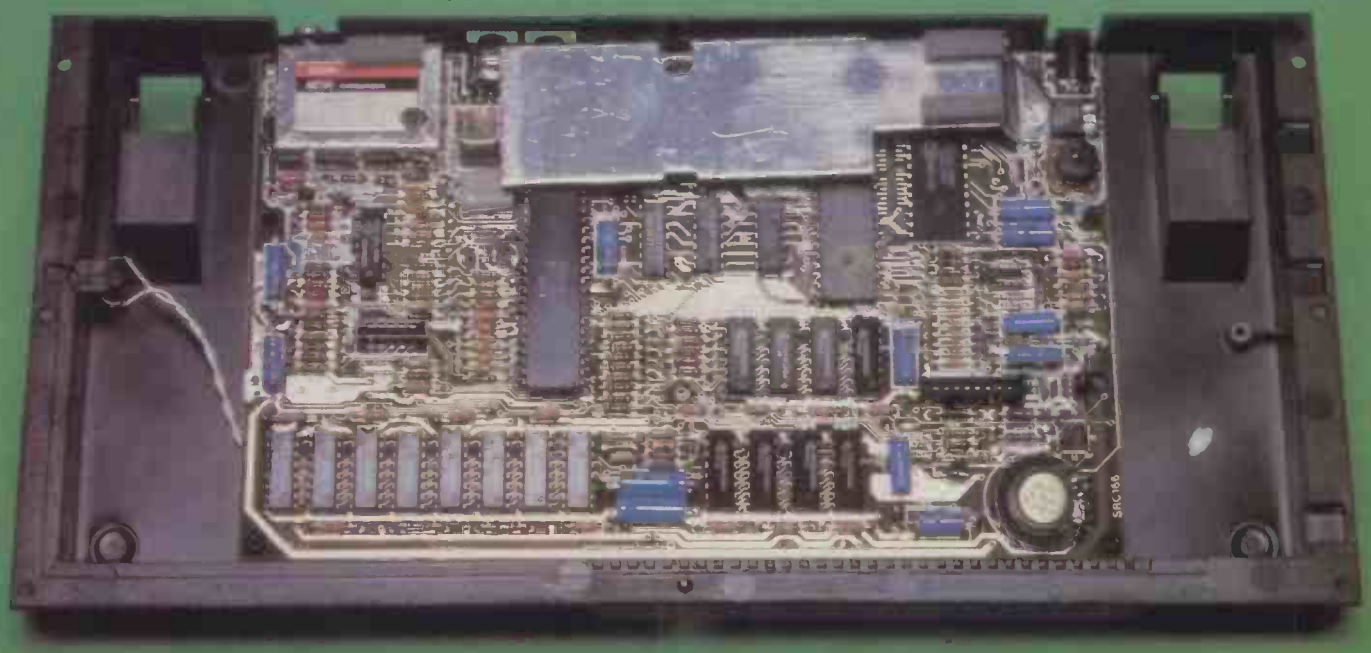
CPU: Z-80 running at 3.5MHz
RAM: 48K
ROM: 16K, including Basic
Keyboard: non-standard QWERTY with 58 moving keys
Display: 32 characters by 24 lines text, 256 by 176 pixels graphics; eight colours
Sound: single tone via small internal speaker
Interfaces: TV output port, cassette interface, edge connector used as printer port and expansion bus
Power supply: 9V d.c. from separate transformer
Other features: single-key keyword entry in Basic; hinged legs on bottom of case
Software included: introductory tape, Tasword 2 word processor and five other programs
Dimensions: 317mm.(12.5in.) by 150mm.(5.9in.) by 40mm.(1.6in.)
Price: £179.95 including VAT
Manufacturer: Sinclair Research Ltd, Stanhope Road, Camberley, Surrey GU15 3PS. Telephone: (0276) 685311

Conclusions

- **The Spectrum Plus is not a new micro, it is a repackaged old faithful.**
- **The new casing is very well done. It makes the Spectrum look more like a proper computer, and worth more.**
- **The keyboard is better, but the layout is a disaster. It is totally unsuited to anything except two-finger typing.**
- **The real improvements in colour, sound and speed are relatively slight, but are attractive to anyone used to an older-model Spectrum.**
- **The new documentation looks nice and introduces the machine well. However, it is not as good an introduction to programming as the old one.**
- **The bundled software is good quality, but unless it is what you want it does not add £50 to the value of the machine.**
- **In hardware terms the Spectrum Plus remains inferior to the Commodore 64, which is around the same price, and the Atari 800XL, which is £10 cheaper. Both of these require special cassette recorders, but are otherwise much better value.**

Benchmarks

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Av.
Spectrum Plus, issue 4	4.5	8.1	20.1	19.5	22.9	52.6	71.0	240	54.8
48K Spectrum, Issue 2	4.8	8.7	21.1	20.4	24.0	55.3	80.7	253	58.5



THE ONE

Data General has packed IBM PC computing power, a 25-line LCD screen and up to 512K of RAM into a truly portable package. Jack Schofield speculates on whether all computers will be like this one day.

Specification

CPU: 80C88 CMOS
Memory: 128K RAM, 64K ROM containing text editor, terminal emulator and diagnostics; 80K of RAM is used by system; RAM is expandable to 512K
Display: 10in. LCD with 80-character by 25-line text or maximum 640- by 256-pixel graphics
Keyboard: 79-key QWERTY with 10 function keys
Discs: 720K 3.5in. disc built in; optional second drive built-in, or external 5.25in. disc
Sound: single tone channel
Interfaces: two RS-232 for modem and printer, expansion bus; optional built-in modem pending BABT approval
Dimensions: 356mm.(14in.) by 305mm.(12in.) by 76mm.(3in.)
Weight: 4.3kg.(9.5lb.)
Other features included in price: built-in clock/calendar, a.c. adaptor, MS-DOS operating system and blank microfloppy discs
Price: £2,490 with single disc drive; £3,675 with two disc drives, 256K of RAM, battery pack and charger
Other options: portable printer, £430; external IBM PC compatible 5.25in. disc drive, £685; 128K memory, £515; carrying case, £85
Origin: Data General, Japan
U.K. supplier: Data General, Hounslow House, 724-734 London Road, Hounslow, Middlesex TW3 1PD. Telephone: 01-572 7455

The LCD screen requires careful positioning.

IN SOME RESPECTS, Data General's The One is not only ahead of its time, it's also ahead of the real capabilities of the technology. It represents an attempt to cram the power of a full-scale IBM PC into a portable micro of the size you can carry in a briefcase.

By "portable", I do not mean transportable, which conjures up visions of the Osborne, Compaq or IBM Portable Personal. The One is portable in the same way as the Tandy 100 and the Epson PX-8: it runs on batteries and you can use it anywhere, although it is by no means as easy to carry around.

Some sacrifices have to be made, the first of which concerns the LCD screen. Though it is full size, measuring about 10in. across the diagonal, it is not as bright or legible as a conventional monitor or flat electroluminescent display.

In truth, The One's screen is not legible even by the standards of the best LCDs, such as that on the Olivetti M-10. As with

the Sharp PC-5000, you have to position the screen and adjust the contrast carefully for it to be usable, and even then it is never comfortable. This is the worst thing about the machine, and the problem is compounded by the absence of a port for an external monitor.

The second sacrifice is relatively minor: the keyboard is narrower than on a desk-top machine. The keys are smaller and the arrangement feels slightly cramped. But it is a good keyboard for the fairly proficient typist, who will adapt easily.

In fact, the keyboard of The One is only four keys short of the full 83-key IBM layout. The major differences are that there is no numeric keypad, and the function keys are across the top. The backslash key has been moved away from the Z to the far right of the same row. Also there are two keys labelled Spcl and Cmd.

The third sacrifice is that the disc drives are 3.5in. Sony-type 360K microfloppies, rather than conventional 5.25in. discs. The discs themselves are extremely good but IBM PC software is usually supplied only in the 5.25in. size.

The fourth sacrifice is that there are no expansion slots into which you can push the usual IBM PC cards. However, The One already has just about everything you are likely to want built on to the main board. It can emulate the IBM PC for both monochrome and colour graphics purposes. It has a clock/calendar card with battery backup. It has two RS-232C ports for driving a modem and printer, and an expansion socket. The American machine reviewed also featured a built-in modem, which was not tested because it is not approved for use in the U.K.

Finally, because it runs from a large lithium battery, The One cannot be operated for very long away from a mains power source. Data General suggests that eight to 10 hours of power is provided by the battery, which was borne out on test.

With these few limitations, The One succeeds in offering desk-top power in a truly portable machine. Data General has foreseen the objections already outlined and offers accessories to compensate. The obvious ones are an a.c. mains adaptor, a battery charger, a carrying case and a portable printer.

Add-ons

Two other add-ons are designed to be left behind in the office. The first is a standard 5.25in. disc drive in a very large box. This enables standard IBM software packages to be loaded and run, or transferred to the 3.5in. format. The extra drive is very expensive at £685, but it does enable software houses to convert their software to microfloppy format easily.

The second accessory is an expansion chassis. It provides five IBM PC compatible expansion slots, as well as a 5.25in. disc drive. This enables the RAM to be expanded beyond 512K. It also has a port to drive an external colour-graphics monitor. A similar port would be a more welcome addition to the machine itself.

On powering-on, The One beeps, then plays dead for 12 seconds while it counts its RAM. After that it goes to the built-in 64K ROM for software and offers five alternatives: Notebook, Terminal, Setup, Diagnostics and Boot DOS.

Notebook is a simple 80-column word processor operated via a menu of function keys. Terminal is a function-key driven versatile communications program. Diagnostics does what it says. Setup enables you to set the date and time, the number of drives in use from one to three, the modem parameters, the printer parameters and the screen mode.

The final Setup option toggles between different keyboard settings. The options are: U.S., U.K., French, German, Swedish/Finn, Spanish, Danish/Norwe, Swiss/French, Swiss/German, Canadian/Eng, Italian, Canadian/Fre, Katakana and No keyboard.

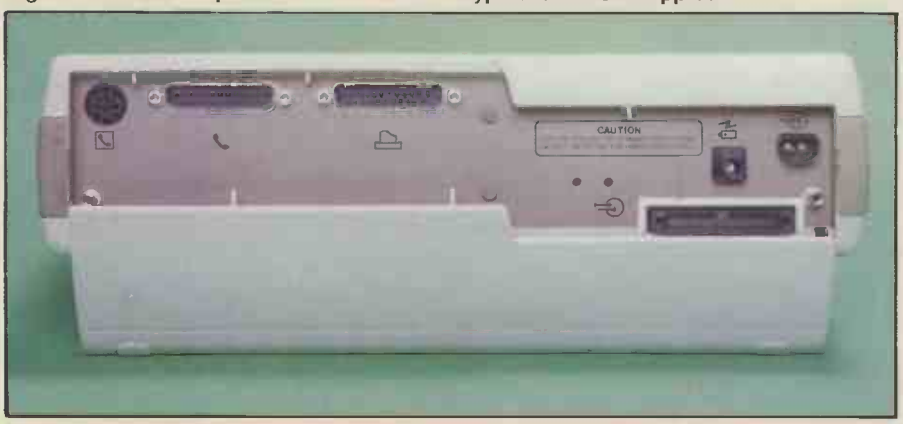
There does not seem to be a built-in Basic, and unfortunately GWBasic was not supplied on the MS-DOS disc. Once you boot a disc under MS-DOS, using The One is just like using any other PC-DOS or MS-DOS machine. The screen and disc operation seemed just as fast as with a normal IBM PC.

I tried dBase II, Volkswriter and the Harvard Project Manager. Apart from the high persistence of the screen making texts illegible during scrolling, no problems were encountered. Software house Tamsys has been signed up to provide other programs on the 3.5in. disc, and a wide range is claimed already. This includes WordStar, Multiplan, Lotus 1-2-3, Knowledgeman, the PFS and Chang ranges, Digital Research languages, the Sublogic Flight Simulator II and the range of Infocom games from Zork I to Seastalker.

Data General also supplies DG Term to enable The One to act as a Data General terminal, and CED Connection to link up to Data General's Comprehensive Electronic Office system.

A rechargeable lithium battery provides eight to 10 hours of power.

The disc drives consist of 3.5in. Sony-type 360K microfloppies.



The One has two RS-232C ports for a modem and printer, plus an expansion socket.

Conclusions

● The One packs the power of an IBM PC with up to 512K of RAM, full-size LCD screen, two disc drives, typewriter keyboard and built-in modem into a 9.5lb. package you can tuck under your arm.

● It is a smart, stylish and very desirable portable micro — if you can afford it.

● The screen is not legible enough for The One to be used for serious work for long periods. Later models can be expected to show improvements.

● The One is genuinely IBM PC compatible but requires either that software is made readily available in the 3.5in. format or else the purchase of an accessory 5.25in. disc at extra cost.

● The One might be a good buy if you have to have portable full-power personal computing. However, a desk-top IBM PC with an Olivetti M-10 and Disk 10 program is likely to be both cheaper and a more serviceable option for most users.

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To the BBC by bus and Tube

Roger Cullis explores some second-processor options for the BBC Micro.

ALTHOUGH the BBC Micro is a very fast machine with comprehensive facilities for driving peripheral devices, it was planned that it would ultimately be the basis of a much more powerful system.

The 6502 which lies at the heart of the BBC Micro is an eight-bit microprocessor, capable of addressing only 64K of memory. Of this, the powerful machine operating system and memory-mapped I/O takes 16K of ROM and a further 2.5K for zero page storage, processor stack and I/O buffers. The Basic interpreter requires 16K and the screen buffer needs up to 20K. As a consequence, there may be less than 10K available for user programs. Acorn's answer to this limitation has been to dedicate the basic computer exclusively to input/output and other housekeeping functions and to provide a second processor for data manipulation.

Ignoring the RS-432 port, which is too slow for this purpose, there are two practical ways of connecting a parasite processor: via the 1MHz bus or via the Tube interface. The latter provides faster communications, since it runs at 2MHz, but at the same time is less tolerant of timing inaccuracies. Most second processors are Tube based, a notable exception being the Torch Graduate.

Torch Z-80

The first commercially available second processor for the BBC Micro was the Torch Z-80, which was launched as a component of the Torch Z-80 disc pack in September 1982. Apart from a change to half-height drives, the current pack is mechanically similar to the original product and comprises a metal housing containing 28-track disc drives and a heavy-duty power supply. A ribbon cable couples the floppies to the disc interface connector on the underside of the BBC Micro.

The second processor electronics are on a double-sided printed circuit board which is mounted inside the main computer. The board contains a Z-80A running at 4MHz, 64K of dynamic RAM, a 2732 bootstrap EPROM and a 6522 versatile interface adaptor which handles communications with the base processor in the BBC Micro. A short 40-way ribbon cable from the Z-80 printed circuit board passes through a slot in the BBC Micro's case and plugs into the Tube connector on the underside. A sideways ROM which contains the BBC Micro housekeeping routines completes the setup.

Torch has done a neat job with the sideways ROM, which has evolved from 8K to 16K to provide system enhancements. The current version, MCP 0.41, contains the routines necessary to interface all the Torch second processors, other than the Graduate, as well as the firmware to control the Torchnet local area network. The operating system for the Z-80 is CPN 0.71, which is configured in the same way as CP/M 2.2 and permits the user to run CP/M software.

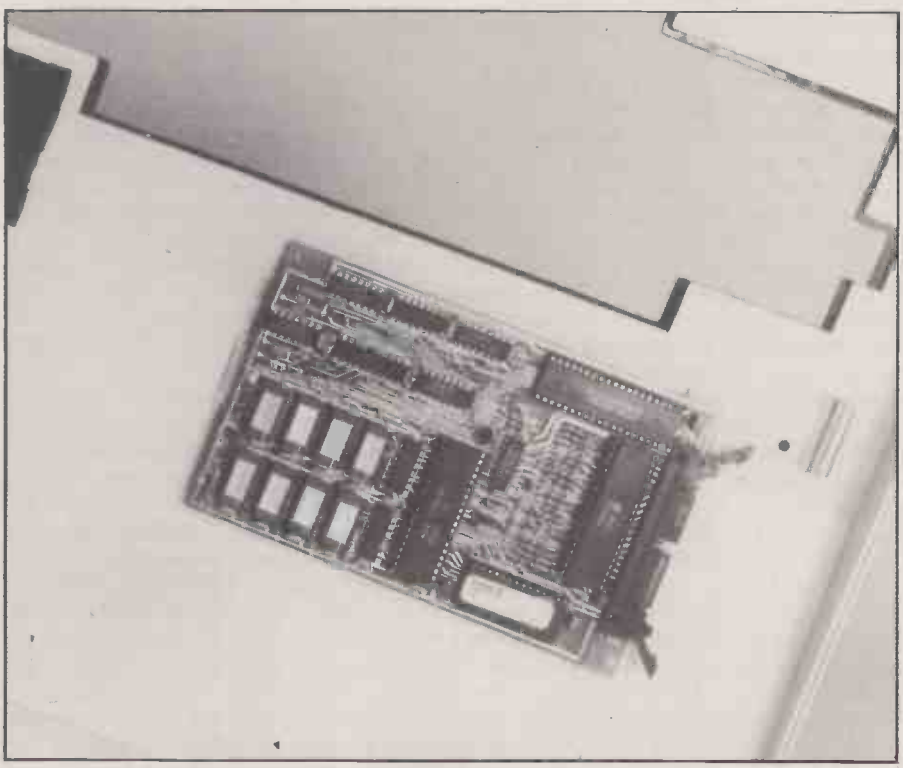
The advantages of having the operating system in ROM are that the cold boot is instantaneous, 63K of RAM is available for user programs and system tracks are not required on the disc. CP/M utilities such as Format, Copy, Input, etc. are normally loaded in from disc. With CPN they are in ROM and instantly ready. BBC * commands are also available from ROM.

Torchnet, which will operate only if the BBC Econet hardware is present, is an enhanced version of Econet which does not require dedicated stations for file and printer servers. Bundled with the Torch disc pack is the Z-80 version of BBC Basic as well as Perfect Writer, Perfect Speller, Perfect Filer and Perfect Calc.

Acorn Z-80 and 6502

In fact, Z-80 and 6502 are misnomers, since the processors are actually a Z-80B and a 65C02. The Z-80B is simply a faster version of the Z-80, but the 65C02 also enhances the instruction set of its predecessor. There are also some timing changes and the famous 6502 page-spanning bug has been removed, together

(continued on next page)



The Torch Z-80 pcb fits under the lid of the host micro.

(continued from previous page)
with the illegal instructions which some people have used as a means of program protection.

Conceptually, the two second processors are very similar. Both are mounted in a narrow case styled to match that of the BBC Micro, both have a power supply with toroidal transformer and transistor regulator on the main circuit board, both address 64K of RAM with a 2732 bootstrap EPROM and both communicate with the Tube through a Ferranti ULA chip.

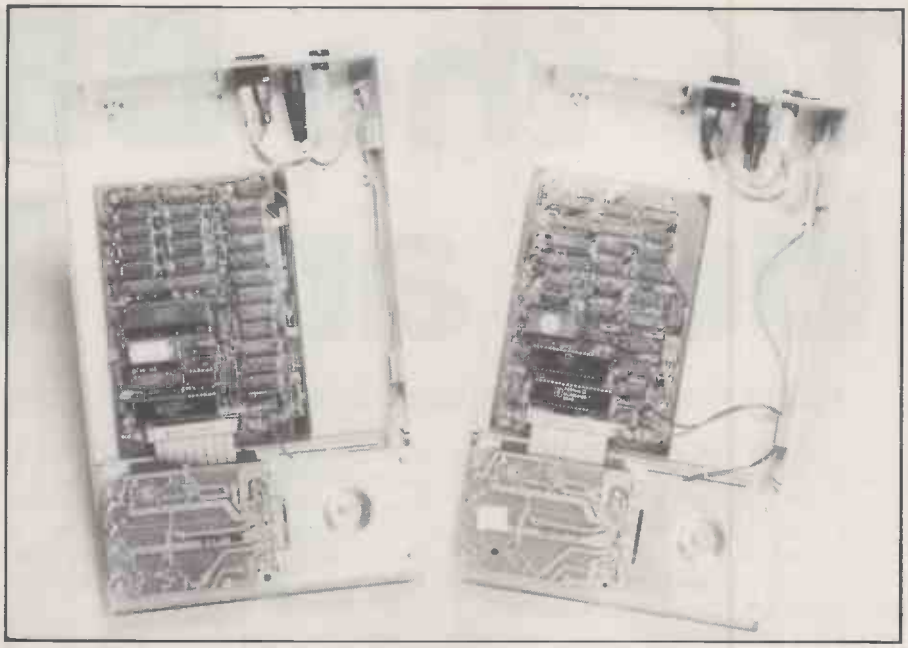
Apart from the differences which are the result of the different processors, the main distinguishing feature is the software which is supplied with the Z-80. To say that there is an abundance is an understatement; a separate box is necessary to hold the 11 manuals and seven discs. Clearly Acorn was not certain of its target market, so it took a shotgun and aimed at everything in sight.

Surprisingly, Acorn chose to make CP/M 2.2 the operating system for the second processor even though the much more user-friendly CP/M Plus has been available for over a year. A possible explanation is that CP/M Plus requires an extra 64K bank of memory to exploit it fully. With the current price of chips it would not have added greatly to the cost, and it would have been a real advantage.

A much more serious drawback is that the accompanying manual is no more than the infamous Digital Research CP/M 2.2 manual in a BBC Micro cover. My advice to new users is to throw it away — having preserved Appendix J, which contains the BBC-specific details — and buy one of the really good books on CP/M, such as *CP/M and the Personal Computer* by Dwyer and Critchfield or *CP/M Primer* by Murtha and Waite.

One particularly interesting aspect of this implementation, is that it includes GSX graphics. GSX-80 is an attempt by Digital Research to establish standards for the software control of graphics devices such as printers and plotters, tracers and light-pens. It is based on a graphics operating system with a structure like that of CP/M itself. Just as CP/M has a Basic disc operating system which interfaces the user program to the physical device drivers of the basic I/O system, so GSX has a graphics device operating system which links the user program to the real devices through the graphics I/O system. Physical device drivers are provided for the VDU screen, modes 0 and 1, and for the Epson and Microline printers.

As well as a Z-80 version of BBC Basic written by M-Tec, Professional Basic is also supplied for applications which require a Microsoft-style Basic. Cobol users will be pleased to see that Acorn has included the industry-standard Cis Cobol written by Microfocus, as well as the two major Microfocus Cobol tools, Animator and Forms-2.



Acorn's Z-80 (left) and 6502 are housed in separate matching boxes.

Moving up through the packages, the next level is a program generator, Nucleus, which can be used by those with no previous programming experience since it is menu-driven. It can create databases, such as records of club members, prepare planning schedules, print reports from accounting programs or design reports to be prepared from programs written by Nucleus itself.

There are three office software packages: Fileplan, described as a database management program or an automated card index; Graphplan, a financial modelling spreadsheet; and Memoplan, a simple word processor. Complementing these is Accountant, which provides simple book-keeping facilities.

Acorn has already established a large user base among small businesses, which will find these packages useful and adequate for many of their needs. However, apart from CP/M and Basic, which are essential components of any system, the other packages will only be of value to a limited proportion of potential users. The others would almost certainly welcome the opportunity to purchase the second processor without paying the £200 premium for the extra software.

Compared with the Z-80, the 6502 second processor is naked and is intended for people who have run into limitations, either of memory size or speed, when running software on the unexpanded BBC Micro. Apart from the DNFS sideways ROM, the only software supplied with the 6502 processor is ROM-based HiBasic, which is BBC Basic assembled at a higher address to give the user a larger amount of free program area when running BBC Basic programs in the second processor.

At present there is not a lot of software which has been specifically written for the 6502 second processor. Bitstick needs it, as does the Level-2 file server software for Econet. Acornsoft has prepared a special version of the View word processor, and a comprehensive macro assembler package, the 6502 Development System, is in the pipeline. This will produce code for the 6502 or the 65C02.

When the BBC Micro was introduced, Acorn issued dire warnings about not accessing the operating system and peripherals directly. All use of the MOS routines should be via specified calls such as Osbyte or Osword. Those who wrote directly to the I/O devices or made Pokes to the screen are now finding that their software is having to be rewritten to run on the 6502 second processor. This is true of a number of sideways ROMs as well as most arcade games which include animation techniques.

Both Acorn second processors expect OS 1.0 or higher and are provided with a voucher for free exchange of earlier versions. They also come with a 16K DNFS filing system ROM which replaces the 8K disc filing system and 8K Econet filing system ROMs, and also contains the interface routines to initialise the Tube for second processor communication.

CMS 6809

The most exciting of the eight-bit add-ons is the 6809 system from Cambridge Microcomputer Systems. It is an engineers' system based on the microprocessor that arrived too late. Compared with the 6502 and Z-80, the Motorola 6809 has a whole orchestra of bells and whistles. Had it been developed sooner it would have been adopted for a wide range of computers rather than just the Dragon and the Tandy Color Computer.

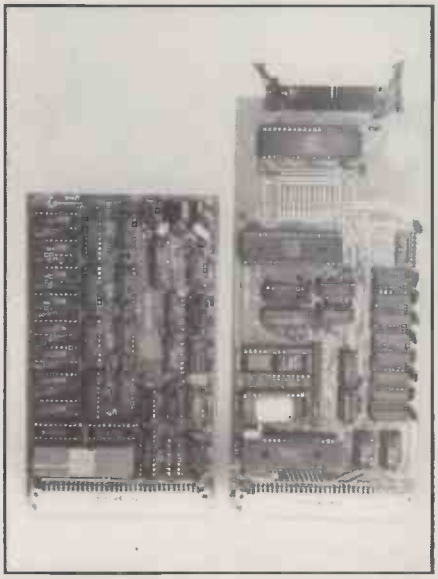
The Motorola 6809 has two eight-bit accumulators, A and B, which can be

CMS mini-rack development system.

combined as a single 16-bit accumulator, D. It has two 16-bit index registers, X and Y; a 16-bit user stack register, U, which is a cross between a typical microcomputer index register and a typical microcomputer stack pointer; a 16-bit hardware stack pointer, S; a 16-bit program counter, PC; an eight-bit direct page register, DP; and an eight-bit condition code register, CC.

The direct page register holds the eight most significant bits of an address and extends the concept of zero-page addressing to any page in memory. It thus allows the programmer to take advantage of short-paged addressing without being limited to the first 256 bytes of memory. Different programs can have different base pages, eliminating the need for multiple use of page zero locations and reducing the possibility of conflict.

CMS sells a 6809 Eurocard which you can mount inside the case of the BBC Micro in the same way as the Torch Z-80 card, but its full potential is only realised as the engine which drives the CMS version of microprocessor Meccano, a rack-based development system connected to the BBC Micro by a trailing umbilical ribbon cable.



CMS colour-graphics card (left) and 6809 card.

Unlike the other second processors in this review, whose main purpose is data processing, the CMS 6809 is mainly used to develop systems which will be used in control applications. The heart of the system is a neat 8in. rack containing a switched-mode power supply and a seven-way buffered backplane which can be used to connect a variety of Eurocard-based sub-systems. As well as the 6809, the processor card itself carries 64K of dynamic RAM, a 4K bootstrap EPROM and a pair of back-to-back 6522 VIAs which communicate with the Tube by way of a 40-way IDC connector. Situated at the other end of the card is a 64-way DIN 41612 connector which plugs into the backplane.

Among the other CMS cards which also plug into the backplane are a high-performance colour graphics card, an IEEE talker/listener controller, a universal controller with either a 6809 or 6502 processor, a memory carrier and a variety of analogue and digital interfaces.

The system is robust. Mechanically it is soundly made and the Tube connector is three or four times as long as those which operate the other second processors without problems of noise or crosstalk. It is even possible to insert and unplug the cards with the system powered up and only experience the occasional crash which requires no more than a reboot to correct.

The colour graphics card is based on the Thompson EF-9366 graphics processor chip and has a 64K graphics memory compared with 20K in the highest-resolution mode on the BBC Micro. It is capable of displaying mixed text of differing sizes, orientations and colours as well as pictorial data. It requires only 32 bytes of system memory.

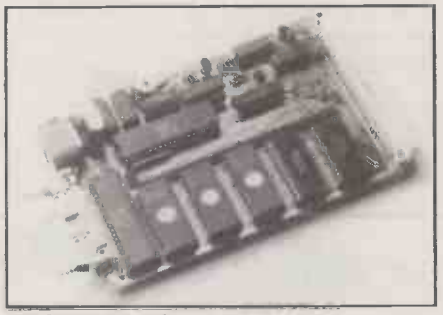
The colour display has three primary colour planes and a luminance plane with a flashing option. Each colour plane is 512 pixels wide by 256 pixels high and is capable of drawing 1.5 million dots per second. In monochrome there are 16 grey levels, and in colour eight colours per pixel with a separate intensity plane. The full ASCII character set is held in ROM and a high-density text mode supports 32 85-character rows in any colour combination.

As this processor is aimed at the industral market, the only software supplied with it is a sideways ROM to initialise the BBC Micro and get the Flex operating system up and running on the 6809. There are a large number of software packages available which will be of immense value to the software development engineer both for the development of 6809 software and for work with other processors. Reflecting the nature of the CMS system as a development tool for control applications, many of the software utilities produce code which can easily be put into ROM. One of these is the editor/compiler/tracer, PL/9. It is a structured language, having procedures and statements such as If-Then-Else, which the user of BBC Basic will find familiar. Lucidata Pascal is another high-level language whose programs can be saved to ROM. Among the low-level utilities is a range of cross-assemblers, disassemblers and simulators for the 6809, Z-80, 6502, 6800, 8080/8085 and 68000.

CMS 6502

A very recent introduction is the CMS 6502 second processor. Based on the CMS universal controller card, it permits the user to select a variety of combinations of ROM and RAM up to a total of 160K. Address decoding is by means of a bi-polar ROM, giving the opportunity to redefine the memory map. Provision is made on the printed circuit board for a real-time clock and battery backup, which are available as an optional extra.

As with the 6809 card, it may be mounted as a stand-alone board inside the case of the BBC Micro, or it may be plugged into the rack-based bus system for further expansion. The card has a 4K monitor ROM which contains the routines necessary for Tube communications and will run all base processor software which is compatible with a 6502 second processor.



CMS 6502 card.

Xcalibur Xmem

Another company looking to the industrial market is Xcalibur with its Xmem, which seeks to marry BBC technology to some of the vast range of peripheral cards that have heen developed for the Apple II. Unlike the other products included in this review, the Xmem is not a second processor. It does not contain a processor chip at all; instead, it provides a 64K bank of expansion memory coupled with five standard Apple expansion slots into which Apple cards can be plugged.

The Xmem is connected to the 1MHz

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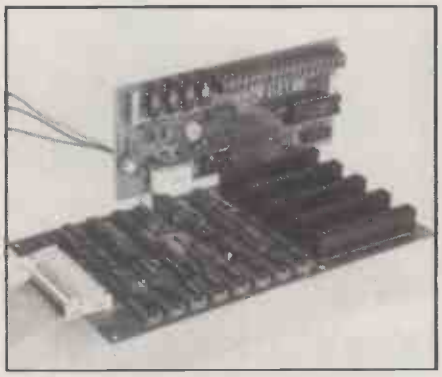
bus and is accessed by calls to Jim, page FD extended memory, the pages being selected one at a time, using the Fred paging register. Power is obtained either from the auxiliary power-connector socket on the BBC Micro or from an independent power supply.

There are a number of limitations on the connection of peripherals, mainly stemming from the passive nature of the device and its alien environment. Since the Xmem has no 6502 processor and no Apple monitor, there is no means of controlling Apple cards with routines in ROM. But this does not present a limitation to Xcalibur, which produces a range of accessories for industrial applications.

Typical of these is the Xad-1 four-channel 12-bit analogue-to-digital converter with a battery-backed real-time calendar/clock. It also controls four channels of isolated relay outputs. The analogue input channels are set to a nominal 0V to 5V range and so can be used to monitor TTL digital lines or contact closures, as well as continuously variable analogue levels. The relay contacts are individually programmable and may be used to actuate external devices, so the card may be used as the basis of a process control system.

Among other cards available are larger and smaller analogue-to-digital converters, thermocouple amplifier modules, counters and digital-to-analogue converters. The Xmem card itself will fit into the standard Xcalibur portable computer case. This will also take a BBC motherboard and the Xcalibur 5in. monitor so that a transportable industrial control system can be assembled.

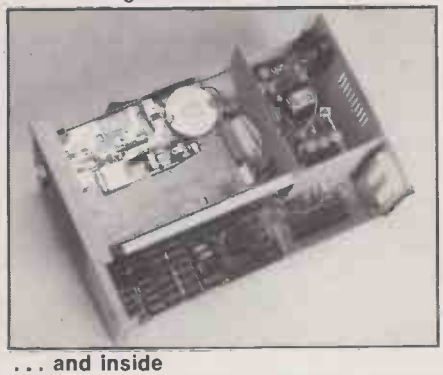


Xcalibur Xmen with I/O converter and clock card.

Torch Graduate

"Add the capability of running IBM software for less than £1,000" was the offer made by Torch when it launched the Graduate. There are four versions, ranging from a single-floppy 128K machine to a twin-floppy 256K RAM model which offers almost complete IBMulation. Using BBC graphics, a 40-column full-colour display can be obtained, which can be extended to 80-column mode by plugging in a standard IBM-compatible expansion card. An 80-column monochrome display is achieved via the BBC display.

The Torch graduate outside . . .

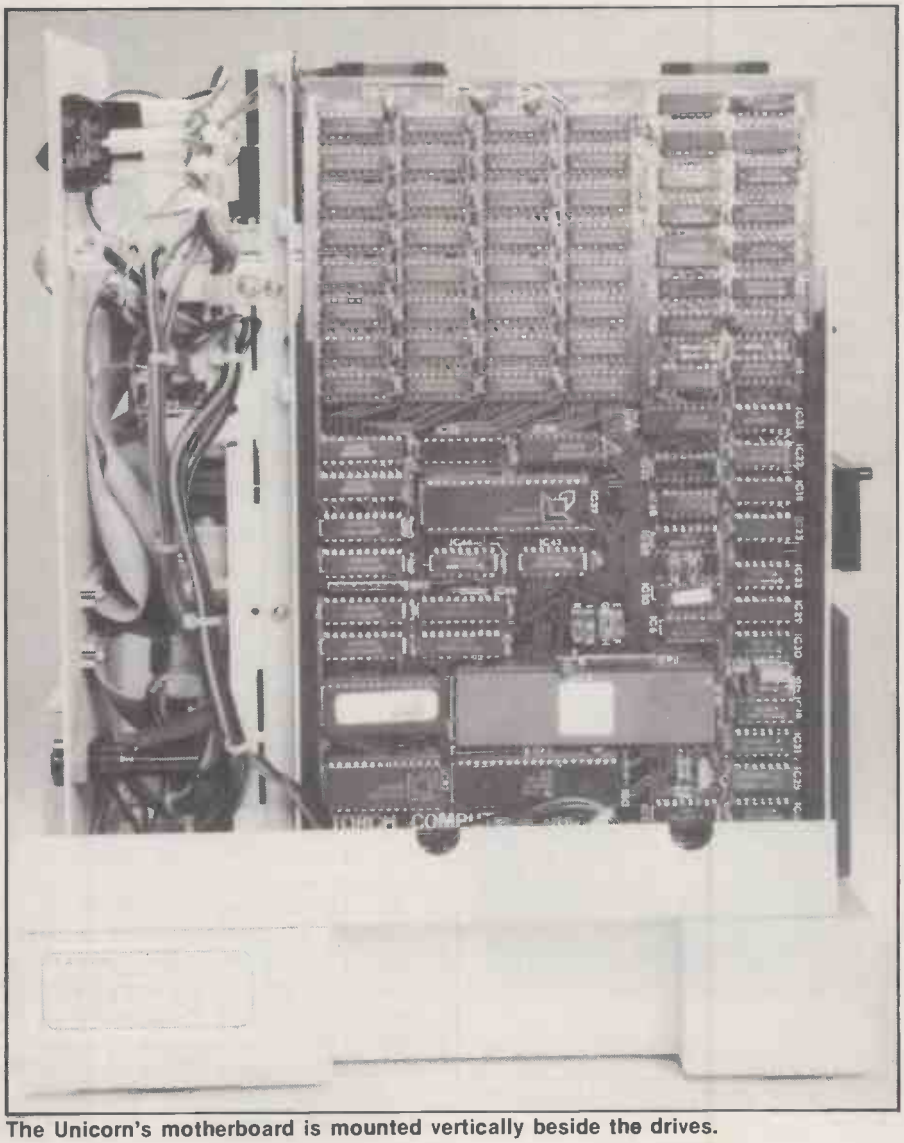


. . . and inside

The Graduate is an exception among BBC Micro second processors as it does not use the Tube to connect its 8088 to the 6502 base processor. Instead, communication is through the 1MHz bus. Another feature is that it does not require the installation of a disc filing system in the host. Its floppy discs are completely self-contained. Two expansion slots are provided for addition of standard IBM expander cards.

Torch Unicorn

By far the most powerful second processor currently available for the BBC Micro is the Torch Unicorn HDP-68K, which comes with a Motorola 68000 16/32-bit processor and a 20Mbyte hard disc and a 400K floppy as backing store. As supplied, there is 256K of dynamic RAM but by changing internal links and substituting 256K chips, this can be

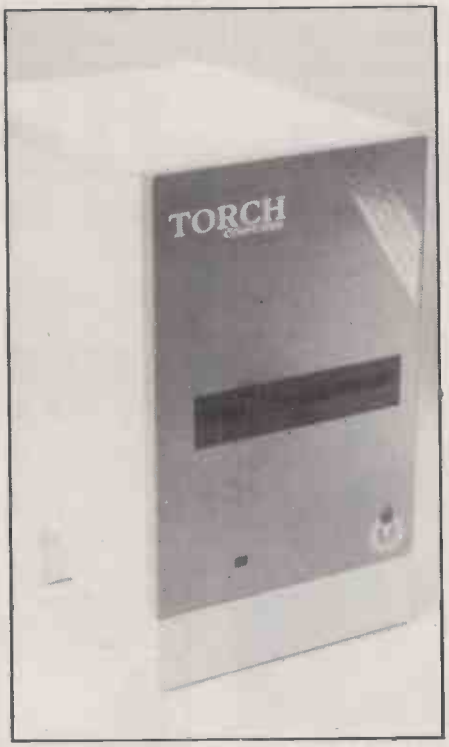


The Unicorn's motherboard is mounted vertically beside the drives.

increased to one megabyte. The main circuit board which carries the processor chip and RAM is mounted at one side, and auxiliary cards are provided for the hard-disc controller and SASI disc interface. A 100W switched-mode power supply and a cooling fan are also squeezed into the case, which measures only 190mm. by 270mm. by 330mm.

The operating system for the 68000 Unicorn is Unix III with the Berkley enhancements. It comes on 24 floppy discs which contain over 200 programs and utilities. There is a full set of supporting documentation including the standard Unix manuals and a description of the Torch enhancements. The complete Unix pack contains a C compiler and editor, the vi screen editor and the csh C shell. Languages available include Fortran 77 and Pascal.

To enable the user to run existing CP/M software as well as Unix, the parasite processor card also carries a Z-80B. Due to the faster memory chips required by the 68000, the Z-80B can be run at 6MHz, rather than the 4MHz of a normal Z-80 second processor. This means that CP/M programs will run 50 percent faster. A memory management unit allows multi-tasking without interference between tasks.



The Torch Unicorn.

Conclusions

● With the second processors covered by this review, BBC Micro owners have the opportunity to enhance their systems to virtually any degree within the current state of the art.

● The availability of the CP/M, Flex, UCSD p-system, Xenix and Unix operating systems together with languages such as Basic in many forms, Pascal, Cobol, Forth, Lisp and Fortran mean that there is the capability of running practically all serious software available for microcomputers.

● It is time for manufacturers to review the practice of giving away software with new machines. Most buyers either have a specific application in mind or have already invested a large amount of time and effort in installing their programs on another machine. They would be far better served by a service which upgrades and configures existing software for the new machine.

	Acorn 6502	Acorn Z-80	CMS 6809	CMS 6502	Torch Z-80	Torch Graduate	Torch Unicorn	Xcalibur Xmem
CPU	65C02	Z-80B	6809	6502 or	Z-80A	8088	68000, Z-80B	None
Memory	64K	64K	64K	Up to 160K in 32K banks of ROM or RAM	64K	128K expandable to 256K	256K expandable to 1Mbyte	64K
Connection	Tube	Tube	Tube	Tube	Tube, disc interface	1MHZ bus	Tube, 1MHz bus, disc interface	1 MHz bus
Operating systems	Acorn DNFS	CP/M 2.2	Flex	DFS	CPN	MS-DOS	Unix 111, CPN, UCSD p-system	Memory-mapped read/write instructions
Expansion	None	None	DIN 41612 connector, optional seven-slot backplane	DIN 41612 connector, optional seven-slot backplane	None	Two IBM PC compatible slots	None	Five Apple II slots
Software	HiBasic	BBC Basic, Professional Basic, Cis Cobol, Animator and Forms 2, Graphplan, Fileplan, Memoplan, Accountant	BBC to Flex linker	Linker to base processor	BBC Basic, Perfect Writer, Perfect Speller, Perfect Filer, Perfect Calc	None	Full Unix suite with over 200 programs and utilities, including C compiler and editor	None
Price	£199	£399	£408	£199	£699	£945	£2,895	£299

Suppliers:
Acorn Customer Services, Cambridge Technopark, 645 Newmarket Road Cambridge CB5 8PD. Telephone: (0223) 210111
Cambridge Microprocessor Systems Ltd, 44A Hobson Street, Cambridge CB1 1NL. Telephone: (0223) 324141
Torch Computers Ltd, Sales Department, Abberley House, Great Shelford, Cambridge CB2 5LQ. Telephone: (0223) 841000
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COMMODORE UTILITIES

Barry Miles suggests that the Commodore Programmers Utilities Package deserves greater recognition.

SOMETIMES a product does not achieve the sort of prominence which it deserves. One such product if the Programmers Utilities Package which has been available from Commodore for some time at £14.95. It represents remarkable value for money for the beginner programmer or anyone who has not stocked up on all the more usual types of utilities. You get programming utilities, graphics, sound and Basic programming aids all on the one disc with a helpful, large and detailed manual.

C64 Menu

The first utility is a Menu program. It creates a sequential file on the disc of the directory in alphabetical order. Typing

LOAD"*",8

will load the first program on the disc, C64 Menu. When it is run you have the choice of loading programs by number rather than by name. Directory entries with a space in front of them are not listed, which is a convenient way of avoiding the listing of machine-code programs which have to be embedded in Basic loaders or are otherwise not suitable for loading directly.

The Change Disk program changes the address which the disc replies to. The old device number is replaced by the new device number, quite commonly 9. It is now possible to run the next program which is called Copy All, copying programs from device 8 to device 9.

Copy All 64 enables you to copy one or more files from one disc drive to another. The 1541 Disk Back-up program allows you to do a copy of the files on to a new disc. You can either copy those areas on the new disc which contain data on the old disc or you can have an exact duplicate of the disc performed. But because this program only loads in 30K of data at a time, a large number of shufflings of discs in and out of the machine takes place.

The Dump program displays a disc on the screen in hexadecimal with 10 bytes per line. It is really a disc monitor which does for discs what a machine-code monitor does for the contents of the machine's memory. The addresses shown on the left of the hexadecimal display are in decimal.

The Load Address program displays the load address of any program file in decimal. This is the number which must follow your Sys call in order to activate the machine-code program. It is convenient to find out the load address of a program. For instance, sprite definitions are saved in program format and have various load addresses.

Machine-code programmers need no introduction to SuperMon, which has been around for a number of years for all Commodore models. It represents a powerful monitor to carry out simple assembly, disassembly, printing of disassembly, hunting for strings, transferring sections of memory and so on.

The Pet Emulator program permits a surprisingly large number of programs written for the Commodore Pet to run on the Commodore 64. The 64 then duplicates the Basic 2 Pet internally and even Pokes to the screen. Other direct-access operations also work properly. CB2 sound is emulated, though sometimes not quite correctly, but other sound effects usually sound better on the emulator than they do on the Pet.

The DOS Support or Wedge program is familiar to most old-timers in the Commodore computing game. However, certain additional commands have been provided which do not exist in the earlier version. In particular, U resets the disc, Q terminates the Wedge program, and % followed by a file name loads the file at its own load address. The left arrow followed by the file name saves the program to disc.

A character editor is provided, which enables you to design your own character set either directly or by modifying the existing character set. This is very pleasant to use, with a large screen display. You edit by using the cursor keys and the full-stop key to turn on the dot under the cursor. The Del key will delete the dot to the left of the cursor and Clr will erase all the dots. Once you are satisfied that you have created what you wanted, you are able to save the new character set on to disc. The disc contains a new character set which you can try.

The Sprite Editor program works on a similar basis giving you a grid of 21 by 24 on which you design your sprites, again with the use of the cursor keys, full stop, space bar and so on. It is very similar in operation to character editor, and when your sprites have been defined, you can save them to disc. It is possible to rotate the sprite through 90 degrees and move it left or right or up and down by one pixel within the overall pattern.

Sprite display is possible so that you can see the various sprites which you have designed. Of course, you can expand sprites vertically and horizontally. You can use high resolution or multi-colour mode for these sprites. Control-V will display the current sprite in motion, and you can also change the speed of movement.

Sound

Sound is catered for on a program called SidMon, which was written by a music expert called Higginbottom, who has recently designed a system to turn the Commodore 64 into a full-sound synthesiser. It is not a music program as such, it enables you to monitor the sound as its name suggests. That is to say, you change the various characteristics Attack, Decay, Sustain, Release, Gate, Ring, Resonance, etc. until you obtain the sound you want. Note the Pokes which caused this sound to use in your own program.

Basic programming aids include a screen editor which permits you to construct input arrangements which are both foolproof and efficient and which operate at machine-code speed. The screen editor also gives additional commands like displaying a program status line at the bottom of the screen, changing colour combinations, editing a single field on the screen, turning the Run/Stop key on and off, and drawing a horizontal line on the screen. These commands can be used within programs.

Conclusions

- **This represents good value. There is something for everybody in this package.**
- **However, one startling omission is any form of Basic programming aid giving the conventional Toolkit commands such as Renumber, Automatic Number, Search and Replace, and Delete.**

1984 COMPUTER OF THE YEAR

EACH YEAR, seven leading computer magazines from different countries join forces to select the Computer of the Year. More accurately, we select four models, with a Computer of the Year being selected in each of four major categories. These are for the home computer, personal computer, portable computer and transportable computer.

This year, for the first time, we have added a software section. The categories are: games, business software, technical software, and tools/systems utilities, etc.

The six magazines which participate along with *Practical Computing* are: *Chip* in Germany, *Chip* in *Italy, Chip Micros* in Spain, *Micro 7* in France, *Micromix* in the Netherlands, and *Personal Computing* in the U.S. Each magazine nominated a winner and a runner-up in each category.

Last year the awards went to the Commodore 64, IBM PC, Epson HX-20 and Kaypro II. Only one of these was to keep its place. Software is even harder to judge than hardware: there are more packages to choose from, and they are even more varied. Also, in this first year of software awards, no one was even sure if the categories were correct. Nevertheless there was no doubt at all about the winning packages.

Practical Computing would like to thank all the magazines that participated in making these awards, particularly *Chip* in Germany for undertaking the organisation. We would also like to thank all the manufacturers and distributors who helped with the loan of equipment, and wish all of them well, even if they were neither winners nor runners-up.

Commodore 64

Home Computer of the Year

Eight different machines secured votes in this category, but the clear winner was — for the second year running — the Commodore 64. This received three first-place votes and one second. The Sinclair QL was second with one first-place and one second-place. The Alphatronic PC was placed third, thanks to runner-up votes from Germany and Italy. The Amstrad received one vote — from *Practical Computing*.

Apple Macintosh

Personal Computer of the Year

In this section, the Apple Macintosh won by a landslide. It received a first-place vote from all seven magazines, although one of these was actually in the transportable category. In second place was the Hewlett-Packard touch screen HP-150, which received four second-place votes. The IBM PC/XT was placed third.

Sharp PC-5000

Portable Computer of the Year

This section was a close-run thing but the Sharp PC-5000 was the clear winner. It received three firsts and one second. The Epson PX-8 was the runner-up with two firsts and one second. The Olivetti M-10 was squeezed into third place with one first and two seconds. The Husky Hunter also received two second-place votes.

Compaq Plus

Transportable Computer of the Year

As with home computers, there was little agreement about transportables, with nine different machines sharing the votes. A narrow victory went to the Compaq Plus, with two first-place votes and one second. The Apple IIc was runner-up with one first and two seconds.

Home Computer of the Year, the Commodore 64.

The Compaq Plus: Transportable Computer of the Year.

Software winners DR Logo, Lotus 1-2-3 and Flight Simulator.

Flight Simulator

Game of the Year

The Sublogic/Microsoft Flight Simulator was the clear winner in this category, with four first-place votes. Zaxxon was the runner-up with two second-place nominations. The Flight Simulator is available for the IBM PC from Microsoft, and from Sublogic for the Apple, Atari and Commodore 64. Datasoft's Zaxxon is available for the Apple, Atari and Commodore 64.

Lotus 1-2-3

Business Program of the Year

The clear winner was Lotus 1-2-3 with four first-place votes. No other program received more than one vote, but Symphony, also from Lotus, was placed first by the Dutch.

Autocad

Technical Software of the Year

Here there were almost as many programs as votes, but the drawing/draughting program Autocad took the award with two first places.

DR Logo

Software Tool of the Year

The votes in this section represent something of a triumph for Digital Research. DR Logo took the award with three first places, while the same company's Concurrent CP/M also received two first-place votes. The other piece of software to do well was Borland's Turbo Pascal, with one first-place and three second-places.

Flight Simulator: clear winner of Game of the Year.

Portable Computer of the Year is the Sharp PC-5000.

Apple's Macintosh: winner of Personal Computer of the Year.

Here comes comms

Chris Bidmead samples the delights of bulletin boards and electronic mail, and explains how you can join in too.

IN 1985 everyone will be doing it. I've been doing it for most of this year, and it has changed my whole attitude to computing. The joy is that the only hardware you need is a computer, a telephone and a modem. Most *Practical Computing* readers will have access to the first two of these, and thanks to the development of dedicated modem chips the cost of the third is plummeting.

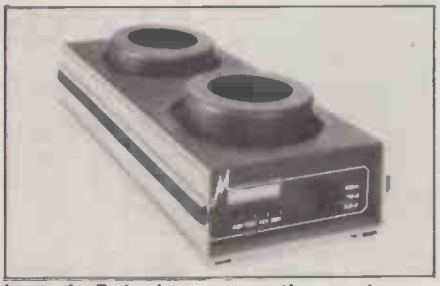
Until recently modems were usually acoustic couplers that took the clumsy form of something which looked like a bed for tired telephone receivers. The telephone handset has to be pushed down into a foam base to make good acoustic connections. Alternatively the modem might be integrated with the computer. The latter type is probably the easiest to use because it can be driven entirely by software. However, it tends to tie you into the manufacturer, since if you change your computer you lose your connections.

The modems I tried out were of the direct-connect type, which are inherently more reliable than acoustic couplers because there is no danger of picking up local noise like the thump of a keyboard. This kind of modem is a small box with three connections. One connection goes to the mains, usually by way of a small power-supply unit, one connects to the computer's serial I/O port, and the third — BT willing — plugs into an ordinary domestic telephone socket.

Probably the best place to start, if you do not mind burning the midnight oil, would be one of the many free bulletin boards dotted around the country. The list in the table was downloaded from London's Central BBS, and compiled by J Wallbridge. It is not up to date, so be prepared to find that particular boards have gone out of business or changed their hours.

Basically, a bulletin board works like its hardware equivalent in the community centre corridor: dial your number, press the appropriate button on your modem when you hear the carrier tone, and watch the text come up on your screen. As you enter you are usually required to identify yourself with name and password, and are then presented with a menu that leads you to the different sections.

One part of the board will be general public messages, which you can read or add to. Another part will give copious



Inmac's Dataphone acoustic coupler.

The Scicon V-21 Buzzbox.

Alpha Datasystems' AD-2426.

help, perhaps with data about the system you are addressing, such as who it belongs to, what the hardware is and so forth. There is usually a section called SIGs, or Special Interest Groups, where you can seek out fellow users of your own particular hardware and/or operating system. There will probably also be a section for games enthusiasts.

Using the bulletin boards tends to be a late, late occupation because between about 6.00p.m. and 2.00a.m. the boards are kept busy by enthusiasts who leave each other messages so inane that you wonder whether their originators are old enough to use a keyboard. Some of the BBs are available during daylight hours, and tend to be more accessible then.

The Sysops, as the operators of the systems like to call themselves, are friendly and knowlegeable, although often too busy to give swift answers to all your questions. If you happen to come across an intelligent correspondent in the public mail section of the board you can usually continue communications via a private mail section.

One of the very best features of bulletin boards is the way you can download software free of charge. Not, of course, proprietory software like Lotus 1-2-3, but hand-crafted Basic programs, C and assembler source code, and general public-domain utilities.

CP/M users are particularly lucky in this respect. There is a deal of garbage among the CP/M User Group freebies, but I collected the following gems during my investigations of Chiltern, South West, London TBBS, Liverpool and other boards:

- A terminal-emulation utility for communication with BBs and directly with other computers. As well as text transmission, binary files can be transferred using standard CP/M Christiansen protocol error-checking techniques.
- An alternative to Sterm by David Back with some rather friendlier features.
- An indispensable utility that lists the names of files on the current disc and at the touch of a key allows you to read them, delete them, rename them, copy them, or mark a selection of them for mass transfer or deletion. NSWP also has a built-in text compression/de-compression algorithm for archiving files.
- A general-purpose disc utility by Ward Christiansen, of the protocol fame, that allows you to dump and edit the sectors of the disc directly. It is a valuable bug fixer for the experienced CP/M user and, for novices, a sure-fire way to destroy your software.
- An upgrade of CP/M's Console Command Processor, the part of the operating system that deals directly with the user. Gary Kildall designed it starkly, always meaning users to remodel it on friendlier lines. ZCPR is a distinct improvement. It is highly recommended, but you need to know a little about assembler and CP/M to put it on your system.

With free bulletin boards, you might wonder why anyone would need to pay £100 down plus £10 a month minimum for the privilege of using electronic mail

commercially. But people do, as is made evident by the fact that Telecom Gold and its Cable and Wireless rival, Easylink, are both expanding rapidly.

Electronic mail

The first big difference is that you usually get on to Gold or Easylink immediately. Whereas the typical free bulletin board runs on a dual-floppy micro with an autoanswer modem, the commercial systems are housed on heavy super-minicomputers and mainframes — timesharing so that everybody gets a look in. Gold and Easylink are both on the Packet Switchstream system, so you can dial into them from anywhere in the world at local rates.

Also, they are a serious alternative to phoning or writing letters. Phoning has the big disadvantage that two busy people can go for days on end leaving messages to ring each other back. Letters on the other hand are slow, and often lend an unnatural formality to transactions.

Electronic mail is the best of both worlds. It has an interesting effect on communication style, encouraging a tone that is more jocular and spontaneous than letter writing, but more thoughtful than everyday speech. Provided your recipient checks the mailbox, a message sent at breakfast time can be read before the coffee break. With electronic mail you check your incoming messages in your own time, rather than allowing a phone call to interrupt you.

Of the two, I spend far more time with Telecom Gold. Easylink is less verbose, probably because it is designed around telex terminals rather than microcomputers — or so I guess from the shoals of Linefeeds it sends at any excuse. They seem to be intended to help telex machines advance their hard copy into view, but this is unnecessary and slow on a micro.

Unlike Telecom Gold, Easylink does not tell you how long you have been on the system when you quit, although the time is given with every system prompt. Because Easylink has no directory of users it was not easy to find anybody to talk to. Although Telecom Gold has a directory called Gold.Users it is a half-hearted affair, listing people who do not mind being sent junk mail — and paying for the time it takes to read it.

Telecom Gold seems to be distinctly more lively. There are games to play, which are expensive if you are footing the phone bill; stat packages to run; cross-compilers; a database management system which your nationwide team of reps can use to log sales calls; and acres of help text. Easylink is so taciturn it does not even tell you when you have mail waiting until you enter the command /MBX. Telecom Gold signals the number of messages in your mailbox the moment you log on, so it is impossible to miss them.

There are still some distinct advantages to Easylink. For low-volume subscribers it is probably cheaper, and there is no big initial payment. With the right hardware you can arrange for the system to notify you the moment mail arrives, something that, for all its software embellishments, Telecom Gold does not provide. The clincher for many small businesses will be the fact that Easylink allows you to send and receive telexs. On Telecom Gold you can send them, but at the time of writing telex reception is not yet generally available.

British Bulletin Boards

As at 16.7.84

ACC, closed — (0908) 44262
Basildon Itec — (0268) 22177 (1,200/75 baud)
Basug — (0742) 667 983
Bettesfield RCP, closed — (0948) 875378
Birmingham North — (0827) 288810
Blandford Board, (Oz) — (0258) 54494
Central (PSS?) — 01-928 9111 (1,200/75 baud); (0753) 6141 (300 baud)
Chiltern — (07073) 28723
City Bulletin Board — closed (300 baud and 1,200/75 baud)
Computer Answers Magazine — 01-631 3076 (300 baud and 1,200/75 baud)
Cumbria CBBS* — closed (300 baud and 1,200/75 baud)
Distel — 01-679 1888
Distel Test Port — 01-679 6183 (300 baud and 1,200/75 baud)
Estelle, 300 baud — (0279) 443511
Estelle V-23 Prestel type — (0279) 441188
Estelle V-22 1,200 Full Dup. — (0279) 441222
Hull, Forum 80 — (0482) 859169
Liverpool, Mailbox 80 — 051-428 8924
London CBBS, MG-Net — 01-399 2136
London, Forum 80 — see Wembley, Forum-80
London, TBBS — 01-348 9400
Manchester, O'Donnell — 061-427 3711
Maptel — (0702) 552941
MG-Net — see London CBBS
Microland — see Southern BB
Micronet/Prestel, Enterprise — 01-686 0311 (1,200/75 baud)
Micronet/Prestel, Kipling/Dryden — 01-618 0311 (1,200/75 baud)
Micro-User, Microweb — 061-456 4157
Milton Keynes, Forum 80 — (0908) 631004 (off-line until further notice)
North-East CBBS — closed
Prestel — see Micronet
Rewtel — (0227) 232628 (apparently off-line)
Sheffield — (0742) 754492
Southampton TBBS — (0703) 437200
Southern BB*, Portsmouth — (0243) 511077
South-West — (0626) 890014 (300 baud and 1,200/75 baud)
Stoke Itec remote CP/M — (0782) 265078
Stourport — see West Midlands
Surrey CBBS — (04862) 25174
Wembley, Forum-80 — 01-902 2546
West Midlands, Mailbox 80 — (0384) 635336

*Ring Back System

Databases

Lately I have been spending my nights conferring with a computer in California. It carries Dialog, a collection of databases used by professional researches of all kinds. The thing they all have in common is that they are not paying for the service out of their own pockets when costs can run to $75 per hour, not counting the phone bill.

However, personal-micro users can access a susbstantial subset of Dialog out of peak hours under the name of Knowledge Index. KI is priced for the home user at $25 an hour, which goes a long way when you know what your are doing and can dip in for a quick one-minute search, then disconnect to assess your findings before dipping back again for a second look.

The data in Dialog consists mostly of abstracts from works published in hard copy. Magazines form a substantial part of the material, but there are summaries of books and government papers in there as well. Summaries of newspaper articles can be found under News1 and News2.

The world of the summary and abstract takes a little getting used to. Some summaries are full enough to make sense on their own, but most offer a glimpse only. For example.

A pop crooner tells the royal mom to shake her fanny and she does, before 11,500 people. (Princess Diana at Neal Diamond concert)
Smith, Terry
People v22 p97(2) July 23 1984
CODEN: PEWEDE
illustration; photograph
NAMED PEOPLE: Diamond, Neal-music
DESCRIPTORS: Diana, Princess of Wales-conduct of life

If you need to know more you can book a full copy of the article, which is then sent to you by post.

KI has databases on everything from agriculture to psychology, inevitably with a heavy U.S. bias, although you will find *Practical Computing* indexed in the computer section. Several other companies in the U.K. are beginning to offer databases on similar lines, typically charging a nominal sum of around £25 to register and cover the cost of the instruction manual, then invoicing you monthly for time on the system.

Although many of these databases are now officially open to the public, the firms that supply them are not necessarily geared to dealing with individuals. Often it is almost impossible to find the right person to talk to, as few of the staff seem to understand these new departures. For example, it was a nightmare trying to track down the relevant department inside Datasolve. Yet among other databases, the company handles World Reporter, a

(continued on next page)

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richly rewarding international news archive which currently contains *The Economist,* the AP Newswire, *The Guardian,* the BBC summary of world news broadcasts and the BBC's external services news. It is aimed at the media and large companies but, theoretically, individuals can register.

More readily accessible was Scicon, one of the BP Group of companies. Scicon has a number of databases on-line on public affairs, and I was invited along to one of the regular training seminars to get an introduction to Polis. This is the Parliamentary On-Line Information Service, which was set up for the use of MPs in 1980 but is now also available to external users. The data is held on Scicon's Sperry-Univac mainframe in Milton Keynes, and comprises indexes on almost all forms of parliamentary proceedings. The indexes can lead you into a second database, no less than the full text of Hansard, which is keyed in at the House of Commons and transferred by floppy disc to Milton Keynes on a daily basis.

Scicon also run three other databases. Acompline is the database of the GLC research library, containing material relating to urban affairs. This is primarily an archive service; for news you go to a parallel database called Urbaline, which keeps an updated daily listing index to current articles, journals and papers on the same subject. Finally there is the DHSS library catalogue, indexing books, papers and journals on health care, health planning, social services legislation and so forth.

Modems

The modem conveys signals to and from your computer by turning the digital data into analogue signals using a process known as modulation and demodulation. Hence the name: a modem is modulator/demodulator. An audible tone called a carrier is sent down the line by the modem and caused to fluctuate in frequency, or modulate, as a result of the data it receives at one end. The modem at the other end, working as a demodulator, reads these frequency changes and converts them back into digital data.

I had a chance to try three different modems during the course of my experiments. The first was the Buzzbox, at £75 a neat device not much larger than a cigarette packet. The Buzzbox is a basic simple-to-operate 300 baud machine with no bell tones or 1,200/75 whistles. Two LEDs tell you whether it is on or off and whether it is currently detecting a carrier. The Buzzbox tends to interpret this last point rather broadly, and I found the carrier-detect light unhelpful for diagnosing problems.

It was only after I had run in my second review modem, the Answercall MM-102 at about the same price, that I began to appreciate the value of an accurate carrier-detect light. You can hear the carrier in the telephone earpiece, but on a long-distance line it may be too weak to be meaningful to the modem. The review Buzzbox suffered from this shortcoming, and it was occasionally impossible to contact bulletin boards in the north of England from London — although the carrier-detect light blazed throughout the attempt.

The Answercall modem had no difficulty at all with long-distance lines, and was exceptionally easy to operate. A single three-position switch — Answer, Originate and Off — did all the work, and two lights with the same functions as those of the Buzzbox faithfully reflected the state of the modem. The Answercall worked for several months but suddenly packed up in mid-transmission. This was probably just a one-off fault, judging by the ruggedness of the design. I can certainly recommend the Answercall as a well-made 300-baud modem from a reliable company.

Its demise gave me a chance to put the £200 Master Systems 21/23 on-line. Immediately life became more complicated because setting up one of these more sophisticated modems requires thought and patience. The RS-232 port at the rear of the 21/23, for example, requires pin 20, Data Terminal Ready, to go high before it will work, which implies an extra line between your computer and the modem. You can bodge it by connecting pin 20 to another high pin, and the 21/23 provides pin 24 for this purpose, but you need at least a soldering iron and preferably a breakout box like the Duplex Sussbox.

Using a genuine handshake line from the computer allows you to switch off the transmission remotely. This is not always an advantage: one corollary is that if you have to reboot the computer in mid-transmission, as when the Sterm program fails to download a data fail in CP/M mode, the modem will instantly disconnect you.

The front panel of the 21/23 has a handsome row of five LEDs to keep you in touch with the state of the RS-232 line. My first reaction was that these are pretty but not really essential — as long as it's working who cares if your DSR is high or not. But the lights certainly do help in setting up the system, and I found it reassuring when collecting a file from a remote bulletin board to see the RX and TX lights switching in and out.

The 21/23 will not allow itself to be switched to data reception by pressing the Data button until it detects the presence of a carrier at the other end. Conversely there is an auto-disconnect feature: when you hang up or the remote carrier tone stops, for some reason the modem waits for about 15 seconds and then disconnects of its own accord.

You have to be careful with this feature because as long as the DTR line is high the modem stays live. Buried deep in the manual is the important information that the 21/23 is auto answer, meaning it responds automatically to incoming calls by opening the line and switching on the carrier signal. This is very useful if you are running a bulletin board, but if the 21/23 is wired to a line normally used for voice you could lose a lot of calls. So you either have to unplug the power supply when the modem is not in use, or make sure your computer turns off the DTR lines.

The 21/23 is so called because it caters not only for the 300-baud V-21 protocol but also for the 1,200/75-baud V-23, as well as allowing you to use half-duplex 1,200 baud, a useful method of moving data fast between individual micros that have the necessary special software. Of course, 1,200/75 baud is the protocol used for Prestel, and allows data to flow relatively quickly in one direction without the complication and expense of using multi-plexing techniques. I found it indispensable for downloading large chunks of text, as when accessing Knowledge Index. The snag is that 75 baud out is painful for a reasonably proficient typist because you have to type slowly. I much preferred 300/300 baud for most of my modem transactions.

The Master Systems 21/23 seems to be designed on the assumption that changing between protocols is not something you are going to be doing regularly. The mode-change switch is a fiddly thumbwheel buried around the back of the machine. It requires you to memorise or have to hand a table of modes, since all the thumbwheel offers in way of guidance is a set of numbers from 1 to 10, some of which are non-functioning.

Conclusions

● Computer users had better reconcile themselves to heavier phone bills if they want to stay in the game. Comms is definitely going to be the flavour of 1985.

● Bulletin Boards are friendly and free, and an excellent way to get speedy advice about your computing problems — and others, because at least one British BBS has a lonely hearts section. Although a lot of the messages are mindless garbage you can get excellent software; unfortunately the best BBSs are often engaged.

● Telecom Gold and Easylink are nearly always on-line and are rapidly becoming the civilised way for busy people to communicate. Computer businesses like Acorn, Ashton-Tate and System C offer consultancy over the line, but so far have not proved very consistent in the regularity of checking for messages.

● On-line databases are still a series of ponds rather than one big pool of information. The scientific approach to data retrieval needs to be supplemented by your own intuition. Once you know what you are doing the price of retrieval compares very favourably with manual systems, but at anything from £25 to £50 an hour you cannot afford to waste time.

THE RIGHT TOOLS FOR THE JOB?

If you've been looking around for business software, you'll probably know all about the latest gadget. It's called "integrated software". A little bit of everything, crammed into one do-it-all package.

But if you're really serious about running your business, you'll know how important it is to get the best possible tool for every job.

That's why we developed Smart Software. The Smart Word Processor, the Smart Spreadsheet with Graphics and the Smart Data Manager are all state-of-the-art, fully-fledged packages in their own right. On their own, they match the best. Yet together, they integrate totally in every way to form a complete software system.

If you think your business might need something a little more powerful than the latest all-in-one software gadgets, you're in good company. A group of America's top corporate decision makers recently voted Smart Software the overwhelming victor in an integrated software showdown that included Lotus Symphony™ and Framework™ from Ashton Tate.

Call one of our distributors now for more details about Smart Software. It could be one of the smartest moves you'll ever make.

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Edgbaston Birmingham B15 3DP West Midlands
Tel: 021-455 7000 Telex 336874

Paradigm Southampton House 192-206 York Road
London SW11 3SA Tel: 01-228 5008 Telex 8954575

MBS Soft Ltd Unit A Horton Trading Estate Stanwell Road
Horton Slough Berks Tel: 02812 4515 Telex 848945

Smart Software

from Innovative Software Inc.

Smart Software is a registered trademark of Innovative Software Inc.

● Circle No. 119

Eight circles

Mark Callaway's graphics program for the BBC Micro compares the speed and accuracy of several circle drawing algorithms.

THERE IS no one algorithm for drawing a circle guaranteed to be fastest under all circumstances. Which is the best choice will depend on how round the circle must be, how quickly it must be drawn, how concise the code has to be, and whether you want to draw an open circle or a solid one.

The Eight Circles program allows you to compare the various options. Five of the algorithms which are programmed contain constants which determine their accuracy and speed. By adjusting them you will be able to find the circle-drawing program that is best suited to your needs.

J E Bresenham's circle algorithm uses the definition of a circle

$$x^2 + y^2 = r^2$$

to find points on a 45° arc of a circle, centred at the origin. The other points on the circle can then be found using the circle's symmetry about the lines $x = 0$, $y = 0$, $y = x$ and $y = -x$. The algorithm was first published in *Communications of the Association for Computing Machinery*, 20 (1977), p.100.

You can thus generate a set of eight points on a circle, centre the origin, as shown in figure 1.

(x,y) (−x,y)
(x,−y) (−x,−y)
(y,x) (−y,x)
(y,−x) (−y,−x)

If you want to draw a solid circle, join each of the pairs of points by a straight line. If you only want to draw the circumference of the circle, plot a pixel at each of the points specified.

Bresenham's algorithm draws a circle in the following way. Imagine you are at point (x,y) in the top right octant of the circle, moving clockwise. If you want to move to the next point on the circle, your choices are point A$(x + \delta x, y)$ and point B $(x + \delta x, y - \delta y)$ — see figure 2 — where δx

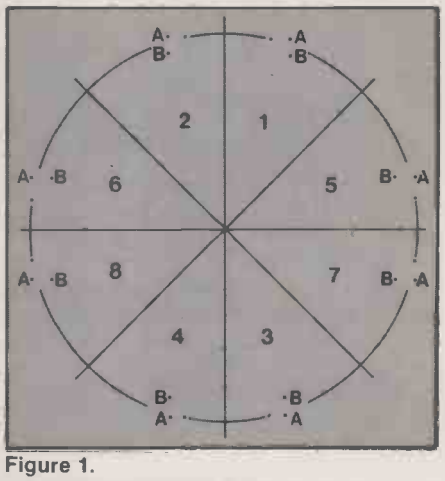


Figure 1.

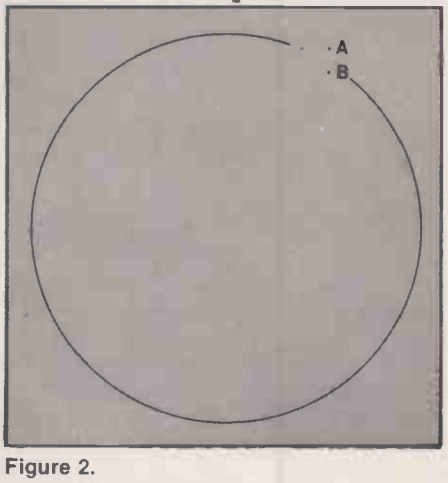


Figure 2.

Listing 1. Eight Circles.

```
   10REM "8 Circles"
   20REM Copyright (c)  Mark Callaw
ay 1984
   30
   40REM Contains code to compare t
he accuracy and the speed of each a
lgorithm
   50REM Note that the calls to PRO
CR (which assesses the accuracy) ta
kes a
   60REM long time.  If you want a
truer comparison of the speed of th
e
   70REM algoritms, remove the PROC
R(....,.....) commands
   80REM and the PRINT"R VARIES....
 statements.
   90
  100MODE4
  110@%=&2020A
  120VDU23,240,60,66,66,126,66,66,6
0,0
  130PRINT'"Circle Comparer by Mark
 Callaway."
  140
  150r=200:min=1E6:max=-min
  160R%=200:XC%=220:YC%=220
  170PRINT''"BRESENHAM"
  180A=TIME
  190X%=0:Y%=R%:D%=6-Y%
  200REPEAT
  210PROCR(XC%+X%,YC%+Y%)
  230PLOT69,XC%+X%,YC%+Y%:PLOT69,XC
%-X%,YC%+Y%
  240PLOT69,XC%+X%,YC%-Y%:PLOT69,XC
%-X%,YC%-Y%
  250PLOT69,XC%+Y%,YC%+X%:PLOT69,XC
%-Y%,YC%+X%
  260PLOT69,XC%+Y%,YC%-X%:PLOT69,XC
%-Y%,YC%-X%
  270IFD%<0D%=D%+X%+X%+12 ELSED%=D%
+X%-Y%+X%-Y%+20:Y%=Y%-4
  280X%=X%+4:UNTILX%>Y%
  290PLOT69,XC%+X%,YC%+Y%:PLOT69,XC
%-X%,YC%+Y%
  300PLOT69,XC%+X%,YC%-Y%:PLOT69,XC
%-X%,YC%-Y%
  310B=TIME-A
  320PRINT"TOOK ";B/100" SECONDS"
  330PRINT"R VARIED BY +/- ";(pmin+
pmax)/2;" %"
  340
  350
  360
  370XC%=640:YC%=220:R%=200
  380r=200:min=1E6:max=-min
  390PRINT'TAB(8);"X=SQR(R*R-Y*Y)"
  400A=TIME
  410R2%=R%*R%
  420FORY%=0TOR%STEP4
  430X%=SQR(R2%-Y%*Y%)
  440MOVEXC%+X%,YC%+Y%:DRAWXC%-X%,Y
C%+Y%
  450MOVEXC%+X%,YC%-Y%:DRAWXC%-X%,Y
C%-Y%
  460PROCR(XC%+X%,YC%-Y%)
  470NEXT
  480C=TIME-A
  490PRINTTAB(8)"TOOK ";C/100;" SEC
ONDS"
  500PRINTTAB(8)"R VARIED BY +/- ";
(pmin+pmax)/2;" %"
  510
  520
  530
  540PRINT'TAB(16);"(R Cos"CHR$240"
,R Sin"CHR$240")"
  550r=200:min=1E6:max=-min
  560XC%=1060:YC%=220:R%=200
  570A=TIME
  580MOVEXC%+R%,YC%
  590FORT=0TO6.5STEP.4
  600X%=R%*COST
  610Y%=R%*SINT
  620DRAWX%+XC%,Y%+YC%
  630PROCR(X%+XC%,Y%+YC%)
  640NEXT
  650D=TIME-A
  660PRINTTAB(16);"TOOK ";D/100;" S
ECS"
  670PRINTTAB(16);"R VARIED BY +/-
";(pmin+pmax)/2;" %"
  680PRINT'"Press any key to contin
ue"
  690A$=GET$
  700CLS
  710
  720
  730
  740r=200:min=1E6:max=-min
  750R%=200:XC%=220:YC%=220
  760PRINT'"DX/D"CHR$240"=-Y"
  770PRINT"DY/D"CHR$240"=X"
  780E=TIME
  790X=R%:Y=0:DTHETA=.1
  800MOVEXC%+R%,YC%
  810REPEAT
  820PROCR(XC%+X,YC%+Y)
  830DRAWXC%+X,YC%+Y
  840X=X-Y*DTHETA:Y=Y+X*DTHETA
  850UNTILPOINT(X+XC%,Y+YC%)>0
  860DRAWX+XC%,Y+YC%
  870E=TIME-E
  880PRINT"TOOK ";E/100;" SECS"
  890PRINT"R VARIED BY +/- ";(pmin+
pmax)/2;" %"
  900
  910
  920
  930R%=200:XC%=640:YC%=220
  940E=TIME
  950r=200:min=1E6:max=-min
  960X=R%:Y=0:N=16
  970PRINT'TAB(8);N" sided polygon.
"
  980A=2*SIN(PI/N)*COS(PI/N):B=2*SI
```

and δy describe a jump of one pixel in each direction. You decide which pixel you should move to by calculating which one gives a value of $x^2 + y^2$ closest to r^2.

Bresenham's algorithm can work very quickly if you perform the following algebraic manipulations. First define D_a and D_b as follows:

$D_a = x_a^2 + y_a^2 - r^2$ (1)

$D_b = x_b^2 + y_b^2 - r^2$ (2)

D_a tells you how far point A (x_a,y_a) is from the circle. Similarly, D_b tells you how far point B (x_b,y_b) is from the circle. On your journey around the circle, you would move to point A if

$$ABS(D_a) < ABS(D_b)$$

Otherwise, you would move to point B.

In the context of the problem, you know point A is always outside the circle and point B is always inside the circle, so D_a is always positive and D_b negative. The decision inequality can therefore be rewritten to read: you would move to point A if

$$D_a < -D_b$$

or

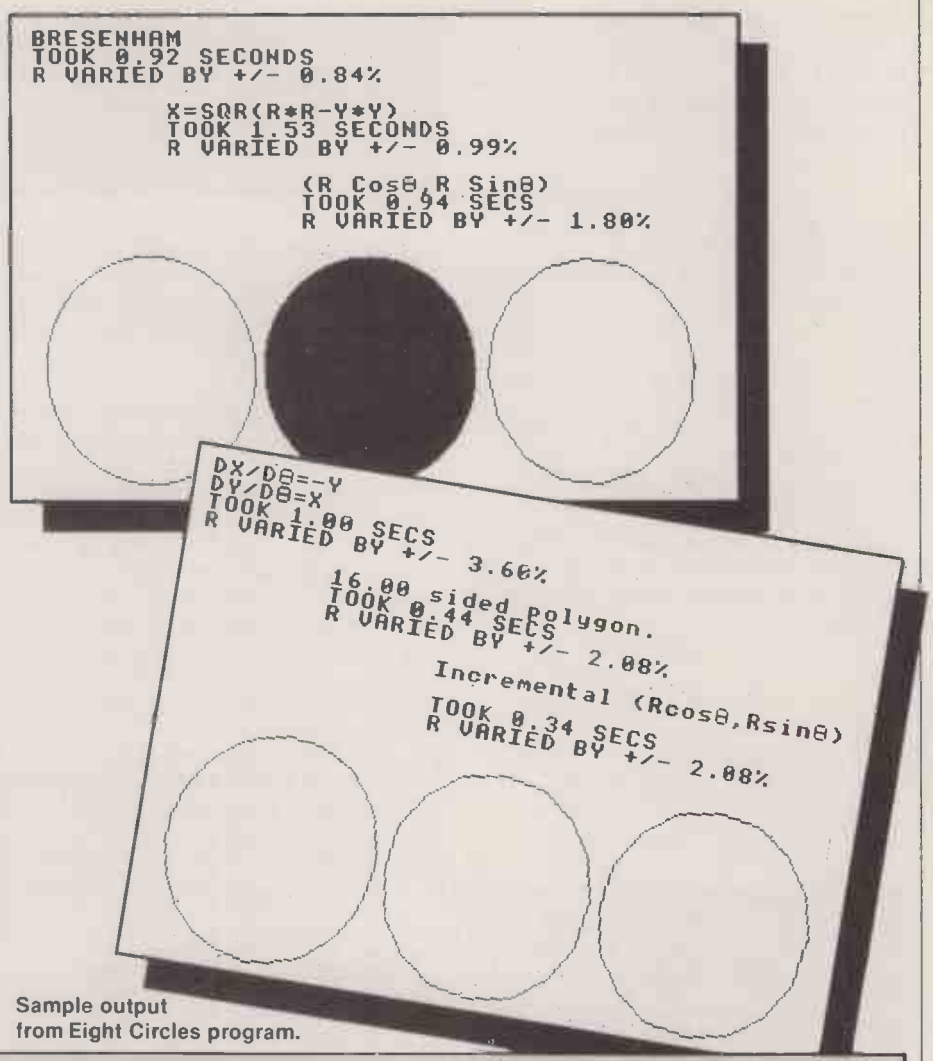
$$D_a + D_b < 0$$

The decision variable D can then be defined as

$D = D_a + D_b$. (3)

Whenever you arrive at a pixel, you could calculate the values of D_a and D_b using formulae (1) and (2), and hence find D. However, it is faster to calculate the new value of D by adding something to the value of D at the previous pixel. If you know D at the first pixel on the circle, you can update D all the way round the circle.

(continued on next page)



Sample output from Eight Circles program.

```
N(PI/N)*SIN(PI/N)
  990MOVEXC%+X,YC%+Y
 1000FORT%=0TON
 1010PROCR(XC%+X,YC%+Y)
 1020DRAWXC%+X,YC%+Y
 1030DX=A*Y+B*X
 1040DY=A*X-B*Y
 1050X=X-DX:Y=Y+DY
 1060NEXT
 1070E=TIME-E
 1080PRINTTAB(8)"TOOK "¦E/100¦" SEC
S"
 1090PRINTTAB(8)"R VARIED BY +/- "¦
(pmin+pmax)/2¦" %"
 1100
 1110
 1120
 1130XC%=1060:YC%=220:R%=200
 1140r=200:min=1E6:max=-min
 1150PRINT'TAB(15)¦"Incremental (Rc
os"CHR$240",Rsin"CHR$240")"
 1160A=TIME
 1170N%=16:C=COS(2*PI/N):S=SIN(2*PI
/N)
 1180X=R%:Y=0
 1190MOVEXC%+X,YC%+Y
 1200FORT%=1TON%
 1210PROCR(XC%+X,YC%+Y)
 1220XD=X*C-Y*S
 1230YD=Y*C+X*S
 1240X=XD:Y=YD
 1250DRAWXC%+X,YC%+Y
 1260NEXT
 1270F=TIME-A
 1280PRINTTAB(15);"TOOK "¦F/100¦" S
ECS"
 1290PRINTTAB(15);"R VARIED BY +/-
"¦(pmin+pmax)/2¦" %"
 1300
 1310PRINT'"Press any key to contin
ue"
 1320A$=GET$
 1330CLS
 1340
 1350
 1360
 1370r=200:min=1E6:max=-min
 1380R%=200:XC%=220:YC%=220
 1390PRINT''"SOLID BRESENHAM"
 1400A=TIME
 1410X%=0:Y%=R%:D%=6-Y%
 1420XC%=4*XC% DIV4:YC%=4*YC% DIV4
 1430REPEAT
 1440PROCR(XC%+X%,YC%+Y%)
 1450MOVEXC%+Y%,YC%+X%:DRAWXC%-Y%,Y
C%+X%:MOVEXC%+Y%,YC%-X%:DRAWXC%-Y%,
YC%-X%
 1460IFD%<0D%=D%+X%+X%+12 ELSEMOVEX
C%+X%,YC%+Y%:DRAWXC%-X%,YC%+Y%:MOVE
XC%+X%,YC%-Y%:DRAWXC%-X%,YC%-Y%:D%=
D%+X%-Y%+X%-Y%+20:Y%=Y%-4
 1470X%=X%+4:UNTILX%>Y%
 1480MOVEXC%+X%,YC%+Y%:DRAWXC%-X%,Y
C%+Y%:MOVEXC%+X%,YC%-Y%:DRAWXC%-X%,
YC%-Y%
 1490B=TIME-A
 1500PRINT"TOOK "¦B/100" SECONDS"
 1510PRINT"R VARIED BY +/- "¦(pmin+
pmax)/2¦" %"
 1520
 1530
 1540
 1550r=200:min=1E6:max=-min
 1560R%=200:XC%=640:YC%=220
 1570PRINT'TAB(8)"STORED SIN & COS"
 1580N%=16:DIMC(N%+1),S(N%+1)
 1590T%=0
 1600FORTHETA=0TO2*PI STEP2*PI/N%
 1610C(T%)=COS(THETA):S(T%)=SIN(THE
TA)
 1620T%=T%+1
 1630NEXT
 1640C(T%)=COS(THETA):S(T%)=SIN(THE
TA)
 1650
 1660A=TIME
 1670MOVEXC%+R%,YC%
 1680FORT%=1TON%+1
 1690DRAWXC%+R%*C(T%),YC%+R%*S(T%)
 1700PROCR(XC%+R%*C(T%),YC%+R%*S(T%
))
 1710NEXT
 1720C=TIME-A
 1730PRINTTAB(8)"TOOK "¦C/100¦" SEC
ONDS"
 1740PRINTTAB(8)"R VARIED BY +/- "¦
(pmin+pmax)/2¦" %"
 1750END
 1760
 1770
 1780
 2000DEFPROCR(X,Y)
 2010REM CALCULATE PERCENTAGE ERROR
 IN THE DISTANCE OF PIXEL (X,Y)
 2020REM FROM THE CENTRE (XC%,YC%).
 2030REM INITIALISE r, min, max, XC
%, and YC% TO BE:
 2040REM CORRECT RADIUS, 1E6, -1E6,
 CENTRE X AND CENTRE Y.
 2050REM Gives results in pmin and
pmax
 2060REM - the worst percentages ab
ove and below
 2070REM the correct values.
 2080
 2090LOCALR
 2100REM Map to integer screen coor
ds
 2110X=(X DIV4)*4
 2120Y=(Y DIV4)*4
 2130
 2140R=SQR((X-XC%)^2+(Y-YC%)^2)
 2150IFR>max THENmax=R
 2160IFR<min THENmin=R
 2170pmin=(r-min)*100/r
 2180pmax=(max-r)*100/r
 2190ENDPROC
```

(continued from previous page)

Suppose you are at the point (x,y) on the circle where the value of D is D_o. You would consider moving to the point A $(x+\delta x,y)$ or B $(x+\delta x,y-\delta y)$. Here

$$\begin{aligned} D_o &= D_a + D_b \\ &= (x+\delta x)^2 + y^2 - r^2 + (x+\delta x)^2 + (y-\delta y)^2 - r^2 \\ &= 2x^2 + 4x\delta x + 2\delta x^2 + 2y^2 - 2y\delta y + \delta y^2 - 2r^2 \end{aligned} \quad (4)$$

If you decide to move to A, the new values of A and B become

$$x + 2\delta x, y$$

and

$$x + 2\delta x, y - \delta y$$

Now

$$\begin{aligned} D &= (x+2\delta x)^2 + y^2 - r^2 + (x+2\delta x)^2 + (y-\delta y)^2 - r^2 \\ &= 2x^2 + 8x\delta x + 8\delta x^2 + 2y^2 - 2y\delta y + \delta y^2 - 2r^2 \\ &= D_o + 4x\delta x + 6\delta x^2 \end{aligned} \quad (5)$$

This tells you how to update D when you decide to move to point A. If you decide to move to B, the new values of A and B become

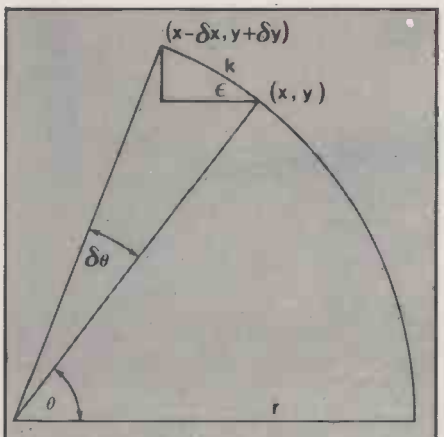
$$x + 2\delta x, y - \delta y$$

and

$$x + 2\delta x, y - 2\delta y$$

Now

$$\begin{aligned} D &= (x+2\delta x)^2 + (y-\delta y)^2 - r^2 + (x+2\delta x)^2 + (y-2\delta y)^2 - r^2 \\ &= 2x^2 + 8x\delta x + 8\delta x^2 + 2y^2 - 6y\delta y + 5\delta y^2 - 2r^2 \\ &= D_o + 4x\delta x + 6\delta x^2 - 4y\delta y + 4\delta y^2 \end{aligned} \quad (6)$$



$$\epsilon = 90 - \theta - \tfrac{1}{2}\delta\theta$$

$$\begin{aligned} k &= 2r\sin\tfrac{1}{2}\delta\theta \\ &= pr \end{aligned}$$

$$\begin{aligned} \delta x &= K.\cos\epsilon \\ &= k.\sin(\theta + \tfrac{1}{2}\delta\theta) \\ &= k(\sin\theta.\cos\tfrac{1}{2}\delta\theta + \cos\theta.\sin\tfrac{1}{2}\delta\theta \\ &= p(y.\cos\tfrac{1}{2}\delta\theta + x.\sin\tfrac{1}{2}\delta\theta) \\ &= Ay + Bx \end{aligned}$$

$$\begin{aligned} \delta y &= k.\sin\epsilon \\ &= k.\cos(\theta + \tfrac{1}{2}\delta\theta) \\ &= k(\cos\delta\theta.\cos\tfrac{1}{2}\delta\theta - \sin\theta.\sin\tfrac{1}{2}\delta\theta \\ &= p(x.\cos\tfrac{1}{2}\delta\theta - y.\sin\tfrac{1}{2}\delta\theta \\ &= Ax - By \end{aligned}$$

$$\begin{aligned} A &= p.\cos\tfrac{1}{2}\delta\theta \\ &= 2r.\sin\tfrac{1}{2}\delta\theta.\cos\tfrac{1}{2}\delta\theta \end{aligned}$$

$$\begin{aligned} B &= p.\sin\tfrac{1}{2}\delta\theta \\ &= 2r.\sin\tfrac{1}{2}\delta\theta.\sin\tfrac{1}{2}\delta\theta \end{aligned}$$

Figure 3. N-sided polygon algorithm.

Mode	δx	δy
0	2	4
1	4	4
2	8	4
4	4	4
5	8	4

Table 1.

You therefore know how to update D whenever you move to another pixel.

Finally you need to know the value of D at your starting point (0,r). Put 0,r into formula (4) to obtain

$$D = 2\delta x^2 - 2r\delta y + \delta y^2 \quad (7)$$

Formulae (5),(6) and (7) can be executed more quickly if you substitute numerical values for δx and δy which are constant throughout the program. The values to substitute are shown in table 1. However, this does not work very well in those graphics modes in which the pixels are not square. The problems arises when using the symmetry properties of the circle to step from one point to another. When moving from the point (x,y) to $(x+\delta x,y-\delta y)$ the computer generates the set of new points

$(x+\delta x,y-\delta y)$ $(-x-\delta x,y-\delta y)$
$(x+\delta x,-y+\delta y)$ $(-x-\delta x,-y+\delta y)$
$(y-\delta y,x+\delta x)$ $(y-\delta y,-x-\delta x)$
$(y-\delta y,-x-\delta x)$ $(-y+\delta y,-x-\delta x)$

In the last four points some of the y co-ordinates have changed by δx and vice versa. This can either result in gaps in the circles, or cause some pixels to be plotted twice. The latter result is the lesser of the two evils, so you can use $\delta y = 2$ in mode 0, and $\delta x = 4$ in mode 2 and mode 5, in place of the values in table 1.

To use the algorithm in a Basic program operating in mode 4, the values $\delta x = 4$ and $\delta y = 4$ are substituted into formulae (4) (5) and (7). Lines 190 and 270 would then include the following terms:

```
190 . . . D% = 48 - 8*Y%
270 . . . D% = D% + 16*X% +
  96 . . . D% = D% + 16*(X% - Y%)
  + 160
```

which have a common factor of 8. Jack Bresenham has pointed out that since only the sign of D% is of interest you can divide throughout by 8 to give

```
190 . . . D% = 6 - Y%
270 . . . D% = D% + 2*X% + 12 . . .
        D% = D% + 2*(X% - Y%) + 20
```

Multiplying numbers together is a slow

Listing 2. A J Price's Circle Circumference machine-code program.

```
   10 REM ************************************************************
******
   20 REM * CIRCLE CIRCUMFERENCE COPYRIGHT M.CALLAWAY AND A.J.PRICE 19
84   *
   30 REM * WITH GRATEFUL ACKNOWLEDGEMENTS TO JACK BRESENHAM
     *
   40 REM ************************************************************
******
   50 A0=2:OSWRCH=&FFEE:MODE 1
   60 *KEY 10 OLD|MMODE3|MVDU19,0,4,0,0,0|MCLS|M
   70 REM ***** SET UP MEMORY SPACE FOR VARIABLES IN ZERO PAGE *****
   80 XC=&70:YC=XC+2:X=YC+2:Y=X+2:D%=Y+2
   90 REM ***** RESERVE MEMORY FOR THE M/C *****
  100 DIM CIRC% 400
  110 REM ***** START OF ASSEMBLY LANGUAGE *****
  120 FOR I= 0 TO A0 STEP A0:P%=CIRC%:[OPT I
  130 \ ***** SET X TO 0 *****
  140 LDA#0:STA X:STA X+1
  150 \ ***** ALTER GRAPHICS ORIGIN TO (XC,YC) *****
  160 LDA#29:JSR OSWRCH:LDA XC:AND#252:JSR OSWRCH
  170 LDA XC+1:JSR OSWRCH:LDA YC:AND#252:JSR OSWRCH:LDA YC+1:JSR OSWRC
H
  180 \ ***** INITIALISE D% AS 6 - RADIUS *****
  190 JSR NEG2:LDA Y:CLC:ADC#6:STA D%:LDA Y+1:ADC#0:STA XC+9:JSR NEG2
  200 \ ***** START OF THE MAIN LOOP *****
  210 .STARTLOOP
  220 \ ***** PLOT EIGHT POINTS ON CIRCUMFERENCE *****
  230 JSR P
  240 JSR NEG2:JSR P
  250 JSR NEG:JSR P
  260 JSR NEG2:JSR P
  270 JSR SWAP:JSR P
  280 JSR NEG2:JSR P
  290 JSR NEG:JSR P
  300 JSR NEG2:JSR P
  310 JSR NEG:JSR NEG2:JSR SWAP
  320 \ ***** TEST IF D>= 0 *****
  330 LDA D%+1:BPL OTHER
  340 \ ***** D% = D% + 2*X + 12 *****
  350 LDA D%:CLC:ADC X:STA D%:LDA D%+1:ADC X+1:STA D%+1
  360 LDA D%:CLC:ADC X:STA D%:LDA D%+1:ADC X+1:STA D%+1
  370 LDA D%:CLC:ADC #12:STA D%:BCC NC3:INC XC+9:.NC3
  380 JMP ENDLOOP
  390 .OTHER
  400 \ ***** DRAW FROM (X,Y) TO (-X,Y) *****
  410 \ ***** D% = D% + 2*X - 2*Y -4 *****
  420 LDA D%:CLC:ADC X:STA D%:LDA D%+1:ADC X+1:STA D%+1
  430 LDA D%:CLC:ADC X:STA D%:LDA D%+1:ADC X+1:STA D%+1
  440 LDA D%:CLC:ADC #20:STA D%:BCC NC6:INC D%+1:.NC6
  450 LDA D%:SEC:SBC Y:STA D%:LDA D%+1:SBC Y+1:STA D%+1
  460 LDA D%:SEC:SBC Y:STA D%:LDA D%+1:SBC Y+1:STA D%+1
  470 LDA Y:SEC:SBC#4:STA Y:LDA Y+1:SBC#0:STA Y+1
  480 .ENDLOOP
  490 \ ***** X = X + 4 *****
```

Conversion

The Eight Circles program should work on any micro with high-resolution graphics, with suitable adaptation of the BBC Basic commands used by the program.

MODE4 — requests black and white high-resolution graphics

@% = &2020A — ensures decimal numbers are printed to two decimal places

VDU23,240... — makes CHR$(240) into a user-defined θ

PROCR(a,b) — sends the values of a and b to the procedure at line 2000

PLOY69,x,y — draws a single pixel at the point (x,y)

MOVE x1,y1:DRAW x2,y2 — draws a line between the points x1,y1 and x2,y2

A$ = GET$ — waits until a key is pressed

POINT(x,y) — finds out what colour pixel (x,y) is; 0 for black, and 1 for white

X DIV4 — equivalent to Int(X/4).

and complex process at processor level, so the program runs faster if line 270 is written as

```
270 ... D% = D% + X% + X% + 12 ...
        D% = D% + X% - Y% + X% -
        Y% + 20
```

as in the listing.

The $x = SQR(r^2 - y^2)$ algorithm. The basic equation for the circle

$$x^2 + y^2 = r^2$$

can be rewritten as

$$x = \sqrt{(r^2 - y^2)}$$

and it is this expression which forms the basis of the second circle-drawing algorithm. As you step through all the possible Y values of pixels on the circle, the equation generates the corresponding X co-ordinates. The loop to generate the circle is thus

```
FOR y = 0 to r STEP δy
x = SQR (r² - y²)
: (by symmetry, there are also pixels at
  (-x,y), (x,-y) and (-x,-y)
:
NEXT y
```

This algorithm generates one pixel on each of the horizontal scan lines through the circle by joining (x,y) and (−x,y) with horizontal lines.

The (R.cosθ,R.sinθ) algorithm. One of the simplest algorithms to program uses the formulae

$x = R.\cos\theta$
$y = R.\sin\theta$

It can draw approximate circles very quickly if only a few values of θ are used. The routine actually draws a 16-sided regular polygon, which looks quite like a circle.

The dx/dθ and dy/dθ algorithm. Differentiating the previous pair of formulae gives

$dx/d\theta = -R.\sin\theta = -y$
$dy/d\theta = R.\cos\theta = x$

Consequently the pair of relationships

$x' = x + \delta x = x - y\delta\theta$
$y' = y + \delta y = y + x\delta\theta$

might be expected to describe a circle, but unfortunately it doesn't. The distance of (x′,y′) from the centre of the circle is given by

$$\begin{aligned} x'^2 + y'^2 &= (x - y\delta\theta)^2 + (y + x\delta\theta)^2 \\ &= x^2 - 2xy\delta\theta + (y\delta\theta)^2 + y^2 + 2xy\delta\theta + (x\delta\theta)^2 \\ &= (x^2 + y^2)(1 + \delta\theta^2) \end{aligned}$$

Since $1 + \delta\theta^2$ is always greater than 1, the radius of the new point is always greater than the radius of the previous point, so the algorithm generates a spiral rather than a circle.

A closer approximation to a circle can be found using the relationships

(continued on next page)

```
500 LDA X:CLC:ADC#4:STA X:BCC NC7:INC X+1:.NC7
510 \ ***** IF X<Y THEN LOOP *****
520 LDA Y+1:CMP X+1:BEQ NXT:BCS LOOP
530 \ ***** OTHERWISE FINISH *****
540 JMP FINISH
550 \ ***** IF HIGH BYTES OF X AND Y ARE THE SAME *****
560 \ ***** COMPARE THE LESS SIGNIFICANT  *****
570 .NXT LDA Y:CMP X:BCS LOOP:BEQ LOOP
580 .FINISH
590 JSR P
592 JSR NEG2:JSR P
594 JSR NEG:JSR P
596 JSR NEG2:JMP P
600 \ ***** GOES BACK TO START OF LOOP *****
610 .LOOP JMP STARTLOOP
620 \ ***** SUB-ROUTINE TO PLOT A POINT AT (X,Y) *****
630 .P LDA#25:JSR OSWRCH:LDA#69:JSR OSWRCH:LDA X:JSR OSWRCH
640 LDA X+1:JSR OSWRCH:LDA Y:JSR OSWRCH:LDA Y+1:JMP  OSWRCH
650 \ ***** NEGATES VALUE IN X AND X+1 *****
660 .NEG LDA X:EOR#255:CLC:ADC#1:STA X:LDA X+1:EOR#255:ADC#0:STA X+1
:RTS
670 \ ***** NEGATES VALUE IN Y AND Y+1 *****
680 .NEG2 LDA Y:EOR#255:CLC:ADC#1:STA Y:LDA Y+1:EOR#255:ADC#0:STA Y+
1:RTS
690 \ ***** SWAPS VALUES IN X AND Y *****
700 .SWAP LDA X:TAX:LDA Y:STA X:TXA:STA Y
710 LDA X+1:TAX:LDA Y+1:STA X+1:TXA:STA Y+1:RTS
720 \ ***** HERE ENDETH THE MACHINE CODE *****
730 ]:NEXT
740 REPEAT
750 PROCCIR(RND(1280),RND(1024),RND(180)+20)
760 UNTILFALSE
770 END
780 REM ***** PROCEDURE TO DRAW CIRCLE *****
790 DEFPROCCIR(X%,Y%,R%):!XC=X%:!YC=Y%:!Y=R%:CALL CIRC%:ENDPROC
```

Listing 3. A J Price's Filled Circles machine-code program.

```
  10 REM ***********************************************************
******
  20 REM * FILLED CIRCLE ROUTINE COPYRIGHT M.CALLAWAY AND A.J.PRICE 1
984  *
  30 REM * WITH GRATEFUL ACKNOWLEDGEMENTS TO JACK BRESENHAM
     *
  40 REM ***********************************************************
******
  50 AO=2:OSWRCH=&FFEE:MODE 1
  60 *KEY 10 OLD|MMODE3|MVDU19,0,4,0,0,0|MCLS|M
  70 REM ***** SET UP MEMORY SPACE FOR VARIABLES IN ZERO PAGE *****
  80 XC=&70:YC=XC+2:X=YC+2:Y=X+2:D%=Y+2
  90 REM ***** RESERVE MEMORY FOR THE M/C *****
 100 DIM CIRC% 400
 110 REM ***** START OF ASSEMBLY LANGUAGE *****
 120 FOR I= 0 TO AO STEP AO:P%=CIRC%:COPT I
```

(listing continued on next page)

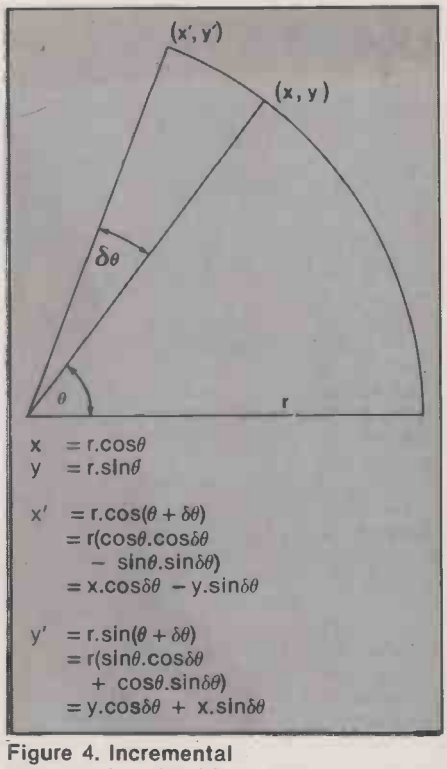


Figure 4. Incremental r.cosθ, r.sinθ algorithm.

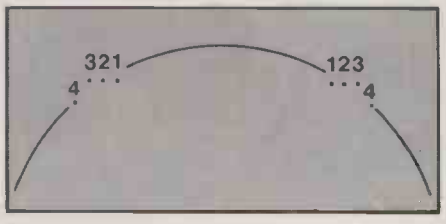


Figure 5.

(continued from previous page)

$x' = x - y\delta\theta$

$y' = y + x'\delta\theta$

$= y + x\delta\theta - y\delta\theta^2$

which forms the basis of a circle drawing algorithm published in the Acornsoft book *Creative Graphics* by John Cowie. The radius at (x',y') is now given by

$$x'^2 + y'^2 = (x - y\delta\theta)^2 + (y + x\delta\theta - y\delta\theta^2)^2$$
$$= x^2 + y^2 + \delta\theta^2(x^2 - y^2) - 2\delta\theta^3xy + \delta\theta^4 y^2$$

In this case, the values of

$$\delta\theta^2(x^2 - y^2) - \delta\theta^3xy$$

average out to zero around a whole circle, though if $\delta\theta$ is large the circle turns into an ellipse. The consistent errors in the values of the radius of the circle are caused by the term in $\delta\theta^4$, which will be extremely small if $\delta\theta$ is small.

The N-sided polygon algorithm. An N-sided regular polygon starts to look like a circle when M becomes large. Values of N as low as 16 produce acceptable circles, and you can easily experiment with the routine shown in the listing to find the value of N best suiting your needs. Figure 3 shows how the N-sided polygon alogrithm is devised.

Incremental R.cosθ, R.sinθ algorithm. A similar technique can be combined with the formulae

$x = R.\cos\theta$

$y = R.\sin\theta$

The basic algorithm using these formulae is slow because it involves calculating sines and cosines many times. These

(listing continued from previous page)

```
  130 \ ***** SET X TO 0 *****
  140 LDA#0:STA X:STA X+1
  160 \ ***** ALTER GRAPHICS ORIGIN TO (XC,YC) *****
  170 LDA#29:JSR OSWRCH:LDA XC:AND#252:JSR OSWRCH
  180 LDA XC+1:JSR OSWRCH:LDA YC:AND#252:JSR OSWRCH:LDA YC+1:JSR OSWRC
H
  190 \ ***** INITIALISE D% AS 6 - RADIUS *****
  200 JSR NEG2:LDA Y:CLC:ADC#6:STA D%:LDA Y+1:ADC#0:STA XC+9:JSR NEG2
  210 \ ***** START OF THE MAIN LOOP *****
  220 .STARTLOOP
  230     \ ***** THE NEXT LINES DRAW THE FIRST TWO LINES ON THE SCREEN
*****
  240 \ ***** DRAW (Y,X) TO (-Y,X) *****
  250 JSR SWAP:JSR SEND
  260 JSR NEG:JSR SEND2
  270 \ ***** DRAW (-Y,-X) TO (Y,-X) *****
  280 JSR NEG2:JSR SEND
  290 JSR NEG:JSR SEND2
  300 \ ***** RESET VALUES TO X AND Y *****
  310 JSR NEG2:JSR SWAP
  320 \ ***** IF D% => 0 THEN GOTO OTHER *****
  330 LDA D%+1:BPL OTHER
  340 \ ***** D% = D% + 2*X + 12 *****
  350 LDA D%:CLC:ADC X:STA D%:LDA D%+1:ADC X+1:STA D%+1
  360 LDA D%:CLC:ADC X:STA D%:LDA D%+1:ADC X+1:STA D%+1
  370 LDA D%:CLC:ADC #12:STA D%:BCC NC3:INC XC+9:.NC3
  380 JMP ENDLOOP
  390 .OTHER
  400 \ ***** DRAW FROM (X,Y) TO (-X,Y) *****
  410 JSR SEND
  420 JSR NEG:JSR SEND2
  430 \ ***** DRAW FROM (-X,-Y) TO (X,-Y) *****
  440 JSR NEG2:JSR SEND
  450 JSR NEG:JSR SEND2
  460 \ ***** RESET TO (X,Y) *****
  470 JSR NEG2
  480 \ ***** D% = D% + 2*X - 2*Y -4 *****
  490 LDA D%:CLC:ADC X:STA D%:LDA D%+1:ADC X+1:STA D%+1
  500 LDA D%:CLC:ADC X:STA D%:LDA D%+1:ADC X+1:STA D%+1
  510 LDA D%:CLC:ADC #20:STA D%:BCC NC6:INC D%+1:.NC6
  520 LDA D%:SEC:SBC Y:STA D%:LDA D%+1:SBC Y+1:STA D%+1
  530 LDA D%:SEC:SBC Y:STA D%:LDA D%+1:SBC Y+1:STA D%+1
```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```
  540 LDA Y:SEC:SBC#4:STA Y:LDA Y+1:SBC#0:STA Y+1
  550 .ENDLOOP
  560 \ ***** X = X + 4 *****
  570 LDA X:CLC:ADC#4:STA X:BCC NC7:INC X+1:.NC7
  580 \ ***** IF X<Y THEN LOOP *****
  590 LDA Y+1:CMP X+1:BEQ NXT:BCS LOOP
  600 \ ***** OTHERWISE FINISH *****
  610 JMP FINISH
  620 \ ***** IF HIGH BYTES OF X AND Y ARE THE SAME *****
  630 \ ***** COMPARE THE LESS SIGNIFICANT  *****
  640 .NXT LDA Y:CMP X:BCS LOOP
  650 .FINISH
  670 JSR SEND
  680 JSR NEG:JSR SEND2
  690 \ ***** DRAWS FROM (-X,-Y) TO (X,-Y) *****
  700 JSR NEG2:JSR SEND
  710 JSR NEG:JMP SEND2
  720 \ ***** GOES BACK TO START OF LOOP *****
  730 .LOOP JMP STARTLOOP
  740 \ ***** SUB-ROUTINE TO MOVE ABSOLUTE (X,Y) *****
  750 .SEND LDA#25:JSR OSWRCH:LDA#4:JSR OSWRCH:LDA X:JSR OSWRCH
  760 LDA X+1:JSR OSWRCH:LDA Y:JSR OSWRCH:LDA Y+1:JMP  OSWRCH
  770 \ ***** SUB-ROUTINE TO DRAW ABSOLUTE (X,Y) *****
  780 .SEND2 LDA#25:JSR OSWRCH:LDA#5:JSR OSWRCH:LDA X:JSR OSWRCH
  790 LDA X+1:JSR OSWRCH:LDA Y:JSR OSWRCH:LDA Y+1:JMP OSWRCH
  810 \ ***** NEGATES VALUE IN X AND X+1 *****
  820 .NEG LDA X:EOR#255:CLC:ADC#1:STA X:LDA X+1:EOR#255:ADC#0:STA X+1
:RTS
  830 \ ***** NEGATES VALUE IN Y AND Y+1 *****
  840 .NEG2 LDA Y:EOR#255:CLC:ADC#1:STA Y:LDA Y+1:EOR#255:ADC#0:STA Y+
1:RTS
  850 \ ***** SWAPS VALUES IN X AND Y *****
  860 .SWAP LDA X:TAX:LDA Y:STA X:TXA:STA Y
  870 LDA X+1:TAX:LDA Y+1:STA X+1:TXA:STA Y+1:RTS
  880 \ ***** HERE ENDETH THE MACHINE CODE *****
  890 ]:NEXT
  891
  895 PROCCIR(640,512,512)
  900 END
  901
  910 REM ***** PROCEDURE TO DRAW CIRCLE *****
  920 DEFPROCCIR(X%,Y%,R%):!XC=X%:!YC=Y%:!Y=R%:CALL CIRC%:ENDPROC
```

calculations can be avoided by applying some simple trigonometry, as shown in figure 4.

Solid circles. To draw a solid circle using Bresenham's algorithm the two sets of points 1,2,3,4 and 5,6,7,8 must be treated differently. Horizontal lines are drawn between the pairs of points 1,2, 3,4 5,6 7,8. In the cases of 5,6 and 7,8 you have to draw a new horizontal line with every move to a new pixel. But in the cases of 1,2 and 3,4 you only move to a new horizontal line if you decided to move to point B so a line between 1,2 and 3,4 is only drawn when moving to B.

Figure 5 shows four points on a typical journey around a circle. A horizontal line is required between points 3,3, rather than joining 1,1 or, worse still, joining 1,1 2,2 and 3,3. A horizontal line is only drawn before a diagonal move.

The stored sin and cos algorithm. This algorithm stores the sine and cosine values in two arrays. Consequently, the slow trigonometrical calculations only have to be performed once. This algorithm works quickly provided you have enough memory to store the sines and cosines.

Machine code. Andrew Price has implemented Bresenham's algorithm for circle circumference and filled circles in BBC assembler. Each program sets up the machine-code program and then defines a procedure which lets you access the machine code from your program.

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Amstrad screen Saves

D J Ellis explains a versatile and economical method of saving CPC-464 screen displays to tape.

SAVING a screen from the Amstrad CPC-464 can be a haphazard process for the unwary. The problem lies in the fact that the Amstrad uses a screen offset to perform its scrolling via hardware. If the offset on loading the information back is different from when it was saved it will probably reappear in the wrong place. Some parts may even be missing.

It is possible to fetch the current screen offset by the short machine-code program shown in listing 1. Once the program has been run

CALL &9000

will store the current screen offset into memory locations &9500/1. The offset value is therefore

PEEK(&9501) * 256 + PEEK (&9500)

The corresponding program to set the screen offset is shown in listing 2. The screen offset must be placed into locations &9500/1 and then the routine is performed by a Call to &9007.

Sideways scrolling is induced by lines 50 to 70. Location &9500 is Poked with the value of Scroll, which will set the screen offset. In this case a right-to-left scroll will take place. A left-to-right scroll can be implemented by changing line 50 to

50 FOR scroll = 80 to 0 STEP – 1

By experimenting with different values for the offset, scrolling can be performed in any direction — even diagonally if you wish. Similar but less flexible results can be obtained by Poking the output port 256 with a value between 0 and 255. This will cause an instant picture shift, but the cursor will not return to the left-hand side of the screen, as it does when the offset method is used. The screen offset should always be an even number.

```
10 FOR location=&9000 TO &9006
20 READ code$ : POKE location, VAL("&" + code$)
30 NEXT location
40 DATA CD,B,BC,22,0,95,C9
```

Listing 1.

```
10 FOR location=&9007 TO &900D
20 READ code$ : POKE location, VAL("&" + code$)
30 NEXT location
40 DATA 2A,0,95,CD,5,BC,C9
50 FOR scroll = 0 TO 80
60 POKE &9500,scroll : POKE &9501,0
70 CALL &9007 : NEXT scroll
```

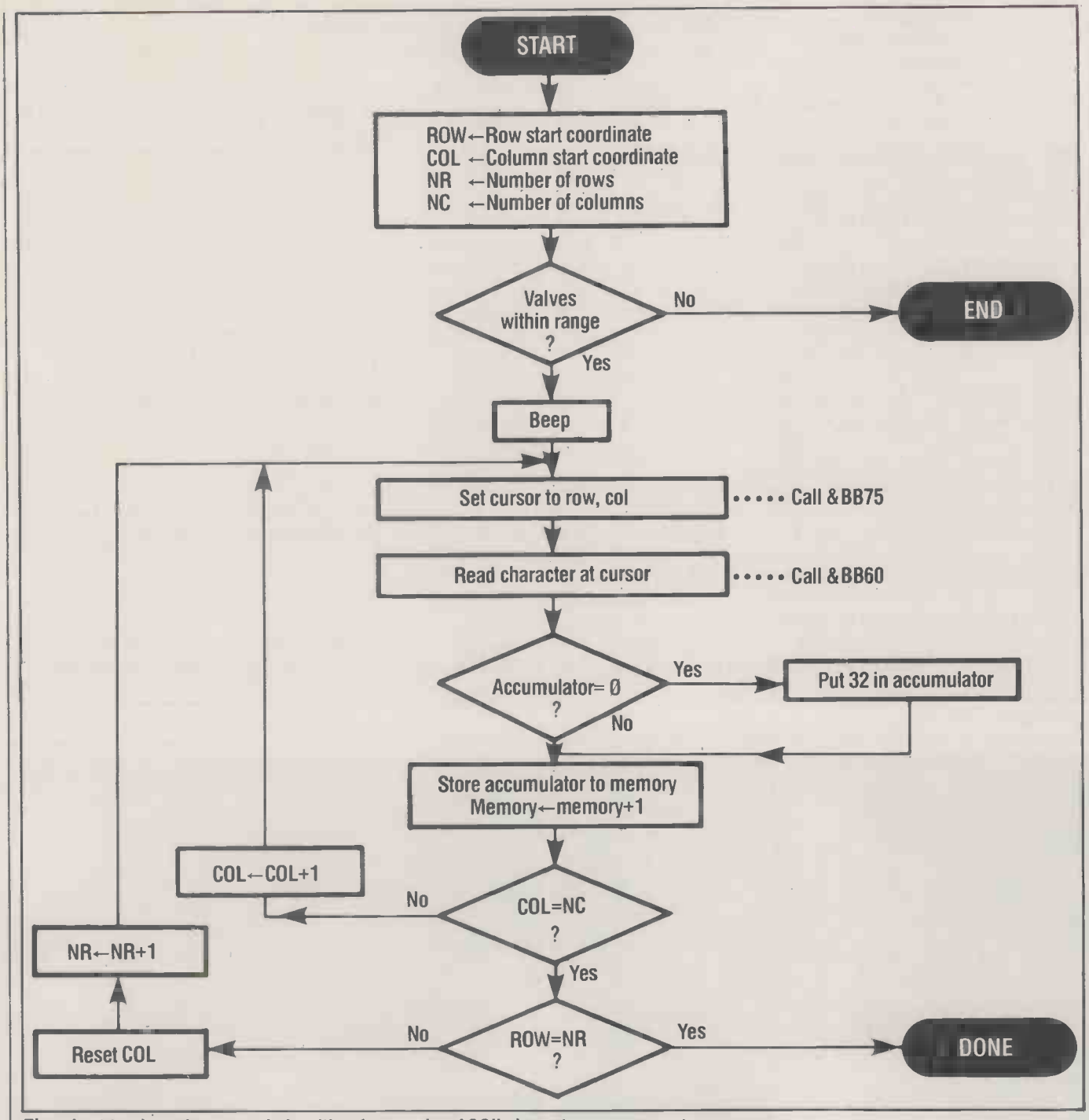
Listing 2.

Not the same

Unless the offset is the same for both saving and loading there is every chance that the original screen picture will not be reproduced in the same form. There are a number of other disadvantages too. It is possible to produce some very sophisticated graphics of up to 640 by 200 resolution using the Amstrad's 256 ASCII characters alone. But even if you only want a screen dump of ASCII characters, the whole of the 16K of screen memory has to be saved to tape. The unusual configuration of the screen memory layout also means that it is not possible to copy, say, the top half of the screen by just saving the first 8K of screen memory even if the screen offset is set to 0 — which it always is on power-up or when a Mode command is used.

Digging into the ROM reveals several routines which make the following possible:

- Save the whole of the screen to tape using just 2,000 bytes of storage.
- Save any part of the screen, such as a window, to tape using an amount of space proportional to the window size.
- Be completely independent of the screen offset: the offset setting at Save and Load becomes irrelevant.
- As a side effect, some useful types of screen formatting can be induced.
- The program will work for all modes.



Flowchart to show the general algorithm for copying ASCII characters on screen to memory.

The limitations are that only ASCII characters or user-defined characters can be saved, and that in mode 1 and mode 0 the colours are ignored so that all text appears with one foreground colour and one background colour.

The second restriction occurs because the colours are encoded as part of the character matrix on the screen. The only way to save all the colours, as well as the characters, is to take a full screen save. Obviously, the program will therefore be of most benefit in mode 2.

The first ROM routine of use is located via the jumpblock at &BB60. This will compare the character at the current cursor position to the 256 ASCII characters stored in ROM — or in RAM if the Symbol After command has been used to define your own characters. If a match is found the accumulator will hold the value of the ASCII character on return from the routine. If no match is found then the accumulator returns with a value of 0.

The next routine needed is the exact opposite and is located at &BB5D. It places the ASCII character whose value is stored in the accumulator to the screen at the current cursor position. All that is needed now is a routine to position the cursor at the required screen position, and this is accomplished by the routine at &BB75. The HL register pair hold the screen co-ordinates. H is set to the column and L to the row: the top left-hand corner of the screen is location 1,1 and the bottom right-hand corner is 80,25.

Utilising these three routines it becomes a fairly simple matter to copy any part of the screen to an area of memory and then transfer it as a binary file to tape or disc. The flowchart shows the general algorithm for copying the ASCII characters on screen to memory. The complete program to perform this and also to put the characters from memory to the screen is shown in listing 3. Once the Basic program has been run it can be dispensed with. Its only purpose is to load the

(continued on next page)

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machine-code routines into memory. Take a copy before you New it though.

Half the program is taken up in checking that the values for the co-ordinates are within range. The values for the number of columns, and the number of rows will depend on the column start and row start co-ordinates. The co-ordinates are passed to the machine code routine as follows

CALL &9921,& (<start column> – <number of columns>),
& (<start row> – <number of rows>)

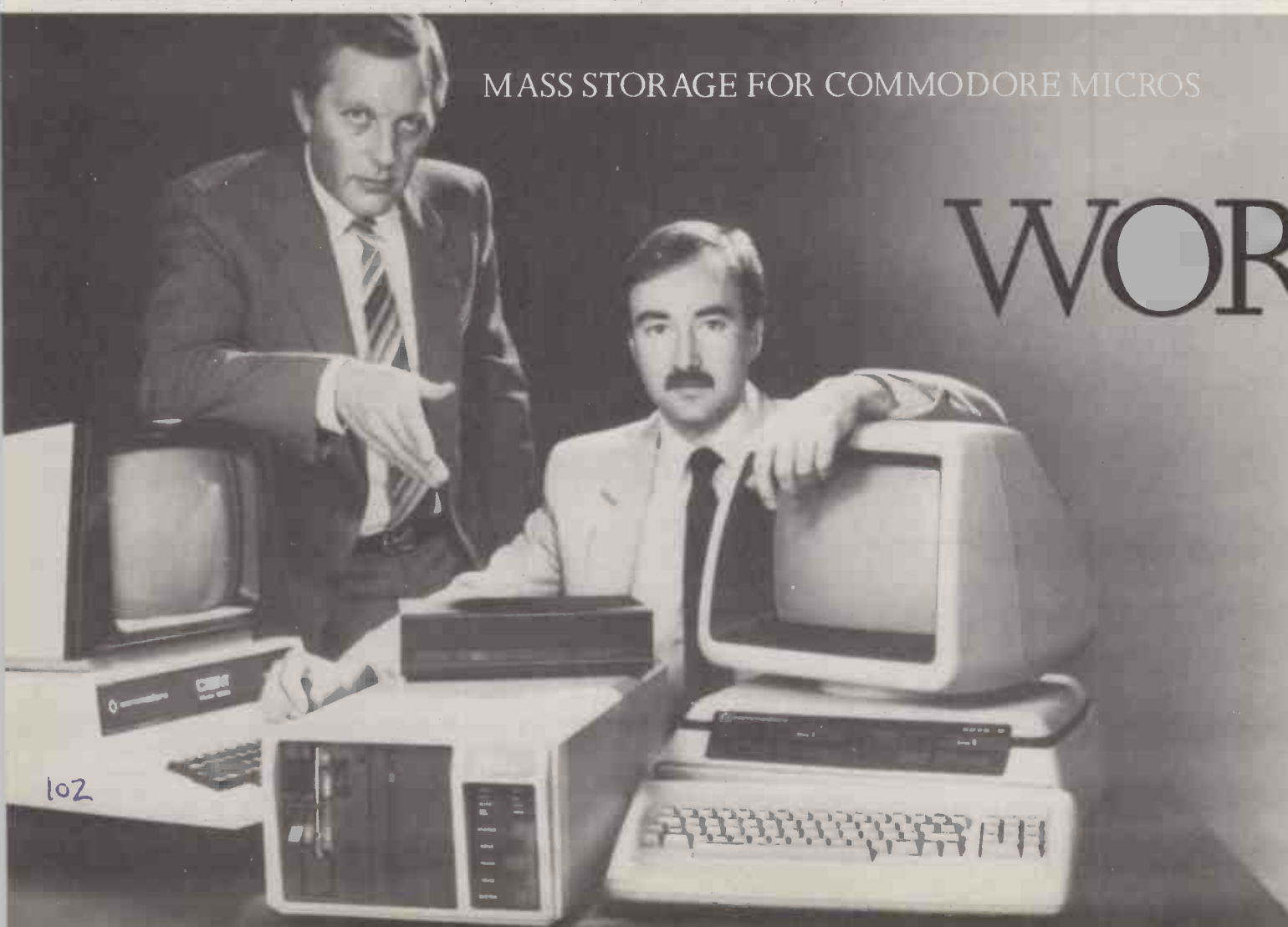
To save the whole of the screen, for instance, you need

CALL &9921,&0150,&0119

since 50 hex is 80 decimal and 19 hex is 25 decimal, and a full screen is 80 columns by 25 rows. The program is fussy about

```
10 location=&9900: MEMORY &8FFO
20 READ a$:IF a$="-1" THEN END
30 POKE location,VAL("&"+a$)
40 location=location+1:GOTO 20
100 '---------------set up sound at &9a00----------------------------------
110 DATA 21,07,9a,3e,0,77,2b,3e,0f,77,2b,77,2b,3e,0,77,2b,3e,1,77,2b,3e,0,6,3
120 DATA 77,2b,10,fc,3e,1,77,c9
130 '---------------put parameters to &9000/3------------------------------
140 DATA fe,0,c8,e,0,6,8,2b,10,fd,6,2,3e,2c,be,c0,23,3e,1c,be,20,8,23,c,e5,23
150 DATA 23,23,10,f5,79,fe,0,c8,11,3,90,6,2,e1,7e,12,1b,23,7e,12,1b,23,10,f5
160 '---------------check parameter values---------------------------------
170 DATA 21,0,90,7e,fe,51,d0,fe,0,c8,46,23,7e,fe,0,c8,80,d8,fe,52,d0,23,3e,19
180 DATA be,d8,3e,0,be,c8,46,23,7e,fe,0,c8,80,d8,fe,1b,d0
190 '---------------OK if reach here...BEEP--------------------------------
200 DATA cd,0,99,cd,aa,bc
210 '---------------store screen values at &9004 onwards-------------------
220 DATA cd,b0,99,7c,65,69,48,47,22,0,90,ed,43,2,90,e5,cd,75,bb,cd,60,bb,fe,0
230 DATA 20,2,3e,20,12,13,e1,24,10,ed,cd,bb,99,fe,0,20,e6,ed,53,fc,99,c9
240 '--------------- 'set up' subroutine-----------------------------------
250 DATA 11,4,90,ed,4b,2,90,2a,0,90,c9
260 '--------------- common subroutine-------------------------------------
270 DATA 2c,7d,21,3,90,46,2a,0,90,6f,d,79,c9
280 '---------------load characters from memory to screen------------------
290 DATA cd,b0,99,d5,e5,c5,cd,75,bb,1a,cd,5d,bb,c1,e1,d1,13,24,10,ef,cd,bb,99
300 DATA fe,0,20,e8,c9,-1
```

Listing 3.



getting the right values — no leading or trailing spaces are allowed.

If the values and syntax are correct, a reassuring beep will sound. The program then stores the ASCII characters to memory location &9004 onwards. For a full screen dump this will take from 10 to 20 seconds, depending upon what characters are on the screen. Any graphics characters that are not recognised, such as a line created by Draw, are converted to represent a space. Once the characters have been stored to memory, they can then be saved to tape by

```
SAVE "XXXX",B,&9000,PEEK(&99FD) *
  256 + PEEK(&99FC) - 36864
```

XXXX is whatever name you give to the binary file, B is for Binary file type, &9000 is where the data starts, and the remainder of the line calculates the number of bytes to save to tape.

To load characters from tape enter

```
LOAD "XXXX"
```

and the original co-ordinates and characters will then be loaded into memory from &9000 onwards. To display the characters enter

```
CALL &99C8
```

and the original screen picture will be displayed in a few seconds.

Any part of the screen can be saved — from 1 to the full 2,000 characters.

```
CALL &9921,&0150,&010C
```

saves the top half of the screen;

```
CALL &9921,&0150,&0D0D
```

saves the bottom half of the screen;

```
CALL &9921,&0128,&0119
```

saves the left half of the screen;

```
CALL &9921,&2928,&0119
```

saves the right half of the screen;

```
CALL &9921,&1E14,&080A
```

saves a 20-by-10 window in the centre of the screen.

If you have a full screen of data held in locations &9004 onwards, then by altering the co-ordinates in locations &9000 to &9003 different parts of the screen may be displayed. The values for the co-ordinates will have to be Poked into their locations. They are &9000 for row start, &9001 for column start, &9002 for number of rows, and &9003 for number of columns. No error checks are carried out now, so be careful.

ASCII characters could also be Poked directly to locations &9004 onwards. For example listing 4 stores eight blocks of 256 ASCII characters from location &9004 onwards. Line 70 Pokes in the co-ordinates, in decimal, to display the whole screen. Line 80 then calls the machine-code routine which will display the characters stored in memory. By using the necessary combination of characters, any message or graphic picture could be displayed easily to any part of the screen.

Remember that in mode 1 the effective screen width is 40 columns, and for mode 0 it is 20 columns. No harm is done if you try to save, say, 80 columns in mode 1, and the picture will be redisplayed with no ill effects. However, trying to dump 2,000 characters from a mode 2 screen to a mode 1 or mode 0 screen may produce unexpected results.

```
10 location = &9004
20 FOR loop = 1 TO 8
30 FOR character = 0 TO 255
40 POKE location,character : location = location + 1
50 NEXT character
60 NEXT loop
70 POKE &9000,1:POKE &9001,1:POKE &9002,25:POKE &9003,80
80 CALL &99C8
```

Listing 4.

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Connect-4

Following his two articles on methods of tree searching, David Levy turns his attention to planning the program of a particular game.

CONNECT-4 is a deceptively simple game marketed by the American games giant Milton-Bradley. It is played on an array with seven columns, each column having six spaces. The players move in turn, using discs of two different colours. A move consists of dropping a disc of your own colour into any column in which at least one of the six spaces is still vacant. Your disc then fills the lowest vacant space in that column. In order to win you need to be the first to create a row, column or diagonal of four of your own discs.

Winning line

Figure 1 illustrates a situation which can arise after three moves. Assume that the discs are white and black, and that White moves first. White's first move was to location a1. In order to create a winning horizontal line utilising this disc on a1, White needs to occupy b1, c1 and d1. In order to create a winning diagonal line utilising the disc on a1, White needs to occupy b2, c3 and d4.

Black's first move, to c1, immediately kills any prospects of a horizontal win for White from a1 to d1. It also gives Black the possibility of killing the diagonal winning chance, a1-d4, because Black now intends to avoid playing on c2 so that when White plays on c2, Black can play on c3.

White's second move, to d1, is a latent threat in more than one direction. White may follow up with a disc on a2, and then a disc on c2. If White's c2 is met by a black disc on c3, White will play to b1. Then, if White can avoid playing a3, it is possible to meet Black's a3 with a white disc at a4. If White can avoid playing b2, he can meet Black's b2 with b3. This strategy is aimed at creating a winning diagonal line from d1 to a4.

Two things become clear from this. First, it is important to make moves which have more than one purpose or threat. Secondly, an important aspect of the game consists of what in chess is known as Zugzwang, which is the compulsion to move in a situation where making a move is a positive disadvantage. Each of these aspects of Connect-4 can be used as the basis for features in your program's evaluation function.

The principle feature in the evaluation function should be based on the concept of degrees of freedom — that is, how many different ways it appears that a particular player might win the game, given the current situation. For an example of this see figure 2 where White's first disc was placed in d1, and Black replied in c1. To see who stands better, count the number of ways in which Black could win the game utilising the discs already in place. The answer is two: the vertical c1-c4 and the diagonal c1-f4. If you perform a similar count for White you find four possibilities: the vertical d1-d4, the horizontal d1-g1, and the diagonals d1-a4 and d1-g4. It is clear that White stands better.

A primitive evaluation function might be simply the sum of the number of theoretically possible winning lines that utilise those discs which are already in place. In this case, White's score would be 4, while Black's would be 2. But all lines are not of equal value; a line that already has two discs in place is in general more likely to be converted into a winning line than is one which has only one disc in place. This should be taken into consideration when creating your evaluation function.

Equal chance

At any time it is reasonable to argue that the probability of a particular vacant space being eventually occupied by, say, a white disc, is approximately 0.5. It may be bad for White to place a disc in a particular space, and if that is the case then White will try to avoid doing so but may not succeed.

You can extend this argument to say that the probability of a particular line of three of one colour being converted into a winning line of four in a particular direction is 0.5 if the adjacent space in that direction is still vacant. Otherwise the probability is zero. If the spaces at both ends of the three-line are still vacant, remembering that some three-lines may have only one adjacent space within the seven-by-six array, then there are two distinct ways in which the three-line can be converted into a win, which is accounted for in the following analysis.

Probabilities

What the program must do is to examine every one of the 69 four-lines in the seven-by-six array — 21 verticals, 24 horizontals and 24 diagonals. It then provides a contribution towards the total score for a player depending on the extent, if any, to which that player has a useful presence in that four-line. If the four-line is empty or has at least one disc of each colour, the contribution towards the score is zero. Otherwise, you can use the probability argument to arrive at the following scores for the four possibilities

- one space occupied scores 0.125 — that is, $0.5 \times 0.5 \times 0.5$;
- two spaces occupied scores 0.25;
- three spaces occupied scores 0.5;
- all four spaces occupied scores 25 — the game is won.

To make the arithmetic integer the

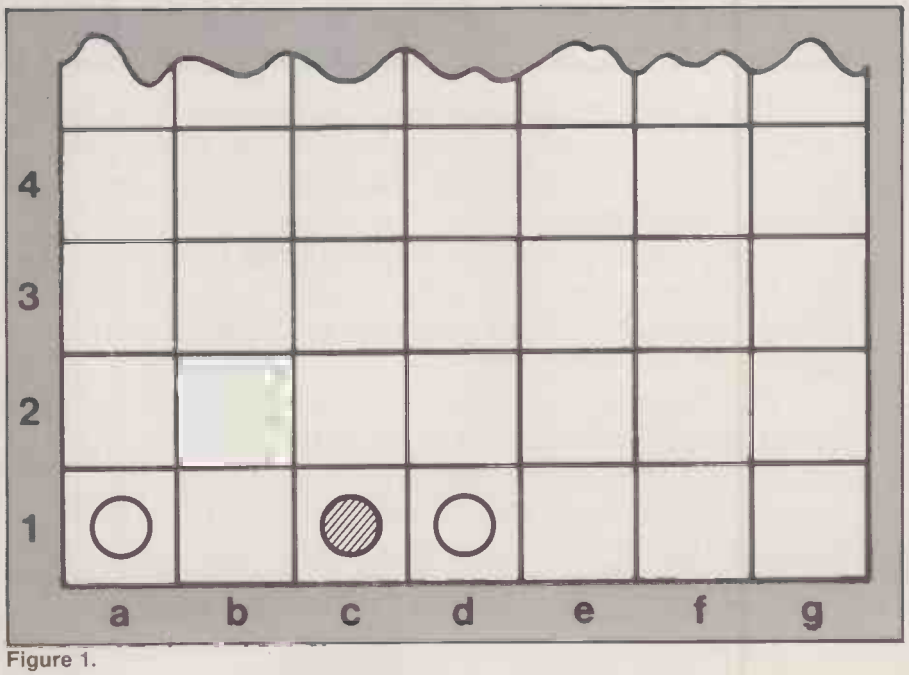


Figure 1.

program can assign values of 1, 2, 4 and 200 respectively.

The concept of Zugzwang is more difficult to quantify, but from the point of view of a particular player, each space in the array may be considered to have some value as a target. If a player has a three-line with a vacant space at the end of it, then the vacant space will have a very high target value because by placing a disc there the player would win the game.

If a player has a two-line with two adjacent vacant spaces, each of the two spaces has a certain value as a target because by occupying both of them the player will be able to win. Since it is more difficult to occupy two specified spaces than it is to occupy just one, the target value for each of the two spaces will be lower than the target value of the vacant space adjacent to the three-line.

For the three adjacent vacant spaces next to a one-line the target value will be even less. Again, you can assign target values in the ratio 1:2:4 for target spaces, depending on whether they are near to a one-line, a two-line or a three-line. A vacant space which is situated at the intersection of two or more such lines should have its target scores added together to provide a more realistic measure of the value of the space as a target.

Zugzwang

When considering Zugzwang, you need to evaluate the undesirability of being the next person to play in each of the seven columns, or whichever of the columns are not yet full. If you have a high-valued target space two, four or six spaces above the highest currently occupied space in a column, then it is undesirable to place the next disc in that column. You want your opponent to place the next disc so that you can place the one after, your opponent the one after, and so on. In this case it will be you who places a disc on the high-valued target square.

From the aspect of Zugzwang, a player should score points for having target spaces two, four or six spaces above the current top disc in a column. The number of points scored should be based on target values of 1, 2 or 4. Target spaces that are one, three or five spaces above the current top disc can be ignored for this feature of the evaluation function. For each column there will be two values; one for White and one for Black. If the program is trying to determine the score for a game situation from White's point of view, the Zugzwang coefficient for a column is measured by White's target value minus Black's target value.

It is not clear what weighting the degrees of freedom and the Zugzwang coefficient should have in the evaluation function. But since there are only two of them it is easy to optimise this weighting by having your program play against itself, one version using one weighting, the other version using a different weighting. A few experimental games should be enough to allow you to arrive at a sensible weighting, but it is likely that Zugzwang will be of relatively little importance during the early part of the game and become much more important during the later stages. If so, it might be appropriate to have an evaluation function of the form

SCORE = DEGREES OF FREEDOM +
[W × log n × ZUGZWANG COEFF.]

where W is the weighting at the start of the game and n is the number of discs already played.

The simplest strategy would utilise the evaluation function without any look-ahead. But if you want to write a program that will play a more challenging game, you need to build in look-ahead and to use one of the tree-searching techniques which have been described or referred to in my earlier articles.

Since there can never be more than seven legal moves at any one moment, the game tree does not grow as quickly as it does in a game such as chess or go. In fact, a game tree 10-ply deep for Connect-4, will have roughly the same number of terminal positions, or fewer, than a five-ply tree in chess. If you plan to write your program in assembler language then you should cater for at least a 10-ply search when your program is set to its strongest playing level.

The benefit, or otherwise, of having the next move is often crucial in Connect-4. So examine your game trees to an even depth or to an odd depth. If some terminal positions are at an odd number of ply and others are at an even number of ply, any comparison between them will be distorted.

Threat

The concept of a threat can be as tactically important in Connect-4 as a checking move can be in chess. Therefore you might consider conducting a full-width search by examining every single move by each side to some specified depth, and then extending the search by two more ply if the last move was a threat. A threat might be a move which created one or more three-lines, having a vacant space at one end at least. If the search is extended because of such a threat, it will often be worth extending it again if the reply to the reply to the threat is another threat. This can continue up to some pre-specified upper limit, and will sometimes result in the program discovering a very long forcing sequence which results in victory.

When there are only 10 vacant spaces remaining in the array, a program written efficiently in assembler language ought to be able to search the whole of the tree that will ensure optimal play right to the end of the game. Using the Alpha-Beta algorithm, with some improvement due to a reasonable ordering of the positions at the root of the tree, the program will need to evaluate only some 8,000 positions from 10-ply out. The evaluation will be very fast because the program need only test for a win, draw or loss.

To search the tree when 12-ply from the end of the game the number of terminal evaluations goes up to about 80,000, but this is still within the bounds of possibility when the program is allowed to think for a minute or two. A foolproof endgame search will add to the power of your program and make it very difficult for most mortals to beat.

I would be interested to hear from anyone who writes a successful program to play Connect-4, or any of the games which I describe in later articles. Please write to me at *Practical Computing*. I cannot guarantee to reply to letters, but I will report on any interesting programs.

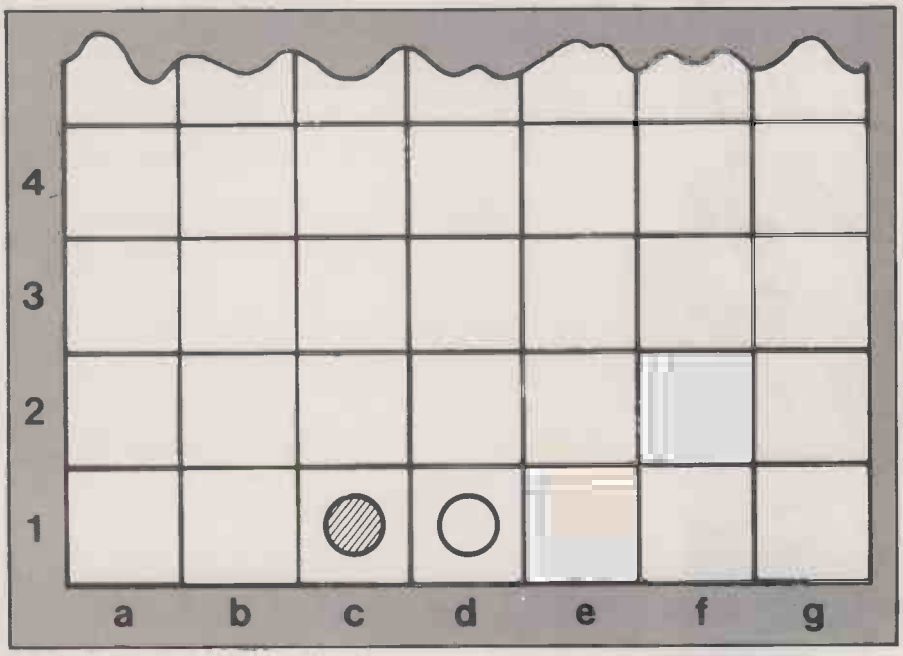
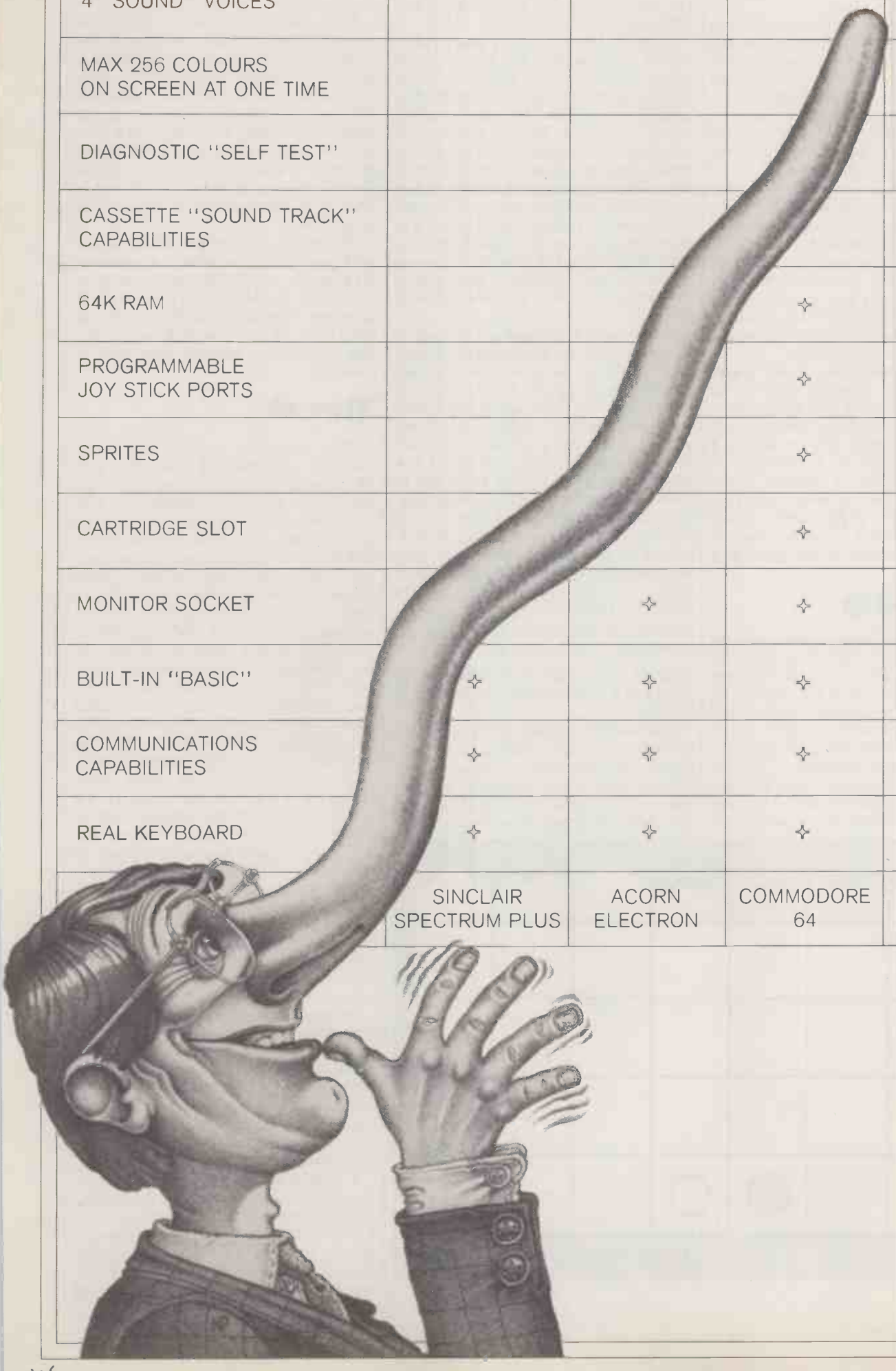


Figure 2.

FEATURES	SINCLAIR SPECTRUM PLUS	ACORN ELECTRON	COMMODORE 64	ATARI 800XL
4 "SOUND" VOICES				✧
MAX 256 COLOURS ON SCREEN AT ONE TIME				✧
DIAGNOSTIC "SELF TEST"				✧
CASSETTE "SOUND TRACK" CAPABILITIES				✧
64K RAM			✧	✧
PROGRAMMABLE JOY STICK PORTS			✧	✧
SPRITES			✧	✧
CARTRIDGE SLOT			✧	✧
MONITOR SOCKET		✧	✧	✧
BUILT-IN "BASIC"	✧	✧	✧	✧
COMMUNICATIONS CAPABILITIES	✧	✧	✧	✧
REAL KEYBOARD	✧	✧	✧	✧



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Advance 86a

16 Bit Micro-Computer

Under £350*

For the home user start with Model A with its massive 144K RAM and outstanding typewriter style keyboard that fits within the base unit for portability and storage.
Note the large return key and position of the numeric keyboard. Fast retrieval from storage and fast action on games is achieved by the use of the Intel 8086 True 16-bit micro-processor running at 4.77 MHz.
The Advance 86 runs IBM PC software.

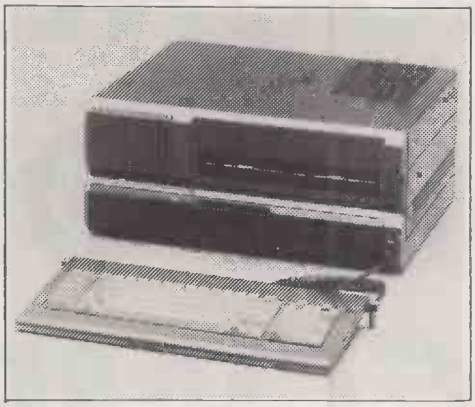
Specification

CPU Type	True 16-bit 8086 running at 4.77 MHz.
RAM	128K or 256K with parity plus 16K video
Languages Included	Basic
Type of Keyboard	Full 84 keys tactile
Keyboard Facilities	10 programmable keys
Character Set	256 in ROM
Method of Display	TV, RGB, Comp/Sync colour or monochrome monitor
Display Facilities	Full screen handling, 4 screen paged
Text	80 x 25 or 40 x 25
Graphics Resolution	320 x 200 or 640 x 200
Colours Available	16
Graphics Facilities	Scroll, reverse image
Cassette Recorder	Audio
Interfaces Included	Cassette port, light pen, joystick, Centronics
Sound	Built-in speaker
Operating System	Built-in ROM
Printers	Any using Centronics parallel interface
Comments	Hardware and software compatible with IBM PC Upgradeable to Model B Provision for 8087 Arithmetic Processor
Warranty	12 months

Benchmarks

The standard Benchmarks were run using Advance Basic, which is the equivalent of Microsoft GWBasic and Basica on the IBM PC.

Machine	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Av.
Advance 86 — 8086	0.8	3.3	7.3	7.4	8.1	14.6	23.9	26.0	11.4
ACT Apricot — 8086	1.6	5.2	10.6	11.0	12.4	22.9	35.4	34.4	16.7
IBM PC — 8088	1.2	4.8	11.7	12.2	13.4	23.3	37.4	30.0	16.8



The business user can upgrade to Model B by adding the Advance Expansion box containing 2 × 5.25" disc drives providing 720K storage at £740 + VAT.
The Advance 86 Model B offers the business micro-computer buyer an IBM compatible disk-based system with twin drives, with Perfect Writer/Speller, Calc and Filer Software (MS/DOS) included for only £1086.95 + VAT.

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Tel: 01-609 0061 for leaflet:

On site warranty for 12 months by National Advanced Systems (part of National Semiconductor) one of the largest companies in the U.S.A. for Model B.
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□ Please send Model 86B which includes Model 86A plus Expansion Box & Software. I enclose £1250 inc. VAT.
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● Circle No. 121

Which micro?

Glyn Moody introduces our 20-page buyers' guide to some of the best micros around at the moment.

MAKING LISTS is as natural as counting: both are attempts to impose some kind of order on an apparently chaotic world. Since the world of microcomputing is notoriously chaotic, making lists is a popular pastime within it.

A list can tell you various things. The more complete it is, the more facts you have, and the less real information. On the other hand, a list of one — that is, a single recommendation — gives you no sense of the context in which the list was made. You either trust it or not. The Hot 100 aims to steer clear of both these problems.

The only hope you have of making even vaguely sensible judgements about machines is by comparing like with like. For this reason we have divided the Hot 100 up into various categories, each of which contains five, 10 or 15 machines which are in some sense comparable. Except for the first category, machines are given in purely alphabetical order. There is no attempt to rank machines within each class. However, sometimes one micro may stand out from the field and this is noted.

The criteria for selection within each class are fairly flexible. Cheap machines may be included because they represent good value, even though they have ordinary specifications. On the other hand, micros that are innovative or important may be included despite the fact that they are expensive — and, of course, sudden price changes in the micro business can change the desirability of a machine.

The classes themselves are loosely defined and sometimes overlapping. For example, there is little difference between a good beginners' home micro and a serious one: machines like the Amstrad straddle the divide quite easily. Similarly, many multi-user systems use an S-100 bus, so the separation of the two is often arbitrary. So if you are after one particular type of machine it is worth looking at those in nearby classes as well as the one you are specifically interested in.

Cheaper machines are placed at the beginning of the guide, and more expensive ones at the end. So nearby groups tend to have similar prices. The price given is usually for the entry-level system. For home machines it normally includes VAT; for business systems VAT must be added. Different manufacturers seem to have varying ideas about what constitutes a basic system: many prices do not include handy items like screens, and some lack keyboards or operating systems. Prices are also constantly changing, so check with the manufacturer or distributor for the latest figures.

Starter systems
These are machines that would be suitable for a beginner either upgrading from a video games machine or really just not sure whether to buy a computer anyway. These machines let you find out.

Homes/games micros
Machines which form the bulk of the market. They are stable, usually have very large software bases, and are well catered for in terms of peripherals. The scene of much fierce price-cutting.

Home/serious micros
The area where most of the interesting developments are happening in the home field. Micros in this class are more likely to be used for word processing, simple accounts or advanced program development.

Pocketables
A new breed of micros that has yet to take off in a big way. One criterion for inclusion is that they must have a usable Basic.

Lap portables
More and more of these battery-powered A4-size computers are coming along. Some offer real computing power that can be carried in a briefcase and used on the lap.

Portables
This category includes some of the more innovative portable machines, which may be battery or mains powered. Other standard portables can be found in the eight- and 16-bit groups.

Eight-bit transportables
These tend to be fairly bulkly CP/M computers equipped with a handle.

Eight-bit desk-top micros
The first generation of business machines, some of which have gained new leases of life.

Eight/16-bit micros
An interesting class of dual-processor machines that offer both eight- and 16-bit capabilities.

Transportable IBMulators
A range of machines combining IBMulation with transportability.

Desk-top IBMulators
This is the class that is currently sweeping the business market. It would be easy to list 20 to 30 nearly identical IBM PC compatibles.

MS-DOS micros
These are 16-bit micros that cannot claim full IBM compatibility.

68000-based micros
The other main class of 16-bit machines, using the powerful and interesting Motorola 68000 chip.

S-100 bus micros
These black box machines offer a huge range of options, including multi-processor operation, multi-user systems and multi-tasking.

Multi-user systems
Machines which are sold mainly on their ability to handle several users at once. May be S-100 or single-board designs.

Specialised systems
Covers a multitude of machines that have one or more special or unusual feature, or are designed to tackle a particular kind of task.

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Hot 100: starter systems

SINCLAIR ZX-81 £39.95 or less

Sinclair Research's classic ZX-81 brought microcomputing to the masses. It may have a horrible touch-insensitive keyboard, only 1K of on-board RAM, a primitive Basic, no colour and no sound, but it has always been affordable. Now it is down to £40 and you can haggle for a 16K RAM pack. Though there is a huge range of add-ons to expand the ZX-81, at its simplest it provides an excellent introduction to real computing. It has a good manual, there are lots of books about it, and it is still well supported by the magazines. After six months with it you will know enough to make a sensible choice about your next machine, while your old ZX-81 can be swapped, sold or used as a paperweight.

For. Cheap, simple, disposable. Has good manuals.

Against. Awful keyboard. No colour or sound.

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

AQUARIUS £49.95

The Aquarius is made by Radofin, a British company with a factory in Hong Kong. It was launched on to the U.K. market in July 1983 by Mattel, but at £79.95 it was far too expensive and failed to catch on. Now back in the care of its maker it is making some progress as the only micro under £50 with colour and sound. Unfortunately it has only about 2K of RAM free for Basic programming, and it costs far too much to expand — you might as well buy a proper micro in the first place. In its unexpanded form it has advantages over the ZX-81 — a better keyboard, for example — but it does not have the ZX-81's large following, and therefore not the same support from software houses and magazines.

For. Cheap. Expandable. Has colour and sound.

Against. Limited RAM and Basic. Expensive to expand.

Radofin Electronics (U.K.) Ltd, Hyde House, The Hyde, London NW9 6LG. Telephone: 01-205 0044.

ATARI 600XL £99.99

Thanks to its advanced sound and graphics chips, the 16K Atari 600XL is one of the most powerful home micros around, with 16 graphics modes, four sound channels and two joystick ports, a cartridge slot and a good keyboard. Accessories include RAM expansion to 64K, printers, touch tablets, etc. and some of the best-quality software on the market. The main drawbacks are that it requires its own special audio/digital tape recorder, and it has a limited 8K Basic. The real reason it is so cheap is that Atari, under aggressive new management, has just cut the price from £160 to clear out old stock and concentrate on the 800XL.

For. Great for games. Great value.

Against. Might be discontinued.

Atari Corporation (U.K.) Ltd, Atari House, Railway Terrace, Slough. Telephone: (0753) 33344.

SPECTRUM £99.95-£129.95

The Sinclair Spectrum, a Z-80 micro available in 16K and 48K versions, is today's dominant home computer, though it has now lost the price advantage partly responsible for its success. Its major limitations are the clammy rubber keyboard, the barely audible beeper that passes for sound, and the lack of things like joystick ports, a cartridge slot or ways to attach a disc drive or proper printer. They all cost extra. On the other hand, the Spectrum is extremely well supported with books, magazines, add-ons and millions of game-crazed addicts writing thousands of cheap programs. The sheer volume of software makes it worth owning a Spectrum. Six of the best programs are currently free to buyers of the 48K model.

For. Vast range of cheap software. Amazing games.

Against. Fairly awful hardware. Not for serious use.

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

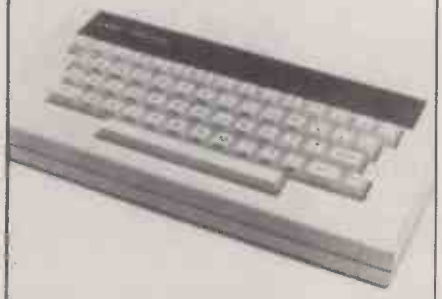
COLECO ADAM £499

Several video-game manufacturers promised to expand their consoles into computers. Coleco, after a long wait, has delivered. The Adam, added to the Colecovision video games machine, provides a Z-80A system with 80K of RAM, Applesoft-type Basic, a built-in word processor, a proper IBM-type keyboard, two games controllers, a fast tape cassette drive plus, the *pièce de résistance*, a daisywheel printer — all for around £500. The printer is huge, somewhat noisy and does not really produce a high-quality image. Nonetheless, for anyone who already has a Colecovision console and some of the excellent games available, the Adam provides not only a way into microcomputing but a useful home system.

For. Easy way to buy a usable system.

Against. Not cheap. Little third-party support.

CBS Colecovision, Headley Road East, Woodley, Berkshire RG5 4SG.



ACORN ELECTRON £199.95

The Electron is a sort of cut-down BBC Model B. Sadly, it has been cut down too far, and most of the best features of the BBC model B, except the Basic, are missing. It has one-part sound, no mode 7 graphics, no sideways ROM sockets, no Tube for second processors, and so on. It has no joystick ports and no cartridge slot — it costs £60 to add these — and as it stands it cannot drive discs or a printer. It is further crippled by its small memory: it has only 32K of RAM, and the graphics can take up to 20K of this, leaving very little for programming. Finally, at nearly £200 it is far too expensive for a 32K micro that appears to have only one use: learning BBC Basic.

For. BBC Basic.

Against. Limited memory. Very expensive. Limited expansion.

Acorn Computers Ltd, Fulbourne Road, Cherry Hinton, Cambridge CB1 4JN. Telephone: (0223) 245200.

ATARI 800XL £169.99

The Atari 800XL is a 64K 6502-based micro with custom-made dedicated graphics and sound chips which make it one of the most advanced machines on the market. It has four sound channels and 16 graphics modes offering a range of 256 colours. It also has a good keyboard, a cartridge slot, joystick ports, a wide range of peripherals and a great selection of high-quality games. Its main drawbacks are its limited 8K Basic and shortage of more serious software. High U.K. prices have made it less popular here than elsewhere, but now they have been slashed it should do better. Unlike the 600XL, the 800XL is expected to continue after the launch of Atari's new 16/32-bit micros next year.

For. Cheap. Excellent software.

Against. Limited Basic. Dedicated peripherals.

Atari Corporation (U.K.) Ltd, Atari House, Railway Terrace, Slough. Telephone: (0753) 33344.

COMMODORE 16 £139.95

The Commodore 16, one of the newest micros on the market, is a replacement for the out of date Vic-20. It looks like a Commodore 64 and has a 6502-type processor but only 16K of RAM, most of which can be taken by the graphics. However, its 32K ROM contains a new version of Basic which is vastly superior to the Commodore 64's. It also has two joystick ports and an expansion bus to which cartridges can be attached. The drawbacks are that it has non-standard joystick ports and cassette interface and, being a new machine, almost no software. Though it seems expensive, it is quite reasonable value since the price includes the Commodore 16's cassette recorder and four free programs.

For. Excellent Basic.

Against. Limited memory. Little software available.

Commodore Information Centre, 1 Hunters Road, Weldon, Corby, Northamptonshire NN17 1QX. Telephone: (0536) 205252.

COMMODORE 64 £199

After two years on the market the Commodore 64 has become a worldwide best seller, challenging even the Spectrum in the U.K. It uses a 6502-type chip and has 64K of RAM. It has good graphics and outstanding sound facilities, a very large software base which stretches from novelty games to serious business programs, and lots of add-ons available. The 64 does have flaws. It has an awful Basic with no sound and graphics commands, so it is hard to program. Its cassette and disc operating systems are incredibly slow. Nevertheless the Commodore 64 is worth buying because it is well supported, has some outstanding software and can do real work as well as play games.

For. Range of software and add-ons available.

Against. Awful Basic and manuals.

Commodore Information Centre, 1 Hunters Road, Weldon, Corby, Northamptonshire NN17 1QX. Telephone: (0536) 205252.

ENTERPRISE £249

The Enterprise was first announced a year ago but has yet to appear. However, it cannot be ignored because, on paper it promises to become the best home micro on the market. It uses a Z-80 with 64K of RAM. It also has two custom-designed chips to provide sound and graphics above Atari/Commodore/BBC levels, and RAM can be expanded up to 3.9Mbyte. The Enterprise promises the best structured 16K Basic of any micro since it is being based on ANSI standards, and in a further 32K ROM it has a built-in word processor. It all sounds very wonderful, but designing a machine on paper and delivering in quantity to the shops are two very different things.

For. Superb specification.

Against. Not yet delivered.

Enterprise Computers, 31-37 Hoxton Street, London N1 6NJ. Telephone: 01-739 4282.

MSX £275-£280

The MSX system represents the Japanese challenge to the dominant Western micro industry. The American software company Microsoft drew up the specification, which includes the Zilog Z-80 and its own excellent Basic language. Some 17 or more companies are all making micros to this same specification, with the idea that software and peripherals will be interchangeable between them. The aim is laudable. The result, however, has been a series of Identikit micros which subscribe to a standard that is already out of date. Though well made and apparently reliable, they are about £100 more expensive than established micros with more raw power and more software. The prices may come down soon.

For. Standardised software. Excellent Basic.

Against. Boring hardware. Lack of software. Price.

MSX micros are made by Canon, Hitachi, JVC, Mitsubishi, Sanyo, Sony, Teleton, Toshiba and others.

ORIC ATMOS £189.95

The Atmos is a debugged and upgraded version of the Oric 1, and if the Oric 1 had been the Atmos it might have given the Sinclair micros a difficult time. It has a good keyboard, excellent sound facilities and reasonable graphics. The screen display uses the unusual serial-attribute system, but this is economical in the use of memory. When it comes to memory, the Oric claims 48K but actually uses 64K chips, so there is lots of room for programming. It also has a Centronics-type printer port, and can take the 3in. Oric disc drive and a modem. What it lacks are joystick ports, and the large software base that only comes through being popular.

For. Ear-destroying sound synthesiser.

Against. Lacks large base of good software.

Oric Products International Ltd, Coworth Park, London Road, Ascot, Berkshire SL5 7SE. Telephone: (0990) 27641.

SHARP MZ-700 £250

The MZ-700 is a beautifully made, quite fast Japanese home micro with a Z-80 CPU and 64K of RAM. The problem with the design is that it is old-fashioned. It does not have high-resolution graphics. It does not even have user-definable characters. Thus it is not very attractive to games writers. As it has a very good keyboard and good range of I/O ports it appeals to the more serious user, but unfortunately it is not really a business machine either — it falls between the two stools. One special feature of the MZ-700 is that you can fit a cassette recorder and printer inside the case, but they cost extra, and even then the machine does not become a good portable micro.

For. Well made. Good keyboard.

Against. Limited graphics. Expensive.

Sharp Electronics (U.K.) Ltd, Sharp House, Thorp Road, Newton Heath, Manchester M10 9BE. Telephone: 061-205 2333.

SPECTRUM PLUS £179.95

The Spectrum Plus is really a 48K Spectrum; only the casing has been changed to make it more like a proper computer. It sports a keyboard with real moving keys styled like that of the QL. Unfortunately the keyboard layout is weird, and unsuitable for anything except two-finger typing. The Plus is very slightly faster, and has a more stable display than the previous models. The sound has not been improved by much, nor have more facilities such as a built-in Interface 1 been added. The Plus comes with six software packages included in the price, but this does not make it a better machine, let alone worth more, than a Commodore 64 or Atari 800XL.

For. Rigid keys. Bundled software.

Against. Awful keyboard layout. Price.

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

TANDY COLOR £100-£200

The Tandy Color Computer 2 is an American micro based on the powerful Motorola 6809 chip, and is available with 16K, 32K or 64K of RAM. The hardware design is very similar to the Dragon, except that it is much better made. Both can run many of the same machine-code programs, and Basic programs can be converted if not loaded in directly from tape. The Extended Microsoft Basic is one of its best features, but it has a horrible line editor and you can only get the best out of the limited graphics and sound facilities via machine code. Where the Color Computer really becomes interesting is when used with a disc drive and the low-cost Unix-like OS-9 operating system and Basic 09, Pascal and C.

For. Good Basic. OS-9 available.

Against. Limited sound and graphics. Keyboard.

Tandy Corporation (U.K.) Ltd, Tameway Tower, Bridge Street, Walsall, West Midlands WS1 1LA. Telephone: (0922) 648181.

ACT APRICOT F1 £995

With the launch of ACT's F1 and F1E machines, the Apricot family is now accessible to the serious home user. The F1 offers an 8086 processor, 256K RAM as standard, a 720K microfloppy, serial and parallel ports plus infrared keyboard; a monitor is extra. Bundled in the price are a word processor, spreadsheet and a diary from the Supercalc suite. ACT also offers the F1E, a cut-down version aimed at the higher-education market. Instead of the MS-DOS that comes with the F1, DR Logo is provided. Both the RAM and the discs have half the capacity of the full-blown machine. One big advantage of the F1 and the whole Apricot range is the ease with which you can upgrade while retaining full compatibility.

For. Full 16-bit power. Large memory and disc.

Against. Price.

ACT plc, Hagley Road, Birmingham B16 8LB. Telephone: 021-454 8585.

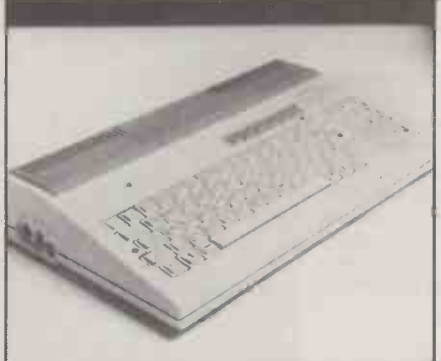
ADVANCE 86A £400

When the British-built Advance machine was first announced its specification seemed pretty incredible. For £400 you get an IBM compatible with 128K RAM, IBM Selectric-type keyboard and Microsoft's GWBasic. For an extra £900 you can add two 360K IBM-format discs, MS-DOS, application software and a serial port. Since its launch the machine has kept a lower profile, but there are no indications to suggest that its initial promise has been unfulfilled. With a full 128K RAM as standard, of which 64K is available from Basic, the Advance is considerably more roomy than the BBC, which costs the same. Its IBM compatibility opens up the fastest growing software base. Initial tests indicate that most IBM programs will run on the Advance.

For. Price. IBM compatibility.

Against. Bulky plastic construction. Limited cassette software.

Advance Technology (U.K.) Ltd, 8A Hornsey Street, London N7 8HR. Telephone: 01-609 0231.



ALPHATRONIC PC £347

The Alphatronic PC is made by Triumph-Adler, a company better known for its office equipment. The Alphatronic PC offers a very high-quality keyboard and provision for expansion. Built around the Z-80 processor, it comes with 64K of RAM, a cassette interface and both colour TV and monitor expansion sockets. Serial and parallel ports together with an expansion bus are provided as standard. The £330, 320K add-on floppy-disc drive comes with CP/M, so the Alphatronic PC is capable of running all sorts of office software packages as well as games. Even the standard cassette-based machine comes with a very thorough Basic in 24K of ROM.

For. Good keyboard. CP/M option.

Against. Not much games software.

Triumph-Adler (U.K.) Ltd, 27 Goswell Road, London EC1M 7AJ. Telephone: 01-250 1717.

AMSTRAD £239

The CPC-464 computer represents the first foray into the computer world by the hi-fi firm Amstrad, and it would be an impressive one even from a seasoned manufacturer. Individually its specifications are pretty standard, but taken together they represent about the best serious home buy around. There is 64K of RAM and a Z-80A running at 4MHz. The Locomotive Basic included as standard outperforms even the BBC variety. There are good sound facilities and full-colour circuitry. For £349 you not only get the micro and a colour monitor but also a built-in cassette recorder. A 3in. disc-drive option is also promised, which will come with CP/M, allowing access to a vast range of business software.

For. Complete system. Upgrades.

Against. Nothing.

Amstrad, 169 Kings Road, Brentwood, Essex CM14 4EF.

APPLE IIe £600

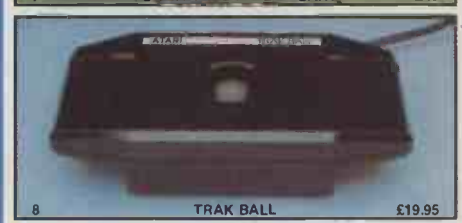
Apart from virtually starting the whole micro boom, the Apple II is now very much all things to everyone. In the U.S. it is predominantly a home machine, though it is also widely used in scientific applications because of its unrivalled software base. But in the U.K. its price has meant that it has tended to surface more as a business machine, so it offers the best of both worlds for the serious user. However, its specification of eight-bit 6502 with up to 64K RAM is beginning to look old-fashioned, and it is hardly one of the fastest machines around. But its expansion slots mean that your can add on almost anything, and the versatility of the machine seems to know no bounds.

For. Huge software base. Expandability.

Against. Expensive. Elderly.

Apple Computer (U.K.) Ltd, Eastman Way, Hemel Hempstead, Hertfordshire HP2 7QH. Telephone: (0442) 60244.

(continued on page 117)



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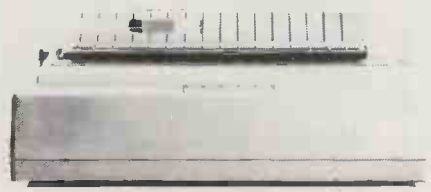

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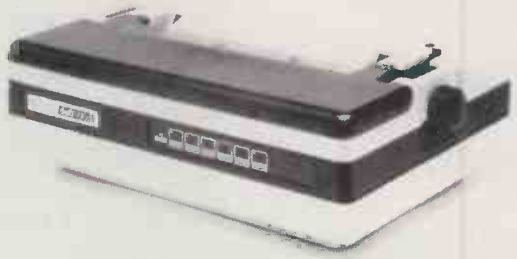

Quen-Data DWP 11/20
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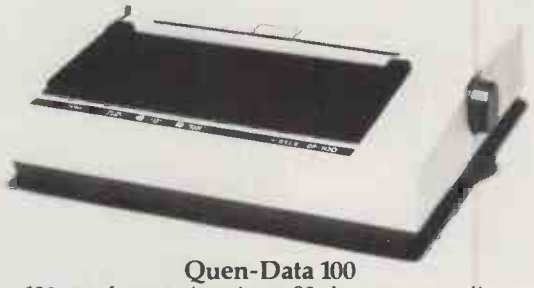
E.U. Price £349 †Dealer Price £279



Quen-Data 100
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Hot 100: home/serious

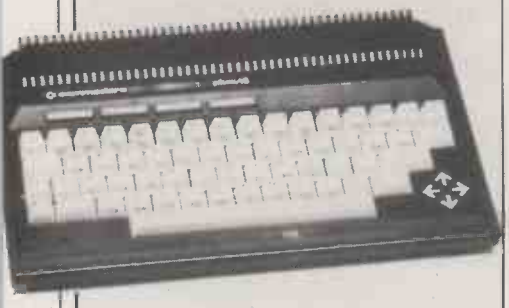
BBC MODEL B £399

In many ways the BBC Model B represents the perfect serious home micro. It is very fast and can cope with solid number-crunching. It has a wide range of expansion possibilities, including a Z-80 second processor for CP/M, and a second 6502 for high-resolution graphics and even greater computational power. The software base is geared very much towards the serious side of micros too, and the BBC is well supported in standard applications. However, it is overpriced and discs are scandalously expensive. Also the standard 32K RAM looks very measly. The new business machines from Acorn go some way to alleviating these problems.

For. Fast. Good software base.

Against. Price. Limited memory.

Acorn Computers Ltd, Fulbourn Road, Cherry Hinton, Cambridge CB1 4JN. Telephone. (0223) 245200.



COMMODORE PLUS-4 £299

In the past Commodore has thrived almost despite its machines; its flagship, the Commodore 64, was shoddy in construction and had a Basic that was high on everyone's hit list. The came the Plus-4, which is everything a micro should be. It is well built, with 64K RAM, and has a Basic that is almost structured. In addition, there are four applications resident on ROM, a tolerable word processor, a useful spreadsheet, a primitive graphing facility and a database which will only work with a disc drive attached. On the games front there are no sprites, sound facilities are limited and the Basic is incompatible with previous versions.

For. Solid construction. Good Basic. Bundled software.

Against. Incompatibility. Limited sound.

Commodore Business Machines (U.K.) Ltd, 675 Ajax Avenue, Slough, Berkshire SL1 4BG. Telephone: (0753) 74111.

EINSTEIN £500

The Einstein is an odd beast. Apart from a Z-80A and 64K RAM, the machine also offers a 3in. Hitachi microfloppy with a capacity of 200K. It features games options such as sprites, 16 colours and three music channels with a six-octave range. So it sits between the normal home market and the more expensive business machines. The operating system Xtal-DOS is claimed to have a high degree of CP/M compatibility, which would be useful for serious applications. For pure home use, the Einstein is hampered by the lack of a cassette port. Although discs are fine, for backup or loading games software a cassette option would have been sensible.

For. Disc drive. Good sound.

Against. No cassette port. Large footprint.

Tatung (U.K.) Ltd, Bridgnorth, Shropshire WV15 6BQ. Telephone: (07462) 15721.

MEMOTECH RS-128 £399

The Memotech RS-128 is an expanded version of the MTX-512. It comes with 128K RAM and 16K video RAM. The processor is a Z-80A running at 4MHz. The 24K ROM holds MTX Basic, which has extended graphics, sprites and window commands, an assembler and the text-handling language Noddy. There are four channels of sound under software control. In the high-resolution graphics mode, there are 16 colours and 256 by 192 pixels. In text mode, 40 lines by 24 characters are available. As well as a cassette port, two joystick ports and a Centronics printer port there is a communications board with two RS-232s which can be added internally. A disc drive costs an extra £399, and offers 500K capacity. There is also the unusual option of a silicon disc.

For. Large RAM. Disc option. Silicon disc.

Against. Unusual Basic.

Memotech Ltd, Station Lane, Industrial Estate, Witney, Oxfordshire OX8 6BX. Telephone: (0993) 2977.

SINCLAIR QL £399

The QL saga has been one of the most involved and interesting micro stories this year, provided you have not been part of it. When all the hype and disinformation had died down, what emerged was a wobbly, 68008-based machine with 128K RAM as standard and four bundled packages. There are many things still to be sorted out: the Basic is slow, and Microdrive cartridges are unreliable. But the four Psion programs offer a powerful, if slow, word processor; a full spreadsheet facility; a colourful graphics package; and a useful programmable database. If the QL succeeds on the same scale as previous Sinclair products, then its general incompatibility should be no handicap.

For. Bundled software. Large RAM.

Against. Microdrives. Slow Basic.

Sinclair Research, Computer Division, Freepost, Camberley, Surrey GU15 3BR. Telephone: (0276) 686100.

CASIO PB-100 £50

Although it looks like a large pocket calculator, Casio's PB-100 qualifies as a genuine computer: it comes with a useful if simple Basic in ROM, and packs a miniature QWERTY keyboard with separate numeric keypad and a 12-character LCD display into its 6.5in. by 2.75in. dimensions. Standard RAM is 1K, expandable to 2K by adding a £14 module. Up to 10 programs can be held in memory, which are retained even with the machine switched off. Numeric results are displayed to 10 significant digits but the Basic's string handling is limited. The user manual is particularly good. A cassette interface and printer are available, costing around £26 each.

For. Cheap. Basic makes it far better than calculator. Good manual.

Against. Limited RAM expansion. Limited string handling in Basic.

Casio Electronics Co. Ltd, Unit 6, 1000 North Circular Road, London NW2 7DJ. Telephone: 01-450 9131.

CASIO PB-700 £139

Top of the small-key Casio range. Measuring 8in. by 3.5in., the PB-700 has a four-line by 20-character LCD, which can also show 32- by 160-dot graphics, and small QWERTY keyboard with numeric pad. Standard RAM is 4K, expandable to 16K by adding 4K modules, which cost £30. The Basic has good string-handling facilities, with Lefts$, Rights$, Mids$ and Inkey$ functions, and includes plotting commands. A battery-powered four-colour printer/plotter unit printing on to 4.5in. paper is available for £194. The printer unit also contains a cassette interface, to which you can fit the Casio microcassette deck to form a single neat battery-powered system. A parallel printer port is also available, but not an RS-232.

For. Large display. Good printer option. Good Basic.

Against. No RS-232 option. Less software than Sharp.

Casio Electronics Co. Ltd, Unit 6, 1000 North Circular Road, London NW2 7DJ. Telephone: 01-450 9131.

HP 75D £851

Upgraded version of the 75C with a bar-code reader port. Measuring 10in. by 5in., the HP 75D has calculator-style keys in a QWERTY layout with almost typewriter spacing, and a single-line 32-character LCD. Standard 16K of RAM is expandable to 24K. A powerful Basic with 12-digit numeric precision is contained in 48K of ROM, along with diary/alarm and address list programs. VisiCalc is available on a plug-in ROM for £160. A built-in magnetic card reader lets you store 1.3K per card, and a wide range of technical and financial software is available on cards or ROM chips. The HP 75D is fitted with an HP-IL socket which lets you connect to a full-size display as well as to HP peripherals and other HP computers.

For. Superb Basic. Optional VisiCalc. Wide range of add-ons.

Against. Expensive. Peripherals and software expensive.

Hewlett-Packard Ltd, PC Group, King Street Lane, Winnersh, Wokingham, Berkshire RG11 5AR. Telephone: (0734) 784774.

HUSKY HUNTER £997

The extremely robust Husky Hunter is the smallest machine running CP/M software. It has a cast aluminium case measuring 8.5in. by 6in., and a compact QWERTY keyboard which is sealed and waterproof. The eight-line by 40-character LCD can also show 64- by 240-dot graphics. Standard RAM is 80K, expandable to 208K, some of it configurable as a silicon disc. A CP/M 2.2 compatible OS, Microsoft Basic, text editor and communications software to drive the machine's RS-232 port are supplied in ROM. The Hunter's CMOS processor, the NSC-800, runs at 4MHz, so this extremely portable battery-powered micro can run CP/M software as fast as a typical eight-bit desk-top system. Options include modems and a mains-powered disc drive.

For. Vast CP/M software base. Fast. Very tough.

Against. Not much.

Husky Computers Ltd, PO Box 135, 345 Foleshill Road, Coventry CV6 5RW. Telephone: (0203) 668181.

SHARP PC-1500A £189

Newly upgraded version of the long-established PC-1500, with more RAM and greater expansion possibilities. Measuring 8in. by 3.5in., the Sharp PC-1500A has a compact QWERTY keyboard with separate numeric keypad and single-line 26-character LCD. The standard RAM is now 9K, expandable to 24K. Some 16K of ROM contains a powerful Basic, with full string handling, arrays and scientific functions. A range of scientific, engineering and financial programs are available as plug-in ROMs. A combined cassette interface and printer/plotter unit costs £150; it plots in four colours on narrow roll paper. A combined RS-232 and parallel interface unit is also available for connecting the PC-1500A to larger computers and full-size printers.

For. Good Basic. RS-232 option and printer/plotter option. Well established.

Against. Small display.

Sharp Electronics (U.K.) Ltd, Sharp House, Thorp Road, Manchester M10 9BE. Telephone: 061-205 2333.

Hot 100: lap portables

EPSON HX-20 £411

Well-established A4-sized battery-powered portable with good range of software and hardware add-ons. Weighing 4lb., the Epson HX-20 has a four-line by 20-character LCD, a good-quality full-sized keyboard and a built-in 24-column printer. Optional £75 microcassette drive fits next to display and is well worth getting for data and program storage. The HX-20 is built around the eight-bit 6301 CMOS processor and comes with 16K of RAM expandable to 48K with clip-on expansion unit. Some 32K ROM holds Microsoft-written OS and Basic, but the software is different to that of the NEC/Olivetti/Tandy machines. A matching battery-powered acoustic coupling modem from Epson costs £160, and a full-size display is available from an independent supplier.

For. Well established. Good software base. Microcassette option.

Against. Screen is too small by current standards.

Epson U.K. Ltd, Dorland House, 388 High Road, Wembley, Middlesex HA9 5UH. Telephone: 01-902 8892.

EPSON PX-8 £798

Powerful A4-sized battery-powered portable, with CP/M and WordStar included in the price. Weighing just under 4lb., the PX-8 has a fold-away LCD which shows eight lines of text across a full 80-columns or 64- by 480-dot graphics. The QWERTY-layout keyboard is full size and of good typing quality. Inside is a CMOS Z-80 look-alike processor running at 2.5MHz, and 64K of RAM. CP/M 2.2 comes built-in, together with WordStar, Microsoft Basic, Cardbox Plus and Calc programs on plug-in ROMs. A built-in microcassette offers storage of 32K per side. A £270 clip-on expansion unit adds 128K of RAM, which is treated by CP/M as a silicon disc. Other options include 5.25in. and 3.5in. disc drives, and a battery-powered modem to plug into the PX-8's RS-232.

For. CP/M and WordStar on battery machine. Big display. Good add-ons.

Against. Not much.

Epson U.K. Ltd, Dorland House, 388 High Road, Wembley, Middlesex HA9 5UH. Telephone: 01-902 8892.

NEC PC-8201 £395

A4-sized battery-powered portable with software in ROM. Weighing under 4lb., the NEC PC-8201 has an eight-line by 40-character LCD and a full-size keyboard. Inside is an eight-bit 80C85 CMOS processor, 16K of RAM expandable to 96K, and 32K of ROM containing a Microsoft-written text-editing program and a full Basic. A cassette interface is built-in. The PC-8201 is built by the Japanese firm Kyocera, which makes the Olivetti M-10 and Tandy 100. The NEC version starts with more RAM and can be expanded further, and its battery-backed RAM expansion cartridges are exchangeable with their contents intact. All the Kyocera variants have a full RS-232 interface and, used with any suitable modem, are ideal for Telecom Gold.

For. Good memory expansion. Good Basic. Nice keyboard.

Against. Less well-established than Tandy variant.

NEC Business Systems (Europe) Ltd, 35 Oval Road, London NW1 7EA. Telephone: 01-267 7000.

OLIVETTI M-10 £430

A4-sized battery-powered portable similar to the machines from NEC and Tandy. Weighing under 4lb., the Olivetti M-10 also has an eight-line by 40-character LCD which pops up for clearer viewing and is probably the most readable. There is a full-size QWERTY keyboard. It is built by Kyocera and uses an eight-bit 80C85 CMOS processor; the base model comes with 8K of RAM, expandable to 32K. A 32K ROM contains Microsoft's text editor, Basic, and simple address list and appointments programs. The Basic is slightly inferior to the NEC's. An RS-232 serial port and cassette interface are standard. Multiplan on ROM costs £95, battery-powered four-pen printer/plotter £140, battery-powered acoustic coupler £250.

For. Good Basic. Nice keyboard. Olivetti name.

Against. Newer than Tandy. Less memory than NEC.

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

TANDY MODEL 100 £390

Well-established variant of the Kyocera A4-sized battery-powered portable. Weighing under 4lb., the Tandy 100 also has an eight-line by 40-character LCD and full-size keyboard with probably the nicest typing feel of the bunch. Eight-bit 80C85 processor and 8K of RAM, expandable up to 32K by adding 8K modules costing £61. The Tandy's 32K of ROM has similar Microsoft-written contents to the Olivetti's. Fitted with RS-232 serial port and cassette interface; mains-powered four-pen printer/plotter and acoustic coupler are options. The Tandy was the first of the three Kyocera machines on the market, and has been very successful in U.S., probably giving it the most software, though this lead is diminishing. Multiplan is promised for January, price £87.

For. Good Basic. Excellent keyboard.

Against. Less memory than NEC. Less scope for memory expansion than NEC.

Tandy Corporation, Tameway Tower, Bridge Street, Walsall, West Midlands WS1 1LA. Telephone: (0922) 648181.

APRICOT PORTABLE £1,695

Innovative mains-powered portable with flat-screen display and voice input. Weighing 13lb., the Apricot Portable has a large LCD capable of showing 25 lines of 80 characters or 640- by 256-dot graphics. Inside is an Intel 8086 processor and 256K of RAM, expandable to 768K. A full-size QWERTY keyboard is connected to the main unit by a cordless infrared link. A built-in double-sided Sony 3.5in. microfloppy provides 720K of disc storage. The Portable comes with a voice-recognition system capable of recognising about 64 words at a time. MS-DOS, Supercalc, Superwriter and Superplanner are included in the price, along with two simple voice-driven applications. Other options include a cordless infrared mouse, an external 10Mbyte hard disc and a colour monitor.

For. Good looks. Bundled software. ACT's large software list.

Against. Voice input is a gimmick. Apricot F1 is better value.

ACT (U.K.) Ltd, Shenstone House, Dudley Road, Halesowen, West Midlands B63 3NT. Telephone: 021-501 2284.

DG THE ONE £2,490

Extremely powerful battery-powered portable computer offering genuine IBM PC compatibility, but at a price. Weighing 9.5lb., Data General's The One has a very large LCD panel measuring 10in. diagonally, which can show 80 by 25 lines of text or 640- by 256-dot graphics. The QWERTY keyboard layout feels slightly cramped but Data General claims it to be full size. Inside The One has a CMOS 80C88 processor, 128K of RAM expandable to 512K, and 64K of ROM containing text editor and comms software. A Sony 3.5in. drive, capacity 720K, is built into the side of the machine, with a second optionally available. MS-DOS is included in the price, and the system is IBM compatible to the extent of being able to run the Microsoft Flight Simulator. The One is reviewed on page 78 of this issue.

For. Battery-powered IBM compatibility. Large memory. Built-in disc.

Against. Vast but barely readable display. High price.

Data General, Hounslow House, 724-734 London Road, Hounslow, Middlesex TW3 1PD. Telephone: 01-572 7455.

GRID COMPASS £3,995

Tough but expensive mains-powered micro with bubble memory and electroluminescent display. Weighs 10lb. The 6in. display can show 25 lines by 80 characters of text or 240- by 320-dot graphics. The Compass has a hard magnesium alloy outer casing, and a full-size QWERTY keyboard. Inside is an Intel 8086 processor, an 8087 maths co-processor, 256K of RAM expandable to 512K, and 384K of bubble memory. To load bubble memory you need to connect to another Compass through the serial port, or use the separate 360K floppy-disc unit, which costs £1,150. The new model Compass II, price £6,495, has sockets to take 512K of software on ROM, so it can be used without discs. MS-DOS and applications software costs extra.

For. Readable display. Tough.

Against. Price. Expensive software and peripherals.

Grid Computer Systems Ltd, Unit House, 33 London Road, Reigate, Surrey RH2 9HZ. Telephone: (07372) 41211.

HP 110 £2,595

Powerful battery-powered portable with very good bundled software. The HP 110, which is also sometimes called the HP Gypsy, weighs 6.5lb. and has a full-size keyboard. A fold-down LCD shows 16 lines of 80 characters or 126- by 460-dot graphics. Inside is an Intel 8086 processor and 272K of RAM, some of it configured as a silicon disc. The HP 110 also comes with a massive 385K of ROM, containing MS-DOS, Lotus 1-2-3, HP's Memomaker word processor and comms software, as well as a user-friendly front end to MS-DOS similar to that offered on the HP 150 desk-top machine. Options include a battery-powered 3.5in. Sony disc unit and batter-powered acoustic coupling modem, which connect to the HP-IL and RS-232 ports fitted as standard to the 110.

For. Lotus 1-2-3 in price. Good range of add-ons.

Against. Keyboard not perfect.

Hewlett-Packard Ltd, PC Group, King Street Lane, Winnersh, Wokingham, Berkshire RG11 5AR. Telephone: (0734) 784774.

SHARP PC-5000 £1,195

Competitively priced battery-powered portable with MS-DOS and optional bubble memory. The Sharp PC-5000 comes with eight-line by 80-character liquid crystal display also capable of showing 80- by 640-dot graphics, and a full-size QWERTY keyboard. Inside is an Intel 8088 processor, 128K of RAM expandable to 256K, and 64K of ROM containing MS-DOS 2 and GWBasic. A plug-in 128K bubble memory module adds £169 to the price. An optional battery-powered A4 printer, price £275, clips on to the PC-5000 to form a single neat portable unit. An external floppy-disc unit housing two 320K 5.25in. drives is available for £675, and some software, including Supercalc, Superwriter and Easywriter, is available on bubble cartridge or ROM.

For. Keen price. MS-DOS. Bubble option.

Against. LCD panel hard to read.

Sharp Electronics (U.K.) Ltd, Sharp House, Thorp Road, Manchester M10 9BE. Telephone: 061-205 2333.

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Now the square disks. There are up to four user selectable 128K ROM chips available, all programmed ready with the software you are likely to need on your travels. GRiD's integrated software provides word processing, databases, spreadsheets, graphics and communication tools.

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Orbital Computer Systems, 29 Drumsheugh Gardens, Edinburgh EH3 7RN. Tel: 031 225 7594

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It takes only two minutes and £59.80 to transform your BBC Micro into the heart of a word processor with VIEW from Acornsoft.

The VIEW word processing system is programmed into a single chip, a 16K plug-in ROM. Once it's installed into your BBC Micro – a simple job for your local dealer – you just switch on and VIEW is operating. (You can switch to other programs, like BASIC, with a single command.)

VIEW is a professional system, yet it's surprisingly straightforward to use.

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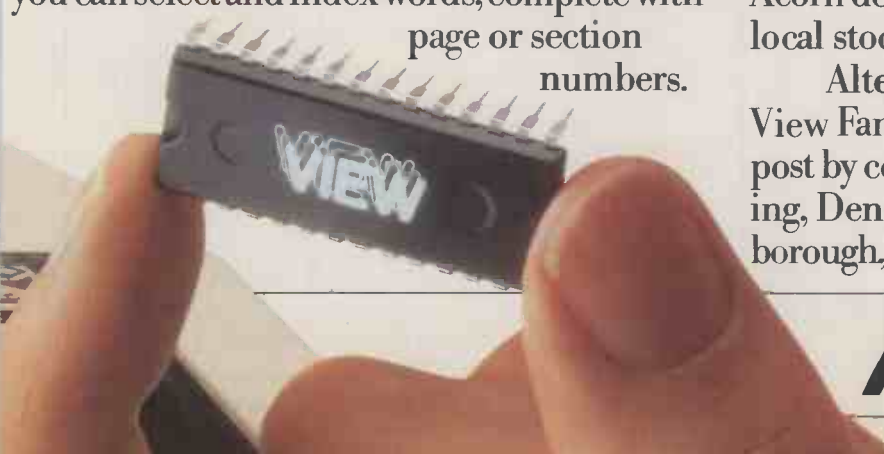
All you do is type out your text on the keyboard, and view it on the screen.

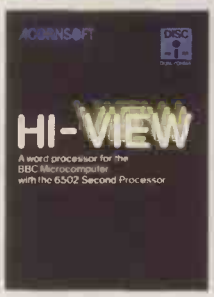
VIEW can search, change and replace particular words whenever they occur in your text. It can swap paragraphs. Automatically alter page numbers. Even count words.

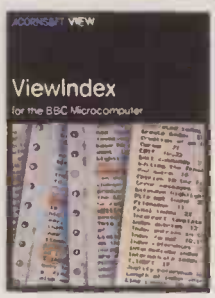
The possibilities are endless, because you can check, edit and change as much or as little as you like until you're satisfied. Then, with a single command, your final version will appear on the screen.

If you want to go even further, the simple addition of ViewIndex, just £14.95, means you can select and index words, complete with page or section numbers.



And of course, when you're ready, any printer that will operate with your BBC Micro will operate with VIEW. But if you want to use the printer's special facilities, such as bold printing or underlining, Acornsoft's Printer Driver Generator (£9.95 on cassette, £11.50 on disc) enables you to do so.





For the more specialised user who wants to take advantage of the extra power offered by the 6502 Second Processor, Hi-VIEW (£59.80) provides 47K of text space in any of the BBC Micro's screen modes.

So whether you're composing a 300 page business document, a letter to the gas board, or a bit of Victorian nonsense, you can polish it to your heart's content, wasting precious little time. And even less paper.

You can get VIEW products from your Acorn dealer. Just phone 01-200 0200 for your local stockist.

Alternatively, you can send off for the View Family brochure and order through the post by contacting Acornsoft, c/o Vector Marketing, Denington Industrial Estate, Wellingborough, Northants NN8 2RL. Tel: 0933 79300.

ACORNSOFT 123

The text on the screen is in Mode 6.

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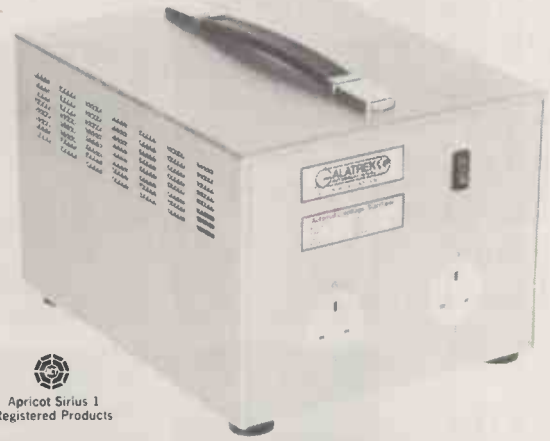

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Simply plug it into the mains and your unit into the socket provided. Spikes, transients and other mains borne interference are now trapped in its circuits and voltage surges or dips are also catered for, as the output is highly stabilised. It also protects itself and the equipment against overload and gives system isolation. If you specify when ordering, it can be used as a step down or step up voltage supply.

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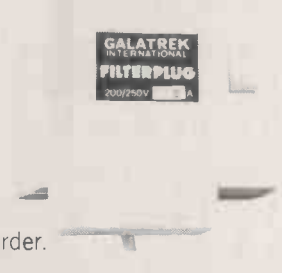

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Hot 100: eight-bit transportables

KAYPRO £1,150

Very competitively priced eight-bit transportable with hard-disc option and good bundled software. Built around the Z-80A, the Kaypro comes with CP/M 2.2, Profit Plan, Basic and Perfect Writer, Speller, Filer and Calc. The machine weighs 26lb. and has a 9in. green screen and 64K of RAM. The base model, the Kaypro 2, has two 200K 5.25in. floppy drives, while the £1,485 Kaypro 4 has two 400K drives and also includes dBase II in the price. Top of the range is the Kaypro 10, £2,635, which has enhanced graphics, one 400K floppy drive and a built-in 10Mbyte hard disc. The Kaypro was voted transportable computer of 1983 by seven European magazines including *Practical Computing*, an honour now accorded to the more expensive IBM-compatible Compaq.

For. Good software. Hard-disc model particularly good value.

Against. Bulky. Unbeautiful.

Kaypro U.K. Ltd, Unit 4, 19 Elmshott Lane, Cippenham, Slough, Berkshire. Telephone: (06284) 75575.

OSBORNE £995

The Osborne 1 is still available for as little as £695 in its 52-column version. Built around the Z-80 processor, the Osborne 1 has 64K of RAM and two 200K 5.25in. floppy drives. Modified to display 80 columns across its 5in. screen it costs £870, and with twin 400K drives the price is £1,365. The Osborne Executive is Z-80 based, and for £1,295 has a 7in. amber screen, 128K of RAM and two 200K 5.25in. floppy drives. It weighs 28lb. Both models come with CP/M 2.2, the UCSD p-system, WordStar, Mailmerge, Supercalc and two Basics; the Executive additionally has CP/M Plus, Personal Pearl, Financial Director and the uprated WordStar 3.3. Hardware options include an external 12in, green screen monitor for £85.

For. Good value bundled software.

Against. Quite heavy. Osborne 1 has very small screen.

Future Management (Portable Computers) Ltd, 38 Tanners Drive, Blakelands, Milton Keynes MK14 5LL. Telephone: (0908) 615274.

PHILIPS P-2000C £995

Range of eight-bit transportables with a variety of disc configurations and good bundled CP/M software. All versions of the Philips P-2000C are built around the Z-80A processor and have 64K of RAM expandable to 320K. The entry-level system, the 2010, has two 160K 5.25in. floppy drives and comes with CP/M 2.2, WordStar, Calcstar, Dataman and MBasic. The £1,690 P-2012 has two 640K floppy drives and the same software plus Graphox business graphics. The hard-disc version is the P-2012W, and has one 10Mbyte disc and one 640K floppy, for £2,995. All the models weigh over 32lb., but they do have a large 9in. green screen which can display 512- by 252-dot graphics. An optional 8088 second-processor board is promised for December.

For. Large display. Good bundled software. Not too ugly.

Against. Heavy.

Kingsway Data Systems Ltd, 30 Guildford Street, Chertsey, Surrey. Telephone: (09328) 68911.

TELEVIDEO TPC-1 £1,595

Eight-bit transportable that easily links into a local area network as well as functioning as a stand-alone CP/M machine. Built around the Z-80A processor, the TPC-1 has 64K of RAM expandable to 128K and comes with CP/M 2.2, Telewrite, Telecalc and Telechart included in the price. The entry-level system has a single 370K 5.25in. floppy-disc drive; a twin-drive version is available for £1,895. Both versions of the TPC-1 weigh about 25lb. and have a 9in. yellow screen capable of displaying 640- by 240-dot graphics. The screen's graphics capacity is supported by the GSX-80 CP/M extension, which also comes with the system. An optional interface allows the TPC-1 to be linked to Televideo's local area network.

For. Good graphics. Large screen. Network option. Televideo name.

Against. Bulky transportable shape.

Thorn EMI Computerald Ltd, The Business Centre, Molly Millar's Lane, Wokingham, Berkshire RG11 2EY. Telephone: (0734) 794664.

WREN £1,000

Competitively priced eight-bit transportable with built-in BT-approved auto-dial modem. Built around the Z-80B, 6MHz version of the eight-bit processor, the Wren has 64K of RAM expandable to 256K and comes with a good set of bundled software included in the price: CP/M Plus, BBC Z-80 Basic, Perfect Writer, Perfect Calc, Perfect Filer, an executive desk-top diary/scheduler program and comms software. The price also includes three months' subscription to Prestel and Micronet 800. The machine weighs under 20lb. and has a built-in 7in. amber screen offering 256- by 512-dot graphics as well as Prestel-type graphics. The standard system has twin 200K 5.25in. floppy-disc drives; with 400K drives the price is £299 extra. A 10Mbyte hard disc costs £1,350.

For. Fast. Good bundled software, including Prestel. BT-approved modem.

Against. Keyboard does not detach. Looks.

Prism Business Systems Ltd, Prism House, 18-29 Mora Street, London EC1V 8BT. Telephone: 01-253 2277.

Hot 100: eight-bit desk-top

APPLE IIc £925

The Apple IIc is a stylish semi-portable business computer using the low-power 65C02 with a built-in 143K floppy. The launch version came with a matching monitor; an alternative model with a 24-line by 80-column LCD is promised. It would have been perverse of Apple to make the new machine incompatible with the older models, and happily it is not. Nearly all Apple-DOS-based software will run on the IIc: only a few older programs making obscure direct calls will be affected. Otherwise the IIc is just like the IIe only better. If you wish to keep using your old Apple software, but want to update your image, this is the machine for you.

For. Semi-transportability. Apple compatibility.

Against. Eight-bit.

Apple Computer (U.K.) Ltd, Eastman Way, Hemel Hempstead, Hertfordshire HP2 7HQ. Telephone: (0442) 60244.

COMMODORE 8296 £795

The Commodore 8000 series has developed from one of the first business micros on the market. The large user base has meant that programs are still available for them, and Commodore is naturally keen to cater for this market. Thus its new machines, the 8296 and 8296D are compatible with the whole range of 8000 software, but offer considerably more in terms of hardware. Based on the 6502, they come with 128K RAM and an integral 80-column by 25-row green phosphor screen. Additionally, the 8296D offers a built-in 2Mbyte floppy. Like the earlier machines in the series, the 8296 uses Commodore's Basic 4.0 and has a detachable keyboard.

For. Base of Commodore business software.

Against. Old technology.

Commodore Business Machines (U.K.), 675 Ajax Avenue, Slough, Berkshire SL1 4BG. Telephone: (0753) 74111.

DASH 80 £1,650

The Dash 80 micro is one of the latest products from Aculab, a company formed in 1978 and manufacturing printer interfaces and controllers. The Dash 80 uses a Z-80B running at 6MHz under CP/M 2.2, and Benchmarks better than many 16-bit machines are claimed. Some 128K of RAM is provided, and it is possible to set up a silicon disc. The dual floppies each have a capacity of 800K. The detached keyboard has four function keys doubling up to eight, a numeric keypad and cursor keys. Bundled software includes WordStar, the WordStar-compatible spreadsheet, Calcstar, and the database application generator, Personal Pearl.

For. Fast. Bundled software.

Against. Not much.

Aculab, Unit A, Station Approach, Leighton Buzzard, Bedfordshire LU7 7LY. Telephone: (0525) 371393.

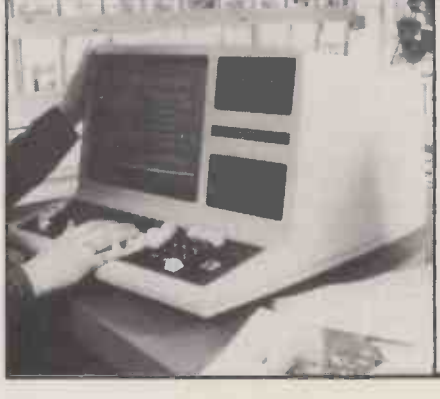
EPSON QX-10 £1,735

The Epson QX-10 is a CP/M machine. It offers 192K RAM expandable to 256K, which is addressed using bank-switching techniques by the Z-80 look-alike. There are two 320K floppies, a 12in. monitor and a 103-key detached keyboard. The main point of interest lies in the QX-10's extended Multifonts CP/M. As well as all the standard operating-system features, Epson has added a very powerful facility which allows you to select from among 16 founts. You can also generate your using a 14-by-18 grid. Epson supplies a Multifonts Basic which lets you use some of these facilities from within programs.

For. Large RAM. Powerful fount capabilities.

Against. Price.

Epson (U.K.) Ltd, Dorland House, 388 High Road, Wembley, Middlesex HA9 6UH. Telephone: 01-902 8892.



TANDY MODEL 4 £749

The Tandy range of computers includes one of almost everything. One of its more standard offerings is the Model 4 which sports a Z-80A running at 4MHz. RAM starts at 64K and is expandable to 128K. The extra memory is accessed via bank switching. There is also a RAM disc option. Storage comes in the form of one or two 5.25in. 184K floppies, and cassette output is also available. A range of operating systems are supported, some more obscure than others, such as TRS-DOS 6.0, TRS-DOS 1.3, and CP/M Plus. Tandy also produces a transportable version, the 4P, which weighs in at 26lb.

For. Bank-switched memory.

Against. Small floppies.

Tandy Corporation (U.K.), Tameway Tower, Bridge Street, Walsall, West Midlands WS1 1LA. Telephone: (0922) 648181.

DEC RAINBOW £2,295

The world's number one mini manufacturer, DEC, has had an embarrassingly rough ride in the micro world. Where Big Blue effortlessly steamed into a dominant market position, DEC has tried hard and failed rather signally. This is a pity, because there is nothing wrong with the micro products themselves. The Rainbow offers an 8088 and Z-80, so both MS-DOS and CP/M software can be run. Standard RAM is 64K expandable to 192K, and there are two 400K floppies. The systems box is large but can be placed beside the desk as well as on it. DEC puts considerable emphasis on the 12-month support bundled in the price.

For. 12-month support. DEC name.

Against. Old-fashioned. Bulky.

DEC Ltd, Imperial Way, Reading, Berkshire. Telephone: (0256) 59200.

HEADSTART £2,800

The design of Intertec's Headstart is unusual. Apart from the dual-processor architecture, it is also semi-transportable, weighing in at about 25lb. It has only one 340K 3.5in. disc drive but goes some way to making up for this by offering a thumping 512K of RAM. Part of this can be configured as a very fast RAM disc. As well as standard RS-232 and Centronics ports, there are provisions for linking up to a local area network. The internal network circuitry is included as standard. Up to 255 users with up to 200Mbyte of central disc storage can be accommodated.

For. RAM disc. Semi-transportable.

Against. Inelegant design.

Icarus Computer Systems, Linton House, 39-51 Highgate Road, London NW5 1RT. Telephone: 01-267 6732.

LSI OCTOPUS £2,090

The Octopus is the latest of LSI's products, whose previous machines included the M-2 and M-4. The Octopus offers dual 8088 and Z-80 processing with 128K RAM expandable to 768K. Disc options vary from one 400K floppy to a 40Mbyte Winchester. Two keyboards are available, a straight IBM look-alike and an LSI word-processing keyboard with 32 function keys. In addition to a Centronics port and two RS-232s, the Octopus has its own Multibus expansion slot allowing a local area network, communications, modems and graphics options to be plugged in. Colour is also available along with a wide range of operating systems and disc formats, set by the user if necessary.

For. Dual processor. Expansion capabilities.

Against. Not much.

LSI Computers Ltd, Copse Road, St. John's, Woking, Surrey GU21 1ST. Telephone: (04862) 23411.

VECTOR VSX £3,800

Vector's latest micro uses an 8086 running at 8MHz and a Z-80B working at 6MHz. There is also an optional 8087 maths co-processor for heavy-duty number-crunching applications. The standard 128K RAM can be upgraded to 896K. Various models are available with one or two 730K floppies and 10Mbyte or 36Mbyte Winchesters. Ports include two parallel, one serial printer and one RS-232 interface. There are three modified S-100 slots. Unusually, the 12in. green monitor is integral to the systems box, which lends an old-fashioned air to the setup. Vector also offers its Linc local area network for use with the machine.

For. Fast. Upgrades.

Against. Old-fashioned styling.

Vector Graphic, Vector House, William Street, Windsor, Berkshire SL34 1BA. Telephone: (07535) 69375.

ZENITH Z-100 £1,795

The Zenith Z-100 is unusual in combining a standard 8088 with the less common 8085, using MS-DOS and CP/M respectively. MP/M-86 is available as an option. Systems come in various configurations, with or without monitor, and with two 320K floppies or a 10Mbyte Winchester. The RAM can be expanded from 192K to a maximum of 960K; 32K of ROM deals with monitor functions. In addition to two RS-232s and a Centronics port, there are four expansion slots. The hard-disc version includes either Lotus 1-2-3 or Peachtext as standard bundled software. Colour options are standard, and networking is available.

For. Bundled software with Winchester.

Against. Non-standard 8085.

Zenith Data Systems, Bristol Road, Gloucester GL2 6EE. Telephone: (0452) 29451.

Hot 100: transportable IBMulators

CHAMELEON £1,995

The Seequa Chameleon is not your average portable IBM PC look-alike. Technically it is different in that it offers both an eight-bit Z-80 and an Intel 8088 on a single board, to provide access to both CP/M and IBM software. The physical construction is also different, being tough and workmanlike rather than fashionably smart. It appears to be constructed mainly of aircraft-type aluminium. It offers a high level of IBM PC software but not hardware compatibility. It also offers good value for money with 256K of RAM, two 320K floppies, colour-graphics adaptor, serial and parallel ports and 9in. green screen. The price also includes some software: Supercalc 3, C-Term, MS-DOS, GWBasic etc.

For. Tough. Good value.

Against. Utilitarian finish. No expansion slots.

Ferrari Software Ltd, Ferrari House, Station Road, Egham, Surrey TW20 9LB. Telephone: (0784) 38811.

COMPAQ £1,795

When IBM did not offer its own portable version of the IBM PC, Compaq was formed to fill the breach — which it did with great success. The Compaq portable now sets the standard for IBM compatibility, and may even be preferred to IBM's own more recent portable. The Compaq is not much cheaper but has a more legible display, comes with a built-in printer port, and is more expandable than the IBM version. It also comes with 128K of RAM, one or two 5.25in. floppy-disc drives, a colour graphics/monochrome adaptor and a 9in. green screen. It has a port to drive a separate colour display, and the RAM can be expanded to 640K. The Compaq is ruggedly built around an aluminium frame.

For. Good screen display. Expandable.

Against. Bulky. Not aggressively priced.

Compaq Computer Ltd, Ambassador House, Paradise Road, Richmond, Surrey TW9 1SQ. Telephone: 01-940 8860.

IBM PORTABLE £1,889

The IBM Portable PC is essentially a repackaging of the standard PC/XT model without the hard disc. All the hardware is familiar, except for the new half-height drives. The repackaging has been done well. The Portable PC is stylish, easy to move and easy to use. The specification includes an 8088 CPU, 256K of RAM, a colour display adaptor, one or two 5.25in. disc drives and a built-in 9in. amber screen. It can drive a separate monitor, but the colour display adaptor does not produce such legible text as the monochrome one. Also the Portable PC offers no I/O ports as standard and has only one full-size expansion slot free. This limits the RAM expansion to 512K.

For. Well designed. Dual U.S./U.K. power supply.

Against. Screen legibility.

IBM (U.K.) Product Sales Ltd, Freepost, Greenford, Middlesex UB6 9BR. Telephone: 01-578 4399.

OLIVETTI M-21 £1,545

The M-21 is essentially a repackaging of Olivetti's M-24 desk-top micro, which has already established a reputation for IBM compatibility. The M-21 shows the same technical advances on the IBM standard. It uses a full 16-bit 8086-2 CPU, so it runs programs more than twice as fast. It comes with 128K of RAM, expandable to 640K, one or two 5.25in. floppy-disc drives, monochrome/colour graphics adaptor, and built-in 9in. amber screen. This is more legible than the IBM or Compaq models and even higher resolution is available. The M-21 also comes with a clock/calendar, printer driver and an asynch serial port as standard. In addition, it is also very aggressively priced.

For. Fast. Screen legibility. Price.

Against. Cannot drive two monitors at once.

British Olivetti Ltd, Olivetti House, 86-88 Upper Richmond Road, London SW15 2UR. Telephone: 01-785 6666.

OTRONA 2001 £2,155

The Otrona is a transportable designed to double as a desk-top micro. In its transportable form it provides a 7in. amber screen which can be tilted to a comfortable viewing angle. The screen can be covered over, and a separate monitor placed on top for desk-top use. The Otrona has an 8088 CPU, 128K of RAM, and one or two 5.25in. floppy-disc drives or a hard disc. The RAM can be expanded to 640K. A Zilog Z-80B can be added to provide eight-bit CP/M as well as IBM PC compatibility, but standard IBM expansion cards cannot be fitted. The Otrona is smaller and lighter than most transportables: it measures 7in. by 15in. by 14in., weighs about 19lb., and can be run from a 3.5lb. battery pack.

For. Smart. Compact. Tilting screen.

Against. Price.

Otrona Advanced Systems Corp., 3 Weedon Lane, Amersham, Buckinghamshire. Telephone: (02403) 5761.

If you are a standard size and all your clothes fit you perfectly, you're the rag trade's ideal customer.

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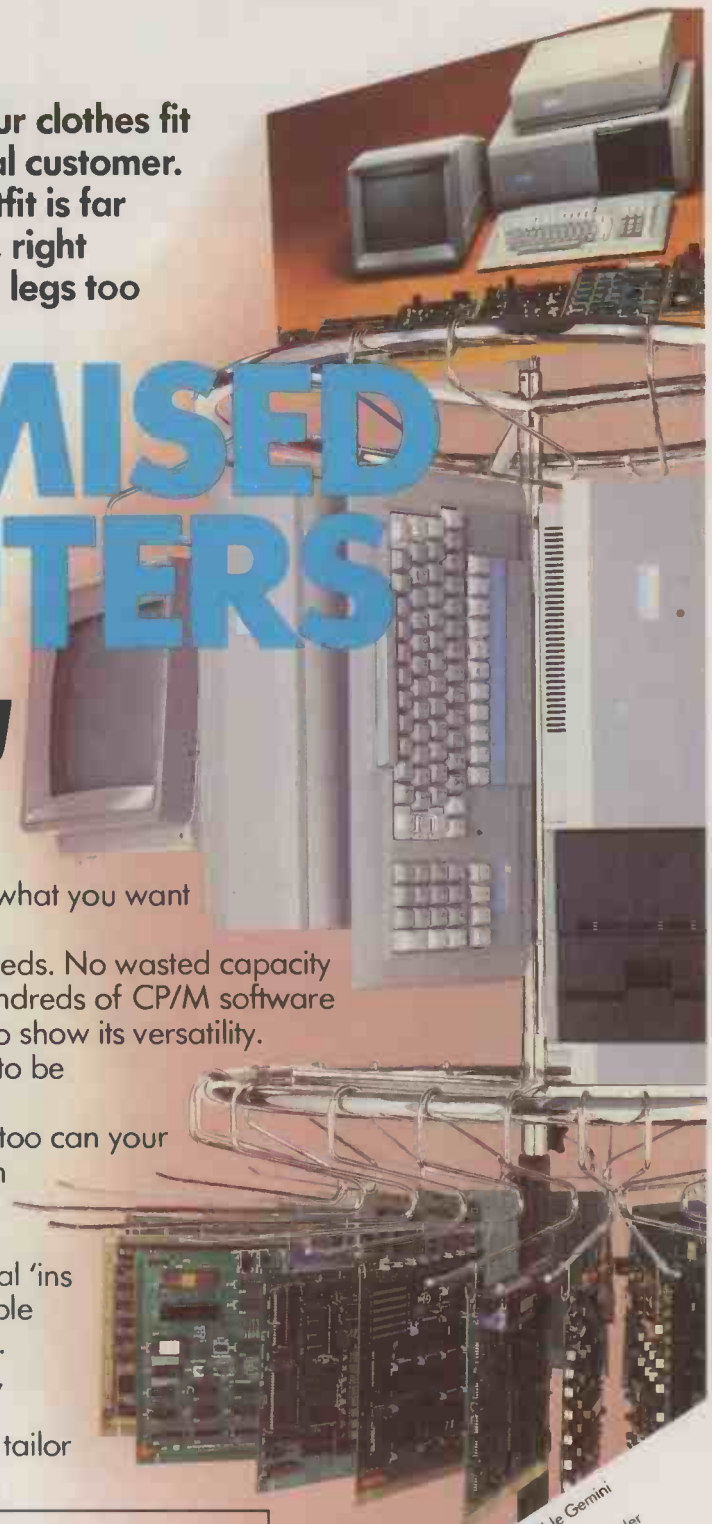

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Gemini Microcomputers Ltd, 18 Woodside Road, Amersham, Bucks, England. HP60BH. Tel: (02403) 28321. Telex: 837788

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● Circle No. 156

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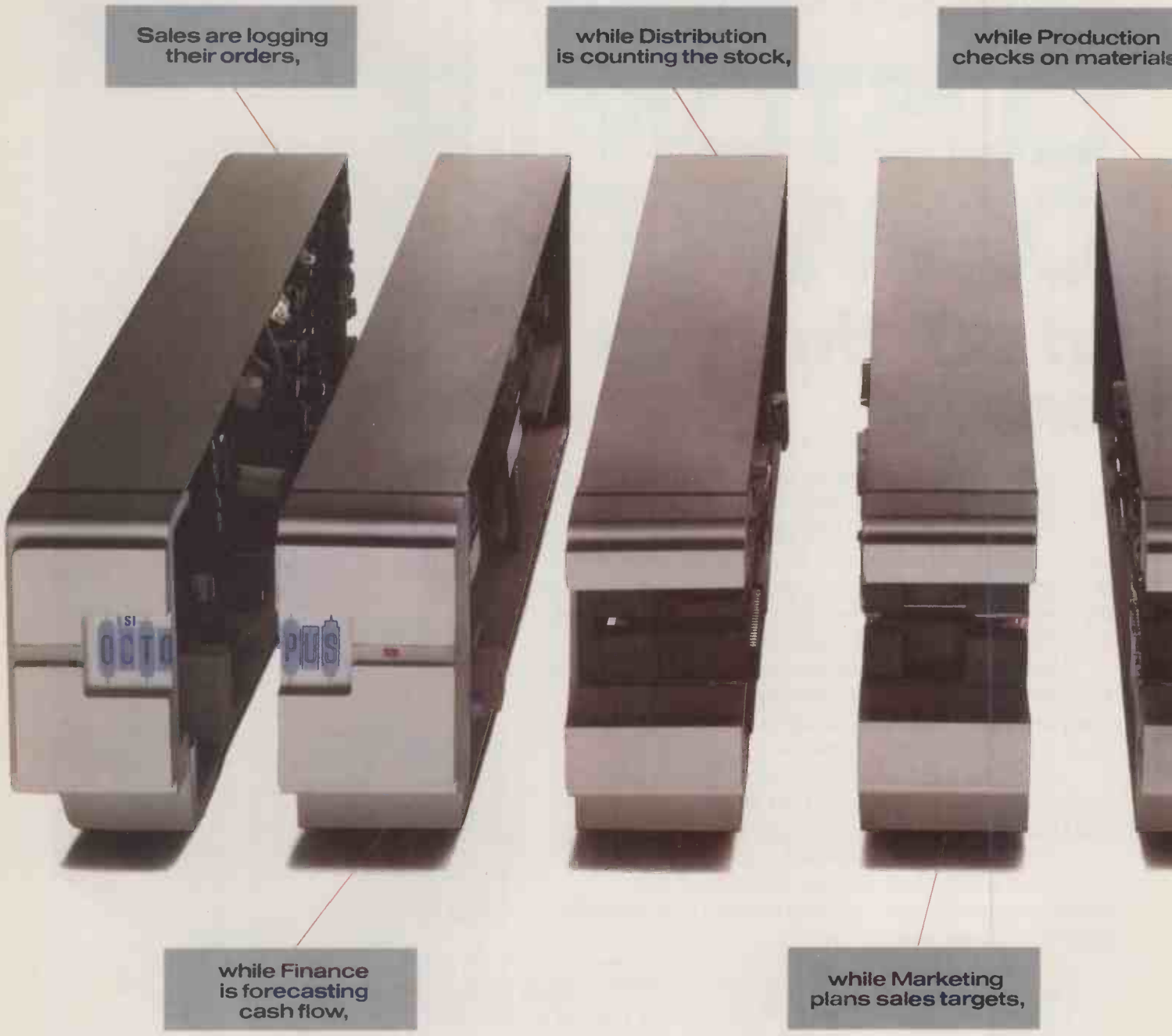

Uniquely at the price or anything like it, the LSI Octopus can work for up to seven people at the same time.

Which you may not think concerns a small business like yours.

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Firstly, the price of another six computers. (An extra keyboard and screen costs a lot less than the whole caboodle.)

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It's a facility known as 'multi-user' and it's more useful than you could possibly imagine until you've worked with it.

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This is a way of linking up more than one computer, so that they can either talk to each other or act quite independently, as you wish.

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LSI OCTOPUS

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MS-DOS is a registered trademark of Microsoft Corporation.
CP/M is a registered trademark of Digital Research Inc.

● Circle No. 191

Hot 100: desk-top IBMulators

CORONA £2,200

Corona was one of the first companies in the IBM compatibles business. Now its desk-top and portable micros are also sold by others. Olivetti sells the desk-top model in the U.S. as the M-18, while Sperry sells the portable. In the U.K. Wordplex and Philips are among the companies marketing versions. By today's standards the Corona is not pretty and a rather boring machine. It has serial and parallel ports, but not a built-in colour-graphics adaptor. However, it has good IBM PC compatiblity, and it is cheaper than the IBM PC itself. To sweeten the mix, distributor Midlectron also throws in some excellent software such as the Multimate word processor and POC Tutor.

For. Fairly competitive. Free software.

Against. Lack of graphics adaptor as standard. Looks.

Vistec/Midlectron Ltd, 2 Chequers Road, West Meadows Industrial Estate, Derby. Telephone: (0332) 381550.

IBM PC and PC/XT from £2,236

Three years ago the PC set a revolutionary new standard which over two dozen other companies have followed. The basic model uses an Intel 8088 running at 4.77MHz and up to 640K of RAM. The PC has one or two 320/360K floppies and the XT has a 10Mbyte hard disc. Although repetition has made the specification seem boring, the IBM is now unbeatable for its range of software and add-ons. In addition the quality of construction and finish — the touch of the keyboard and the clarity of the green screen display — make the PC a joy to use. The only real flaw is the separation of monochrome- and colour-graphics drivers: the monochrome screen does not do graphics, while text on the colour screen is not as legible as it should be.

For. IBM name and quality.

Against. Text clarity with colour-graphics driver.

IBM (U.K.) Product Sales Ltd, Freepost, Greenford, Middlesex UB6 9BR. Telephone: 01-578 4399.

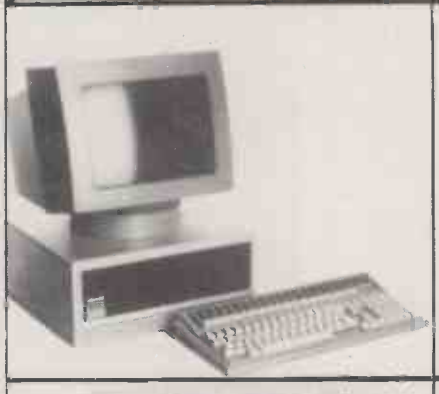
ITT XTRA £2,104

ITT has twice failed to make an impact in microcomputing, with the 2020 Silver Apple and its overpriced Z-80 business micro, the 3030. This time it has followed the Industry standard faithfully and given the job of selling to someone else, STC. The ITT Xtra is very well made, in Korea. It looks a lot smarter than the IBM PC, has good documentation, and shows a high level of compatibility. Unfortunately, it does not have an Olivetti/Compaq-type combined monochrome/colour-graphics adaptor. Also it is not that much cheaper than a real IBM PC with the same specification, so there is only one real reason for buying it — you want an IBMulator that does not look just like all the others.

For: Good looks. Quality.

Against: Lack of graphics adaptor as standard.

British Olivetti Ltd, Olivetti House, 86-88 Upper Richmond Road, London SW15 2UR. Telephone: 01-785 6666.



OLIVETTI M-24 £1,939

The Italian-made M-24 is, like the ITT Xtra, stylish, but it also has several technical advantages over the IBM PC. It uses the full 16-bit 8086 chip running at 8MHz, which makes it more than twice as fast. It combines monochrome text and colour graphics, offering a 640- by 400-pixel higher-resolution mode. The quality of the screen display is excellent. The M-24 has 128K of RAM, a much smaller footprint than the PC, and good documentation. Though you need to add a bus expander for hardware expansion, the M-24 has most features built in: serial and parallel ports, clock/calendar and Reset button. It is 20 percent cheaper than an IBM PC of the same specification, which makes it a best buy.

For: Good looks. High specification. Price.

Against: Only one free slot without bus expander.

STC Business Systems Ltd, Maidstone Road, Sidcup, Kent DA14 5HT. Telephone: 01-300 7788.

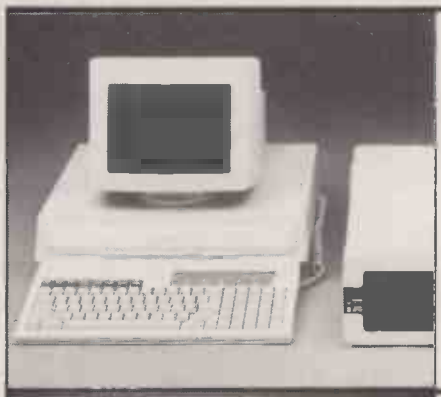
TASHKL PC-16 £1,650

The Tashkl is one of the first of a dozen or so IBM PC compatibles being made in Taiwan to be imported into the U.K. It uses the Intel 8088 chip, has 128K of RAM, two 360K floppy-disc drives, colour/graphics adaptor, serial and parallel ports, clock/calendar, 12in. Taxan monitor and a good keyboard. It includes all you need, from a hardware point of view, for a very low price which also includes a year's on-site service from National Advanced Systems and software support from Software Ltd. It is strongly constructed, though there is a slight budget feel to the finish. It seems to run the major IBM packages without trouble, including the Flight Simulator.

For. Great value. Service included.

Against. Unknown brand.

Tashkl Computer Systems, 24 Logan Road, Wembley, Middlesex HA9 8PX. Telephone: 01-904 4467.



APRICOT £1,400

The Apricot was the first micro designed and built by ACT, the distributor of the popular Sirius 16-bit. It offers an 8086, 256K RAM and two 315K microfloppies, together with a detached keyboard and a neat 9in. monitor. The whole setup is semi-transportable. Upgrades available include a double-sided disc drive and 5Mbyte and 10Mbyte Winchester versions. ACT has also launched network systems that allow a number of Apricot machines to be linked together with IBM PCs. Taken with the Apricot F1, the whole range represents one of the most completely integrated and upgradable available. Business software is also becoming more plentiful.

For. Price. Upgradable.

Against. Small screen.

ACT plc, 111 Hagley Road, Birmingham B16 8LB. Telephone: 021-454 8585.

HP 150 £2,900

The most remarkable feature of Hewlett-Packard's Model 150 is the touch screen. Various command options are displayed on the screen, and as you touch the one you want a grid of infrared beams detects which command is to be initiated. Apart from this novelty, the machine offers an 8088 running at a fast 8MHz, 256K RAM, and one or two 265K microfloppies. Winchester options of 5Mbyte and 15Mbyte are available. The HP 150 includes a user-friendly front-end called Pam, designed to make application software and MS-DOS easier to use. There are two RS-232 ports and the Hewlett-Packard Interface Bus. There is no Centronics parallel port. It is possible to add an internal thermal printer.

For. Touch screen. Fast.

Against. No parallel port. Small screen.

Hewlett-Packard Ltd, Personal Technical Computers, Eskdale Road, Winnersh, Wokingham, Berkshire RG11 5DZ. Telephone: (0344) 773100.

LOGICA KENNET £2,500

Logica's latest machine uses a standard 8086 processor, and comes with 256K RAM expandable to 1Mbyte, two serial ports and a parallel interface. Storage options include one or two 600K floppies and one or two 10Mbyte Winchesters. The monitor is a large 15in. diagonal, and the keyboard is a 114-key detached unit. The Kennet has been designed very much with networking in mind. Apart from IBM compatibility, the new machine offers most of the leading operating systems such as Concurrent CP/M on the network. Although the specifications are conventional, the Kennet is appreciably faster than most 8086-based machines; the processor runs at a swift 8MHz.

For. Speed. Large screen.

Against. Unremarkable specification.

Logica, Drakes Way, Swindon, Wiltshire SN3 3JL. Telephone: (0793) 36291.

SANYO 555 £1,100

The Sanyo 550 and 555 cater for the very bottom end of the business market. They are straight MS-DOS machines, running a straight 8088. Standard RAM is 128K that can be upgraded to 256K. There is 8K of ROM. Disc options start at one 160K for the 550 and two 160K for the 555. There is also a 320K upgrade available. The 12in. monitor is monochrome, but full colour circuitry is included as standard. The 81-key detached keyboard has 10 programmable function keys. A Centronics parallel port is included, but serial ports are extra. The bundled software is generous, and geared strongly towards the small business. It includes WordStar, Calcstar, Planstar and Mailmerge, as well as an accounting package.

For. Bundled software.

Against. Small floppies.

Sanyo Marubeni (U.K.) Ltd, Sanyo House, 8 Greycaine Road, Watford, Hertfordshire. Telephone: (0923) 46363.

TI PROFESSIONAL £1,595

The TI Professional offers an 8088, 64K RAM expandable to 768K, 360K floppies and five expansion slots. The keyboard follows the IBM Selectric layout. Options available include an 8087 maths co-processor, 10Mbyte Winchester, LAN and various communications protocols. Perhaps the most interesting expansion feature is the possibility of adding a speech-recognition facility. Texas Instruments has developed a compact speech-storage system that enables you to store up to four hours of voice input on a 10Mbyte hard disc. The recognition software allows vocabularies of about 50 words to be set up for specific voices. The speech unit costs about £1,200.

For. Basic price. Voice recognition.

Against. Cost of voice option.

Texas Instruments Ltd, International Data System Division, Manton Lane, Bedford MK41 7PA. Telephone: (0234) 67466.

APPLE LISA £2,625

The Lisa was Apple's first attempt to win back the micro supremacy it had gained with the Apple II and then lost to the IBM PC. It was a brilliantly innovative machine, with a whole new way of using computers, which included the use of icons, pull-down menus and the mouse. Unfortunately the machine was vastly overpriced and rather slow. Worst of all, there was little software. Since then the price has dropped dramatically, speed has been improved, and a few software packages have appeared. It is still an exciting machine, but not really the practical executive proposition Apple hoped it would be. That had to wait until the Macintosh.

For. Exciting technology. Great graphics.

Against. Little software.

Apple Computer (U.K.) Ltd, Eastman Way, Hemel Hempstead, Hertfordshire HP2 7HQ. Telephone: (0442) 60244.

APPLE MACINTOSH £1,795

The Macintosh draws very heavily on the ideas and technology of the ill-fated Lisa. It uses the same 68000 processor and icons, and has the mouse facility. But instead of the elephantine footprint of the Lisa, the MacIntosh takes up only the space of an A4 pad. It is neat and stylish in appearance, but more importantly it is far more realistically priced. Apple has also learnt from its experiences with the Lisa that a solid software base is crucial. There are signs that a steady stream of packages is beginning to come through. The basic machine has a 400K microfloppy and 128K RAM. Recently Apple has released the Big Mac: the same machine, but with a far more usable 512K RAM.

For. Powerful systems software. Exciting product.

Against. Limited storage capacity.

Apple Computer (U.K.) Ltd, Eastman Way, Hemel Hempstead, Hertfordshire HP2 7HQ. Telephone: (0442) 60244.

DIMENSION £3,200

The basic Dimension system offers a 68000 running at 7.2MHz, 256K RAM, two 400K floppies, and a parallel and serial port. The operating system is CP/M-68K, and other bundled software includes Basic, a C compiler and a 68000 assembler. The machine can be upgraded to include a full 16Mbyte of RAM, 20Mbyte or 40Mbyte Winchesters, and up to eight serial ports. Unusually, the Dimension offers the possibility of adding various emulation co-processor cards, which let you run Z-80, 8086 and Apple software directly. The price for the system does not include a monitor, but full colour circuitry is standard. The keyboard has 83 keys, including 10 programmable function keys and a numeric keypad. The Dimension is made in America by Micro Craft.

For. Fast. Emulation facilities.

Against. No screen.

Tahski Computer Systems Ltd, 24 Logan Road, Wembley, Middlesex HA9 9PX. Telephone: 01-904 4467.

FORTUNE 32:16 £5,070

The Fortune 32:16 was one of the first machines to use the now well-established Motorola 68000 running under Unix. The entry-level PS-20, part of the Professional Station family, offers a 20Mbyte Winchester and a 1Mbyte floppy as standard. Apart from the 512K of RAM, there is 40K of boot and self-test diagnostics in ROM. In addition to RS-232 and IEEE ports there are facilities for IBM communications. The 12in. screen swivels on its own separate mounting, though only block graphics are available. The keyboard includes 20 program keys and a numeric keypad and cursor controls. The Fortune system is intended as a high-performance single-user system with the option of expanding into a full two- or three-user version. Fortune is a U.S. based company.

For. Winchester standard. Multi-user.

Against. Cost. Limited graphics.

Fortune Systems, 2-14 Shortlands, London W6 8DJ. Telephone: 01-741 5111.

PINNACLE £4,995

The Pinnacle micro is a joint venture from TDI and Pinnacle Systems Incorporated of Dallas. It is one of the first systems to push the 68000 to something like its limits. The processor runs at 12MHz and has no wait states, which means really fast computing. Up to seven users can be run off the one systems box. The basic machine has 256K RAM, seven RS-232 ports, parallel port, 14in. tilt and swivel VDU, and a 101-key detached keyboard. Operating systems available include p-system, CP/M-68K, and BOS. TDI has also developed Mosys, an operating system written in the fashionable Modula 2. Upgrades include RAM up to a maximum of 1.5Mbyte, and 10Mbyte, 21Mbyte and 32Mbyte Winchesters.

For. Speed. Multi-user.

Against. Not much.

TDI Ltd, 29 Alma Vale Road, Bristol BS8 2HL. Telephone: (0272) 742796.

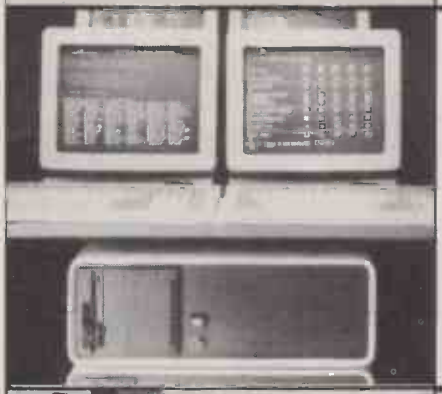
BROMCOM SUPERSTAR £2,500

The Bromcom Superstar uses an S-100 bus based system to offer upgradability to 16 users. Each additional user's board includes its own processor so there is no degradation of response as more are hooked up. Either 80186 or Z-80A chips can be used, depending on the intended application of the terminal. The memory per user can go up to 128K for an eight-bit user and 1Mbyte for the 16-bit system. Options include 400K floppies, Winchesters from 10Mbyte up to 160Mbyte, and a 40Mbyte tape streamer. Operating systems available include CP/M, MS-DOS and Xenix. Bromcom has also produced a range of applications software. The entry-level system comes with an eight-bit slave, one 400K floppy, 10Mbyte Winchester screen and keyboard.

For. Price. No multi-user degradation.

Against. Not much.

Bromcom, Bromley Computer Consultancy Ltd, 417-421 Bromley Road, Bromley, Kent BR1 4PJ. Telephone: 01-697 8933.



COMART 1000 SERIES £2,295

Comart's Communicator range of single- and multi-user micros started life in 1980, and has since grown to include 10 basic systems. At the top of the range is the CP-1000 series which has been on sale since January 1982. Based on an 8086, with 256K RAM expandable up to 1Mbyte, it offers a 790K floppy or Winchesters. Both CP/M-86 and MS-DOS are included in the price. Multi-user upgrades are easily accommodated. Digital Research's CP/Net is also supported, and for users wanting to communicate with mainframes, Comart supplies IBM 2780/3780 and ICL CO2/CO3 protocol emulators.

For. Good comms facilities.

Against. Elderly.

Comart, Little End Road, Eaton Socon, St. Neots, Cambridgeshire PE19 3JG. Telephone: (0480) 215005.

COMPUPRO £4,150

The Compupro series is a range of American computers built around the S-100 bus by a Californian company of the same name. The basic configuration begins with an 8088 running at 8MHz with an optional 8087 maths co-processor. There is 768K RAM of which 512K can be configured as a RAM disc. Storage consists of two 5.25in. 800K floppies with an option of a 40Mbyte Winchester. There are two RS-232s, and one parallel port. Four slave Z-80B processors can be attached, each with 64K RAM, and one RS-232 port. The operating system is MP/M 8-16, a version of Digital Research's MP/M-86 which allows eight- and 16-bit programs to run simultaneously. Application software includes a spreadsheet, database and word processor.

For. Storage upgrades.

Against. 8088 main processor.

Comcen Technology Ltd, 45/46 Wychtree Street, Morriston, Swansea SA6 8EX. Telephone: (0792) 796000.

MINSTREL £6,265

The Minstrel 2 multi-user micro from HM Systems ensures no degradation of response as more users are added. A basic S-100 card cage is fitted with an eight-bit Z-80B as master processor. The operating system is Turbo-DOS. The main card includes 64K or 128K of RAM, two RS-232s, one parallel port and a real-time clock with battery backup. There is a Winchester and floppy controller board capable of supporting two 5.25in. floppies, two 8in. floppies and two 5.25in. hard discs. Extra users are added by slotting in a slave processor card with Z-80B or 8086 processors, and up to 256K of RAM. A maximum of 12 users can be accommodated. Other options include 20Mbyte and 40Mbyte Winchesters, tape backup, telex and modem units.

For. No multi-user degradation.

Against. Non-standard operating system.

HM Systems, 69 Loudun Road, London NW8 0DB. Telephone: 01-328 8737.

ULTRAFRAME £5,000

Dataday's Ultraframe uses the S-100 bus and a standard card cage design to offer a complete upgrade path from one to 32 users, and storage up to 1,160Mbyte. The master CPU is a 4MHz Z-80A, with a 2K EPROM. Slave processors can be either Z-80s, which come with 64K or 128K RAM, or 80186s with 256K RAM; both options have two RS-232 ports. The master I/O system has four serial ports and two parallel ports. Floppies start at 315K, and Winchesters at 10Mbyte. There is a video-tape backup system that allows about 100Mbyte to be stored in this form. The Turbo-DOS operating system gives access to UCSD-p and CP/M software.

For. Eight- or 16-bit processors.

Against. Limited multi-user software.

Dataday Computing, Bechers Building, Racecourse Estate, Ormskirk Road, Aintree, Merseyside L9 5AI. Telephone: 051-521 3966.

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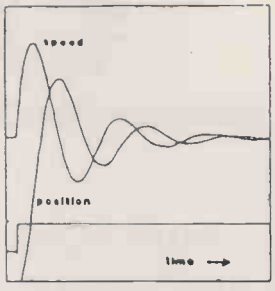

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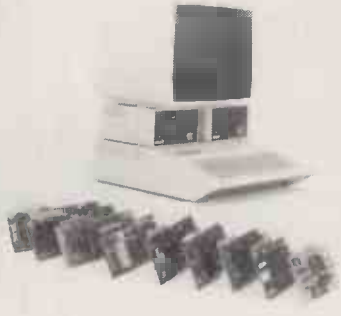

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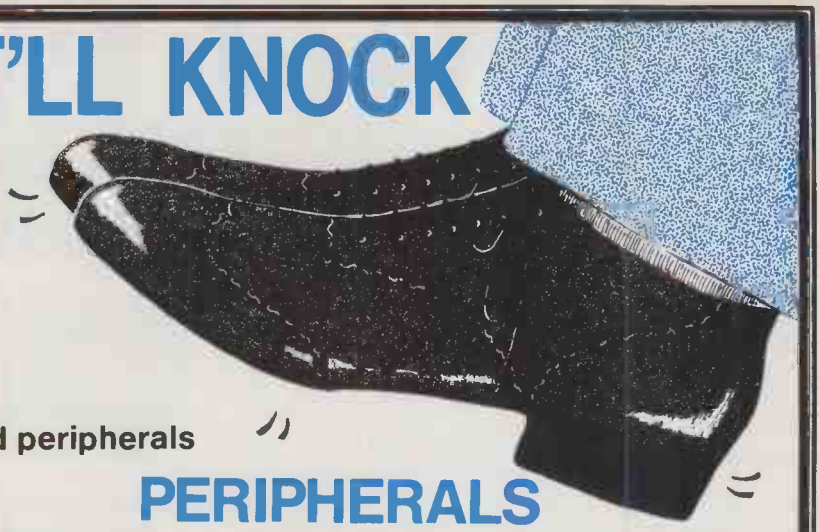

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ALPHA MICRO 1000 £6,000

The AM-1000 is the entry system for an extensive range of multi-user micros all based on the 68000, costing from about £6,000 to over £33,000. The compatibility between the machines and their software presents a useful upgrade path. The AM-1000 offers 128K expandable to 768K, with up to two 800K floppies. Up to seven 20Mbyte Winchesters can be linked to the system, an indication of the general scale of the configurations envisaged. There is a QWERTY keyboard with numeric keypad and function keys, three RS-232 ports and a Centronics parallel printer port. Up to 11 users can be accommodated. Up to 100Mbyte backup is available via a standard video cassette recorder.

For. Upgrades.

Against. Entry price. Non-standard operating system.

Alpha Micro Great Britain, Berkshire House, 56 Herschel Street, Slough, Berkshire SL1 1PY. Telephone: (0734) 821922.

BLEASDALE 680A £8,000

The Bleasdale 680A is a Unix system that can handle up to 16 users. The 68000 processor runs at 10MHz and comes with 512K RAM as standard, expandable to 1.5Mbyte. There is one 5.25in. floppy and a choice of Winchesters with capacities from 20Mbyte to 140Mbyte. Ports include two RS-423s, eight RS-232s expandable to 16, and an optional two parallel printer ports. Languages available include Basic, Cobol, APL, C and Pascal. There are various application packages such as word processing, spreadsheets and databases. Bleasdale, now eight years old, is a public company listed on The Stock Exchange. It has specialised in Unix-based systems.

For. Established company.

Against. Not much.

Bleasdale Computer Systems plc, Francis House, Francis Street, London SW1P 1DE. Telephone: 01-630 9761.

CRYSTAL 68000 £6,205

The Crystal 68000, assembled at the Aston Science Park, is one of the few 16-bit machines that runs under the Pick operating system. The Crystal's main claim to fame is its software capabilities: it runs Basic, Cobol, Fortran, Pascal, APL and C. There is also the Pick systems builder, an applications generator which can also run on IBM machines and aims to give users the power to build their own applications programs. Four RS-232 ports are provided and a further eight can be added to give a total of 12 additional users. Crystal produces intelligent work stations with Z-80s, allowing them to run CP/M programs independently of the main unit as well as accessing storage common to the whole system.

For. Pick. Range of software.

Against. Non-standard system.

Aston Technology, Aston Science Park, Love Lane, Birmingham, B7 4BJ. Telephone: 021-359 4861.

IBM PC/AT £2,950

IBM's Advanced Technology PC/AT represents the second wave of Big Blue's assault on the business micro market. After selling well over a million PCs, the company has launched a machine designed to keep the range viable well into the late 1980s. The chip is the 80286, the latest version of the 8088 family that lies at the heart of the PC itself. The new machine offers two to three times the performance of the PC while retaining upward compatibility. It can also support multi-user and multi-tasking operation. Hardware improvements include 1.2Mbyte floppies and 20Mbyte Winchesters. The cost is surprisingly competitive, and could tempt many people away from the standard XT version.

For. IBM. Multi-user.

Against. IBM.

IBM (U.K.) Ltd, PO Box 41, North Harbour, Portsmouth, Hampshire. Telephone: (0705) 32121.

RAIR SUPERMICRO £10,750

Like the IBM, Rair has opted for the new generation of chips from Intel for its latest range of micros. Called rather grandly the Rair Supermicro, the entry system uses both the 80286 CPU and the 80287 maths co-processor chip. RAM starts at 512K and external storage includes a 1Mbyte floppy, a 50Mbyte Winchester and a 45Mbyte tape streamer. There is a parallel bus socket and eight RS-232 ports, which allow up to eight users to be attached. Rair claims that there is no significant degradation of response up to this level. The Supermicro can run under either Multi-concurrent CP/M or Unix System V. Upgrades include a second Winchester and a further eight RS-232 ports.

For. Large storage. Second processor.

Against. Price

Rair Ltd, 6-9 St. Martin's Lane, London WC2H 9EQ. Telephone: 01-836 6921.

ABC 200 — tba

The Acorn Business Computer range of micros is Acorn's first concerted foray into the business market. Based on the perennial BBC model B micro with its trusty 6502, the various models cater for slightly different sectors of the market. The ABC 200 and 210 use the state-of-the-art 32016 processor from National Semiconductor. Both machines are geared towards specialist and scientific applications, with the emphasis on number crunching. A number of languages are provided: Fortran 77, C, Lisp, Pascal, Forth and BBC Basic. The ABC 200 comes with two 720K floppies, while the 210 has a 10Mbyte Winchester and colour screen, and can run under Xenix.

For. Brand-new processor. Operating systems.

Against. Not here yet.

Customer Services, Acorn Computers Limited, Cambridge Technopark, 645 Newmarket Road, Cambridge CB5 8PD. Telephone: (0223) 210111.

DEC PROFESSIONAL 350 £5,000

The DEC Professional 350 is designed for scientific and engineering uses, and aims to provide desk-top mini-computer power. The processor is the same as that used in the PDP-11/23 minicomputer, and the operating system is P/OS, a version of the RSX-11/M-Plus used by DEC on its minis. There is full terminal emulation and file transfer to DEC Vax and PDP-11 hosts. DEC has also bowed to the inevitable and provided IBM protocols. The entry-level machine comes with 512K RAM, two 5.25in. 400K floppies and an RS-232 port. Upgrades available include a Z-80 CP/M card, two more floppies and 5Mbyte or 10Mbyte Winchesters. A wide range of languages are available, including more obscure ones like Dibol.

For. Compatibility with PDPs. Upgradability.

Against. Non-standard micro operating system.

DEC Ltd, Imperial Way, Reading, Berkshire. Telephone: (0256) 59200.

FIELDWORK FIFTY — £1,700

The Fieldwork Fifty is a tough, light portable that runs under an extended CP/M and uses bubble memory. Intended for use in harsh environments and designed to keep operating in temperatures from −30°C to +70°C; it is also waterproof and it floats. It is guaranteed to survive a drop of three feet on to concrete. It weighs under 4lb. and has a two-line by 40-character liquid crystal display. Full-size keyboard is available in QWERTY, ABC or AZERTY layouts. The Fieldwork is designed around a CMOS variant of the Z-80, and comes with 56K of RAM. The standard 64K of bubble memory is expandable to 256K; it functions like a disc drive but is tougher. Bundled software includes a comms package that allows you to download to CP/M systems.

For. Very tough. CP/M.

Against. Price. Small display.

Immediate Business Systems plc, 3 Clarendon Drive, Wymbush, Milton Keynes, Buckinghamshire MK8 8DA. Telephone: (0908) 568192.

HP MODEL 16 — £3,700

Hewlett-Packard's Model 16 is a tightly designed machine occupying a mere one-foot square. It is geared very much to the scientific market, offering fast computing power in a neat and functional desk-top micro. The 68000 system runs at 8MHz, and produced about the fastest Benchmarks this magazine has seen. The healthy 512K of RAM can be expanded to 768K, and there are two 270K microfloppies. There are also 5Mbyte and 10Mbyte Winchester versions available. The Basic that comes with the machine is powerful and big: it takes up about 277K of RAM. A number of more general business-type packages are also available for the HP Model 16.

For. Powerful. Good Basic.

Against. Limited storage.

Hewlett-Packard Ltd, Personal Technical Computers, Eskdale, Winnersh, Wokingham, Berkshire RG11 5DZ. Telephone: (0344) 773100.

HP 85B — £2,855

Expensive eight-bit transportable of special interest to scientists and engineers. Built around a custom-designed HP eight-bit processor, the HP 85B comes with an HP series 80 operating system and a very good Basic. The machine weighs 20lb. and has a 5in. screen displaying text across 32 columns, a built-in 32-column thermal printer capable of dumping screen graphics, and a 210K digital cassette drive with random-access capability. Standard RAM is 32K; another 32K, optionally expandable to 512K, is configured as a silicon disc, which allows very rapid data transfer in data-logging applications. the HP 85B is fitted with an IEEE-488 port; HP offers other interface options and a wide range of disc drives, plotters and instruments.

For. Good Basic. HP name. Wide range of peripherals.

Against. High price. Small screen. Fixed keyboard.

Hewlett-Packard Ltd, PC Group, King Street Lane, Winnersh, Wokingham, Berkshire RG11 5AR. Telephone: (0734) 784774.

Hot 100: Specialised systems

HUSKY M-208 £6,800

Military specification ultra-robust battery-powered portable that runs CP/M software. The Husky uses battery-backed CMOS RAM for storing data and programs rather than floppy discs or bubble memory. It weighs just over 6lb. The Husky M-208 has a four-line by 32-character liquid crystal display which can also show 64- by 240-dot graphics, and an almost standard-size keyboard of flat, membrane-protected waterproof construction. Built around a CMOS version of the eight-bit Z-80 processor, the Husky comes with 208K of RAM. A CP/M 2.2 compatible OS, Microsoft Basic, text editor and comms software to drive the M-208's hardened RS-232 port all come in ROM. The Husky is designed to be safe in potentially explosive atmospheres.

For. Very tough. Runs CP/M software.

Against. Price.

Husky Computers Ltd, PO Box 135, 345 Foleshill Road, Coventry CV6 5RW. Telephone: (0203) 668181.

IBM XT/370 £8,228

The IBM XT/370 is an upgrade and extension of the normal Winchester hard-disc version of the IBM PC. In addition to the 256K RAM, 360K floppy and 10Mbyte or 20Mbyte hard disc, three extra circuit boards add various terminal capabilities. There is a processor card that allows the XT/370 to work with a host System 370 mainframe and execute many host programs directly. A second card provides up to 4,000,000 characters of virtual memory for interactive computing under VM/CMS, the virtual machine/conversational monitor system. There is a coaxial attachment which enables the processor to act as a 3277 model 2 terminal when connected to a suitably programmed host computer by an IBM 3274 display-control unit.

For. Mainframe link. Powerful development tool.

Against. Price.

IBM (U.K.) Ltd, PO Box 41, North Harbour, Portsmouth, Hampshire PO6 3AU. Telephone: (0705) 32121.

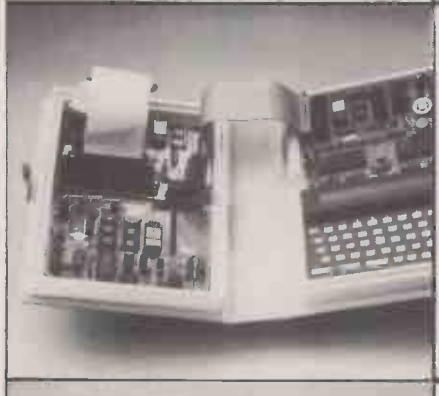
MICRO-APL SPECTRUM £11,250

Unlike the other Spectrum, MicroAPL's machine is a very specialised 68000-based system, designed specifically for APL language developments. The micro is built around the S-100 bus and uses a 20-slot backplane. Memory options start at 256K RAM and go up to 16Mbyte. Storage devices includes 760K 5.25in. floppies, 2Mbyte 8in. floppies, or 10Mbyte and 36Mbyte Winchester. All systems are supplied with a wide range of software, mostly of a development nature. Included is the APL/68000 re-entrant interpreter, project-development software and an interactive APL self-teaching program. The operating system is Mirage, which is multi-user. Ethernet is also available as an option.

For. APL system. Bundled software.

Against. Limited general application.

MicroAPL Ltd, Unit 1F, Nine Elms Industrial State, 87 Kirtling Street, London, SW8 5BP. Telephone: 01-622 0395.



MICRO PROFESSOR £150

The Micro Professor is designed to provide a complete introduction to micros, from chips to assembler. Functionally, it offers a full Z-80A system, with 4K RAM, 8K ROM, QWERTY keyboard, and a 20-digit, 14-segment, alphanumeric, green-tube display. It comes with its own internal power supply. The ROM contains a line assembler, disassembler, text editor and two-pass assembler. The system also has an interface to Basic and Forth interpreters. Extras include an EPROM memory board, a speech-synthesis board, and a sound and music option. It is also possible to add an on-board printer, TV interface, I/O and memory expansion boards. Three user manuals provide an introduction to micro architecture and programming.

For. Educational . Compact.

Against. Limited memory. Small keyboard and screen.

Pelco Electronics, Spring Gardens, Romford, Essex RM7 9LP. Telephone: (0708) 61911.

MIDAS 2D/TE £2,500

The Midas 2D/TE is designed to cope with environments where there are high ambient temperatures, large quantities of dust and unreliable mains supplies. It is aimed mainly at third-world users. The basic specification is a Z-80 running CP/M, 64K RAM and two 5.25in. floppies, which can have capacities from 140K to 800K. There are two high-volume fans, one of which blows directly on to the cage card carrying the computer boards. The other cools the power supply and floppy discs. Two fine dust filters are used to clean the air. Mains supply problems are overcome by avoiding any components that require a.c. voltages, using no voltage over 35V and providing a simple battery backup.

For. Rugged design.

Against. Limited computing power.

Sirton Computer Systems, Unit 14, 29 Willow Lane, Mitcham, Surrey CR4 4NA. Telephone: 01-640 6931.

Hot 100: Specialised systems

RML 480Z £2,100

Research Machines' 380Z has done sterling service in schools for many years. Unfortunately, it looks old-fashioned, with its huge processor box and 8in. floppies. The more recent 480Z is more plausible as a machine of the eighties. It offers a Z-80A running at 4MHz, 64K RAM expandable to 256K, two 328K floppies and one parallel and two serial ports. There is also a network interface as standard which connects to RML's Chain local area network. The new machine is still very much aimed at the educational market, but the presence of CP/M in the bundled software means that large numbers of serious and business programs can be run. The 480Z also has a ROM cartridge slot.

For. Robust construction. LAN port.

Against. Large. Expensive.

Research Machines Ltd, PO Box 75, Mill Street, Botley Road, Oxford OX2 0BW. Telephone: (0865) 249866.

SHARP MZ-5645 £3,890

General-purpose MS-DOS machine with large colour display and optional mouse, well suited to many graphic applications. The MZ-5645 comes with a 15in. colour display, capable of showing 400- by 640-dot graphics in eight colours and 25-line by 80-character text. With a 12in. monochrome screen the price is £300 less. The system is built around an Intel 8086 running at 8MHz, with 256K of RAM expandable to 512K, and 96K of video RAM expandable to 192K. A 640K floppy drive and 10Mbyte hard disc are standard with this model; the mouse costs £95. MS-DOS and CP/M-86 are in the price. Sharp's Electronic Technical Drawing System, written by Graphics Avant Garde, is available for £1,500.

For. Low cost for graphic system. Runs general MS-DOS software.

Against. New.

Sharp Electronics (U.K.) Ltd, Sharp House, Thorp Road, Manchester M10 9BE. Telephone: 061-205 2333.

TORCH £2,950

The Torch is a dual-processor machine from the company recently acquired by Acorn. The 68000 runs at 8MHz and the Z-80B at 6MHz; they run under Unix and CP/M respectively. In addition to the 320K RAM expandable to 1Mbyte, there is a sizeable 64K ROM, which includes Basic and Acorn Mos. Bus expandability is possible via a 1MHz bus. Standard options include eight colours and four music channels plus speech synthesis. The keyboard has a total of 103 keys, including 17 function keys. Torchnet is provided as standard, along with an electronic mail package. Bundled software includes four programs from the Perfect suite. The standard system has twin 400K floppies; a 20Mbyte version is also available.

For. Dual processor. LAN.

Against. No IBM compatibility.

Torch Computers, Abberley House, Great Shelford, Cambridgeshire CB2 5LQ. Telephone: (0223) 841000.

WHITECHAPEL MG/1 £5,495

Graphics-orientated system built around National Semiconductor's powerful 32016 processor. The MG/1 has an 800- by 1,024-dot high-resolution bit-mapped display, 512K of RAM expandable to 4Mbyte, QWERTY keyboard and a mouse. It comes with one 800K floppy drive and a 10Mbyte hard disc as standard; a 22Mbyte version costs £6,495, and with 45Mbyte hard disc, £7,495. The operating system included in the price is Genix, National Semiconductor's version of Unix. A bus adaptor to take IBM PC expansion cards costs £195, and an Ethernet option is promised. The MG/1 is the first product of a new London-based company. Application packages have not yet been announced, but are likely to be primarily in the CAD/CAM areas.

For. Very high-resolution display. Takes IBM PC cards.

Against. New. Not much general-purpose software.

Whitechapel Computer Works Ltd, 75 Whitechapel Road, London E1 1DU. Telephone: 01-377 8680.

YAMAHA CX-5 £534

An MSX home computer sold only with built-in FM sound synthesiser and music keyboard. The picture shows the CX-5 together with a 3½ octave keyboard with 3in. long keys; a keyboard with full-size keys costs £80 more. The synthesiser itself is built into the base of the CX-5. It lets you play monophonic notes and eight-note chords in any of 48 preset voices, or you can modify the voices. A Midi socket allows connection to other Midi-equipped music kit. In other respects the CX-5 is a typical MSX machine, with Z-80 processor, 48K of RAM, a cartridge slot for loading MSX software and Microsoft's MSXBasic in ROM. It has a full-size QWERTY keyboard and outputs 192- by 256-dot graphics or 24-lines by 40-characters to a TV.

For. High-quality music synthesiser. Functions as general home computer.

Against. Conservative spec. Little software yet.

Kemble Yamaha Ltd, Mount Avenue, Bletchley, Milton Keynes, Buckinghamshire MK1 1JE. Telephone: (0908) 640202.

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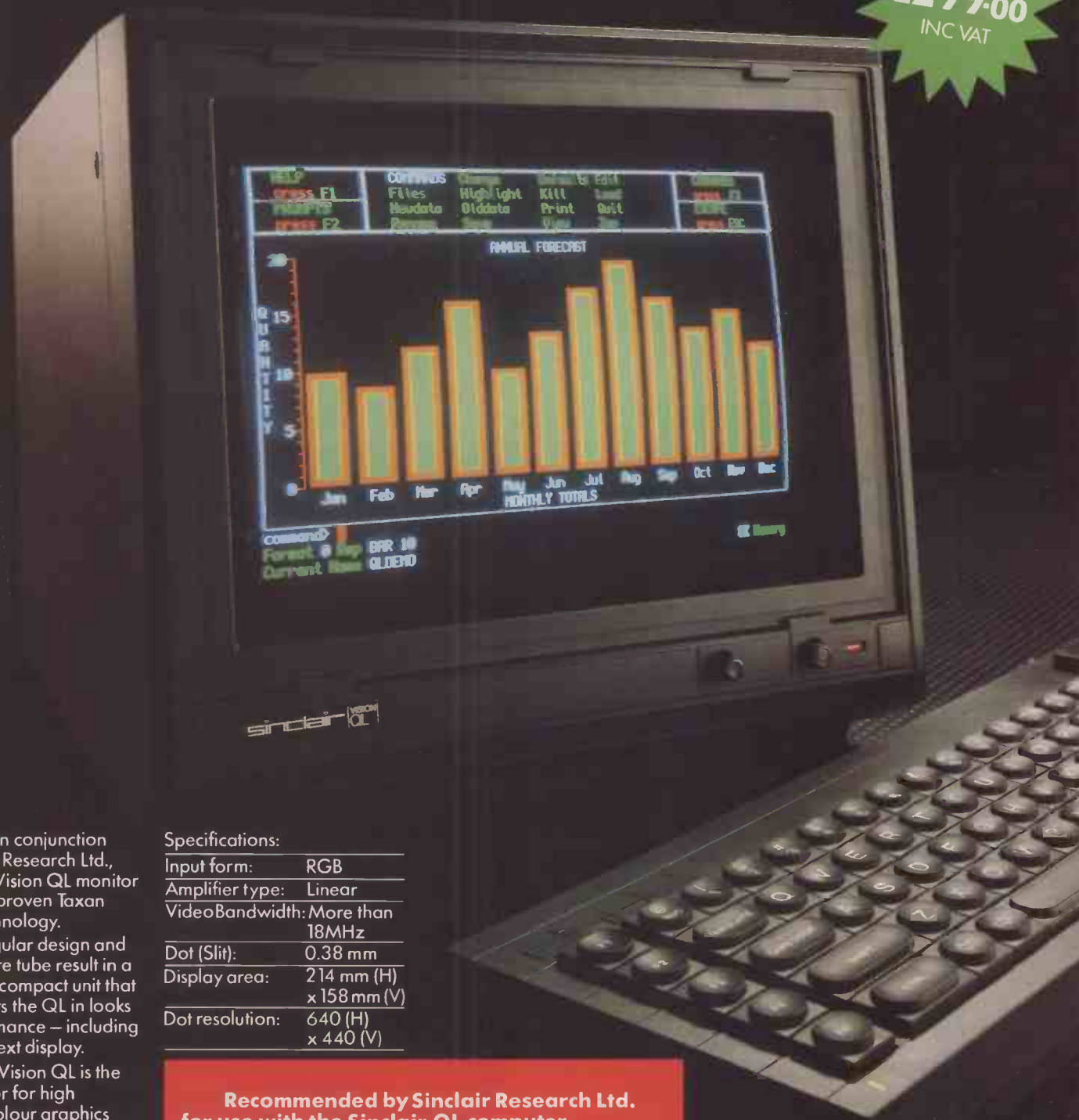

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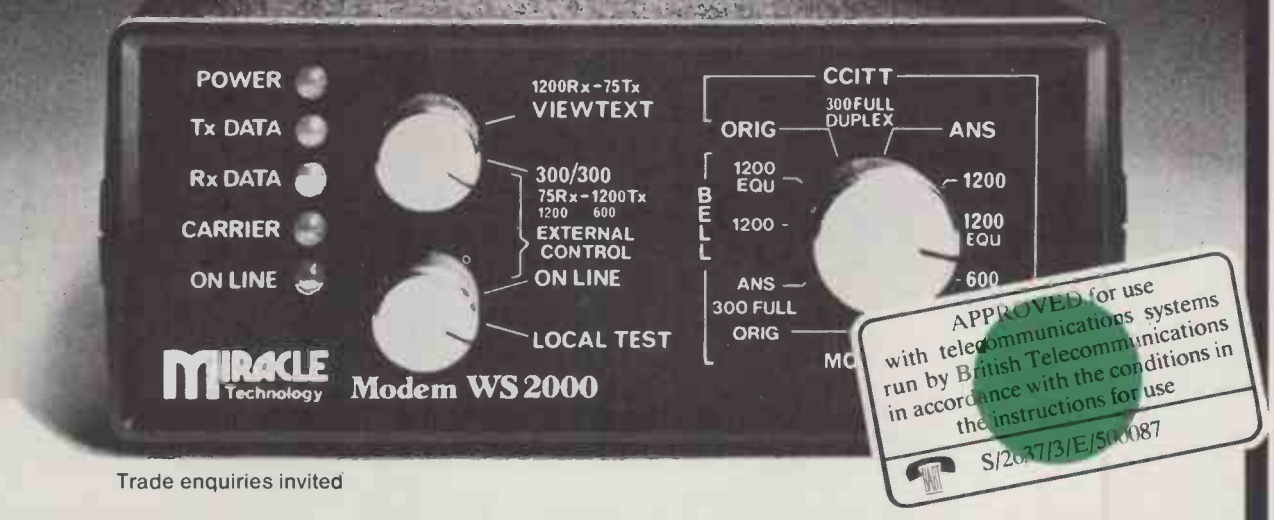

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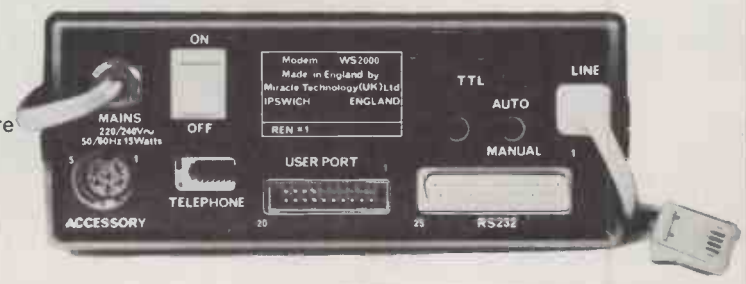

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>OPEN FILE

PRACTICAL COMPUTING DECEMBER 1984

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Open File is the part of the magazine written by the readers of *Practical Computing*. All aspects of microcomputing are covered, from games to serious business software and utilities. Fully-debugged programs can be submitted for any micro, and for standard CP/M machines such as the Osborne and Superbrain. Programs can be in machine code or any language.

Submissions should include a brief description which explains what your program does, and how it does it. If possible it should be typed, with lines double-spaced. We need a printed program listing. Hand-written listings cannot be accepted. A tape or disc of the program helps if it is in a standard format.

When printing listings, please remember to use a new ribbon or double-intensity printing — faint listings reproduce badly. Use plain paper only, and try to list the program across either a 35-character or a 70-character width. Also, make sure all special graphics or inverse-video characters are either listed correctly or else include Rem statements to explain them fully.

Each program listing, tape or disc must have your name and address on it, or we cannot promise its safe return. A stamped addressed envelope is appreciated.

If you write in with a comment, correction or enquiry please remember to 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.

>BBC

148 REAL-TIME CLOCK Lee Payne's routine provides you with a real-time clock which is accurate up to 10 seconds a day.

148 PATTERNS This graphics demonstration program sent in by M E Hughes allows you to make a variety of patterns.

149 ARCS IN BASIC Leon Goodfriend's procedure can be used to draw circles, arcs or ellipses, which can be shaded.

149 MEDIA MOVES You can move files between media with this program from Wouter Kolkman. It is capable of copying every file on a disc to tape without changing the reload address.

150 SINGING HEADS This program, supplied by D Chalazonitis, is in the vein of the Simon game, where you try to copy a tune as it is lengthened note by note.

>COMMODORE

152 MUSIC MAKER Yet another program for music enthusiasts. It helps you program the Commodore 64's music synthesiser to compose, edit and save a three-part song.

152 POKES SELECTION Some Pokes to disable different features of the Commodore 64.

>APPLE

156 BIG FACTORIALS A factorials generator for those of you into large numbers, supplied by Georgios Gallios.

157 MASTERMIND Relive your youth playing this variation of the Post Office game, with graphics elements, not numbers, to deduce.

>ATARI

159 TYPE-AHEAD Frank O'Dwyer has sent in this useful utility which is a type-ahead buffer that will sit in page 6 until required.

159 FASTER CSAVING AND CLOADING You can save both time and tape with Robert Breeds' machine-code routine, which allows you to set any baud rate you wish.

160 TRAPPED! While away your spare time with David Klein's game for any 16K Atari.

>SINCLAIR

163 UNIVERSAL CALENDAR A comprehensive calendar program from A M Tucker.

164 NUMBER FORMATTER A short routine to format the input of a specified number of digits and return the value of the input.

164 CONVERSIONS A handy program for the 16K Spectrum which converts imperial measurements to metric and vice versa.

>RESEARCH MACHINES

166 CURVEFIT A program which offers three different methods of plotting data.

Send your contribution to:

Open File, Practical Computing, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS

Real-time clock

```
  10 REM   *** REAL-TIME CLOCK ***
  20 REM   ** Lee Payne 28/9/83 **
  30 REM
  40 DIMT% 65,S% 35
  50 *K.10?&D00=&78:?&220=0:?&221=&
0D|MCALL&D00|M*FX14,5|M
  60 MODE7
  70 LOC=&7C
  80 FORI%=0TO2STEP2:P%=T%
  90 [OPTI%
 100 LDA#14
 110 LDX#5
 120 JSR&FFF4
 130 LDA#&0
 140 STA&220
 150 LDA#&0D
 160 STA&221
 170 LDA#47
 180 STA LOC
 190 LDA#48
 200 STA LOC-1
 210 STA LOC-3
 220 STA LOC-4
 230 LDA#186
 240 STA LOC-2
 250 LDA#&82
 260 STA LOC-5
 270 LDA#&FF
 280 STA&74
 290 STA&75
 300 STA&76
 310 LDA#&94
 320 STA&72
 330 LDA#&E8
 340 STA&73
 350 RTS
 360 ]:P%=S%
 370 [OPTI%
 380 SEI
 390 PHA
 400 TXA
 410 PHA
 420 TYA
 430 PHA
 440 LDX#&72
 450 LDY#&00
 460 LDA#4
 470 JSR&FFF1
 480 CLC
 490 LDA&350
 500 ADC#73
 510 STA&70
 520 LDA&351
 530 ADC#0
 540 STA&71
 550 JMP&D6F
 560 ]
 570 P%=&D00
 580 [OPTI%
 590 .timer SEI
 600 PHA
 610 TXA
 620 PHA
 630 TYA
 640 PHA
 650 LDX#&72
 660 LDY#0
 670 LDA#4
 680 JSR&FFF1
 690 CLC
 700 LDA&350
 710 ADC#73
 720 STA&70
 730 LDA&351
 740 ADC#0
 750 STA&71
 760 LDA LOC
 770 CMP#57
 780 BNE one
 790 LDA#48
 800 STA LOC
 810 JMP two
 820 .one INC LOC
 830 JMP out
 840 .two LDA LOC-1
 850 CMP#53
 860 BNE three
 870 LDA#48
 880 STA LOC-1
 890 JMP four
 900 .three INC LOC-1
 910 JMP out
 920 .four LDA LOC-3
 930 CMP#57
 940 BNE five
 950 LDA#48
 960 STA LOC-3
 970 JMP six
 980 .five LDA LOC-3
 990 CMP#51
1000 BNE extra
1010 LDA LOC-4
1020 CMP#50
1030 BEQ reset
1040 .extra INC LOC-3
1050 JMP out
1060 .six INC LOC-4
1070 JMP out
1080 .reset LDA#48
1090 STA LOC
1100 STA LOC-1
1110 STA LOC-3
1120 STA LOC-4
1130 .out LDA&71
1140 CMP#&7C
1150 BNE end
1160 LDY#6
1170 .loop LDA &76,Y
1180 STA(&70),Y
1190 DEY
1200 BNE loop
1210 .end PLA
1220 TAY
1230 PLA
1240 TAX
1250 PLA
1260 CLI
1270 RTS
1280 ]NEXT
1290 CALLT%
1300 PRINT'"    *** MODE 7 REAL-TIM
E CLOCK ***"
1310 INPUT'"Enter time  (e.g. 14:27
) >"T$
1320 IFLEN(T$)<>5THENCLS:PRINT'"Ple
ase re-enter as shown.":GOTO1310
1330 FORN=1TO5:T2$=MID$(T$,N,1):IFT
2$=":"THENGOTO1340:ELSE?(&77+N)=VAL(
T2$)+48
1340 NEXT
1350 CALLS%
1360 PRINT'"Press R to reset time."
1370 PRINT'"Any other key to exit."
1380 A$=INKEY$(1500):IFA$="R"THENGO
TO1310
1390 CLS:PRINT'"Ready":CLEAR
1400 END
>
```

LEE PAYNE from the Isle of Bute has sent in a mode 7 real-time clock, which is accurate up to about 10 seconds a day. It provides you with a 24-hour digital clock, leaving normal operations of the machine unaffected. The routine will work with OS 1.0 or later and takes up about 130 bytes when assembled.

The program works by using the BBC's event timer to call up a section of machine code. This updates the screen display every 60 seconds. The position of the display on the screen is fixed by the user. It is affected by scrolling or clearing the screen but will reappear at the same place at the next 60-second update.

The object code is assembled into page &D but this can be altered by changing all references to &D in both the setup and code to a more suitable spot for disc users. Page &D is taken by the DFS but &9 is generally free.

Patterns

This graphics demonstration program provided by M E Hughes was originally written on an IBM PC. The program asks for a number between 0 and 500, and then goes on to draw some modulus functions of this number. The program has two different modulus functions provided. When running the program, select which you require by editing the program itself.

Patterns.

```
  10 REM PATTERNS by M. E. Hughs
  20 REM For input of number n, draws
 n-1 circular patternas using a
  30 REM modulus function.  Some patt
erns are pleasing, others not.
  40 REM Suggest you try Nos. between
 10 and 30 or 80 and 200.
  50 MODE1: r = 300: x0 = 540: y0 = 5
12
  60 INPUT"Enter number of points ",n
  70 theta = 2*PI/n
  80 DIM x(n),y(n)
  90 FOR I% = 1 TO n
 100 x(I%) = x0 + r*COS(theta*I%)
 110 y(I%) = y0 + r*SIN(theta*I%)
 120 NEXT I%
 130 FOR J%= 1 TO n
 140 CLS: PRINTJ%;"  ";n
 150 FOR I% = 1 TO n-1
 160 k = ((I%*J% MOD n/2)+I%) MOD n
 170 REM k = I%*J% MOD n
 180 IF k = 0 THEN k = 1
 190 MOVE x0,y0: DRAW x(k),y(k):DRAW
x(I%),y(I%)
 200 NEXT I%
 210 g = GET
 220 NEXT J%
 230 END
```

Arcs.

```
  3000 IF F=0 THEN F=P2
  3010 DEF PROCARC(X%,Y%,R%,S%,A,S,F)
  3020 S=ABS(S): F=ABS(F)
  3030 LOCAL  P2,T
  3040 P2=2*PI: IF S%=0 THEN S%=5 ELS
E S%=85
  3050 S=S-P2*INT(S/P2)
  3060 F=F-P2*INT(F/P2)
  3070 IF F=0 THEN F=P2
  3080 IF F=S THEN ENDPROC ELSEIF S>F
 THEN F=F+P2
  3090 MOVE X%+R%*COS(S),Y%+R%*A*SIN(
S)
  3100 FOR T=S TO F STEP.1
  3110 IF S%=85 THEN MOVE X%,Y%
  3120 PLOTS%,X%+R%*COS(T+.1),Y%+R%*A
*SIN(T+.1)
  3130 NEXT
  3140 ENDPROC
```

Media moves. Tape to disc.

```
    5 REM Program by Wouter Kolkman
   10 REM to make copies from tape t
o disc
   11 REM copies all programs includ
ing Wordwise, machine codes etc. wit
hout changing loadadress, startadres
s
   12 REM this program may be corrup
ted if an attempt is made to copy a
program of over 22k Byte
   14 REM Check if you are in doubt
(print &finalnumber  on *CAT of a pr
ogram)
   20 ON ERROR GOTO 210
   30 MODE7
   40 VDU15:name$=""
   50 VDU26:CLS:PRINT'CHR$(141)"Copy
 tape]disc"
   60 PRINTCHR$(141)"Copy tape]disc"
:VDU28,0,24,39,5
   65 REM Chain cassette programs?
   70 PRINT"Do you want more than on
e program";:INPUT more$:IF LEFT$(mor
e$,1)="y" OR LEFT$(more$,1)="Y" THEN
 more%=1 ELSE more%=0
   80 CLS:PRINTTAB(0,2)"*CAT":PRINTT
AB(5,19)"<ESCAPE>":VDU28,0,22,39,5:P
RINTTAB(3,2):OSCLI"T.":OSCLI"OPT1,2"
:OSCLI"*."
   85 REM cassette name may be alter
ed before saving:default first 7 cha
racters
   90 IF more%=0 PRINT'"New name";:I
NPUT name$
  100 REPEAT
  110 VDU28,0,24,39,5:CLS
  120 OSCLI"LOAD "+""""""+"1900"
  130 PROCread
  140 IF name$<>""THEN fn$=name$
  150 REMIF load$="0E00" THEN load$=
"1900":REM conditions may be entered
 for relocating the program on disc
  160 OSCLI"D.":OSCLI"SAVE "+fn$+" 1
900"+" +"+length$+" "+exec$+" "+load
$:OSCLI"ACCESS "+fn$+" L":OSCLI"T."
  170 IF more%=0 THEN fn$="       "
  180 UNTIL fn$="       "
  190 PRINT'"Do you want to repeat
the program ";:INPUT repeat$:IF repe
at$<>""AND(LEFT$(repeat$,1)="Y" OR L
EFT$(repeat$,1)="y")THEN 70
  200 END
  210 IF ERR=17 AND ERL=80 GOTO90
  220 IF ERR=17 THEN 190
  230 PRINT ERR,ERL:REPORT
  240 END
  250 DEFPROCread
  260 Y=0
  270 REPEAT
  280 search$="":FOR X=0 TO 3:search
$=search$+FNREADCH(X,Y):NEXT
  290 Y=Y+1
  300 UNTIL search$="Load"
  310 Y=Y+1
  320
  330 fn$="":load$="":length$="":exe
c$=""
  340 FOR X=0 TO 6:fn$=fn$+FNREADCH(
X,Y):NEXT
  350 FOR X=26 TO 29:load$=load$+FNR
EADCH(X,Y):NEXT
  360 FOR X=14 TO 17:length$=length$
+FNREADCH(X,Y):NEXT
  370 FOR X=35 TO 38:exec$=exec$+FNR
EADCH(X,Y):NEXT
  380 ENDPROC
  390 DEFFNREADCH(X,Y)
  400 LOCAL A%,LASTX,LASTY,C
  410 LASTX=POS
  420 LASTY=VPOS
  430 VDU31,X,Y
  440 A%=135
  450 C=USR(&FFF4)
  460 C=C AND &FFFF
  470 C=C DIV &100
  480 VDU31,LASTX,LASTY
  490 =CHR$(C)
  500 REM Load program at page=&7000
>
```

Backup disc to cassette.

```
   10 REM Backup disc > cassette
   20 ON ERROR GOTO360
   30 MODE7
   40 CLS:PRINT'''"Are you using a p
rinter? ";:print$=GET$:PRINT;print$:
print%=1+INSTR("NnYy",print$):ON pri
nt% GOTO40,50,50,50,50
   50 PRINTTAB(0,12)"Taperecorder re
ady?":WAIT=GET
   60 VDU26:CLS:PRINT'CHR$(141)"Back
up disc]cassette"
   70 PRINTCHR$(141)"Backup disc]cas
sette":VDU28,0,24,39,5
   80 CLS:*.
   90 PRINTTAB(0,16)"Copy or Backup
(C/B) ";:VDU127;:copy$=GET$:PRINT;co
py$:copy%=1+INSTR("BbCc",copy$):ON c
opy% GOTO90,100,100,100,100
  100 PRINTTAB(0,18)"Entire director
y?  ";:VDU127;:dir$=GET$:PRINT;dir$:
DIR%=1+INSTR("NnYy",dir$):ON DIR%GOT
O100,120,120,110,110
  105 REM dir$  causes copying in al
fabetic order on the first character
 of a program name
  110 dir$="!0123456789ABCDEFGHIJKLM
NOPQRSTUVWXYZ":dir%=1:INPUT'"Directo
ry name";n$:A$=n$+"."+MID$(dir$,dir%
,1)+"*":GOTO130
  120 dir$=" ":INPUT"WHICH FILES ",A
$:REM same syntax as *INFO
  130 Y=0
  140 REPEAT
  150 y%=Y
  160 CLS:OSCLI"INFO"+" "+A$
  170 PRINT:PROCread
  180 IF EVAL("&"+length$)<22000 THE
N 190 ELSE VDU7:PRINT"Program ";fn$;
" is to long":VDU7:wait%=INKEY(50):G
OTO280
  190 OSCLI"LOAD "+fn$+" 1900"
  200 b%=INSTR(fn$,".")
  210 fnb$=RIGHT$(fn$,LEN(fn$)-b%)
  220 PRINT"   SAVING ";fnb$;
```

(listing continued on next page)

Arcs in Basic

Leon Goodfriend of Cardiff has written a Basic arc plotter. The procedure can be used to draw circles, arcs or ellipses, which may be shaded as an option.

The procedure is entered with the following parameters

X%,Y% — co-ordinates of centre of arc
S% — shade flag
A — aspect ratio
S,F — start and finish

The co-ordinates are in standard graphics units. When non-zero, the shade flag causes the shape to be shaded, otherwise the shape will be plotted as a single line.

The aspect ratio is the ratio of the height of the arc to its width. This should be set to 1 to produce a circular arc. The start and finish of plotting are for specifying in radians the angle at which plotting should start and finish. To draw a complete circle both values should be set to 0.

For example, to draw a circle of radius 200 units with its centre at the point (500,380), the command would be

PROCARC(500,380,200,0,1,0,0)

and to shade the circle the 0 after the 200 would be 1.

Try experimenting with different values and you should soon get the feeling of what is going on. Here are a couple of examples to type in. Enter

PROCARC(640,420,400,0,1,PI,0)

followed by

PROCARC(640,420,400,0,1.5,PI)

Or you could try

PROCARC(640,612,100,0,0.9,0,3*PI/2)

and

PROCARC(640,432,100,0,0.9,PI,PI/2)

Media moves

This program from Wouter Kolkman is capable of copying every file on a disc to tape without changing the reload address. However, it will only work with files that are less than 22K long.

The backup facility renames files to directory ' so you can see that the program has been backed up. When using the facility, you may use wild cards # and *.

The program is currently written for OS 1.2 but this can be changed by altering the Oscli on line 160 and all subsequent occurences to

PROCoscli(command$)

and coding a

DEF PROCoscli(text$)

at the end of the program. See page 463 of the *User Guide*.

Mr Kolkman has also provided a means of reversing a backup on to cassette. The program starts with a

*CAT

on the tape to allow you to find the right program. When it has been found, press Escape and you will be asked whether you wish to rename the program or use the first seven characters of the file name. If you

(continued on next page)

(listing continued from previous page)

```
  230 *T.
  240 *OPT1,0
  250 OSCLI"SAVE "+fnb$+" 1900"+" +"
+length$+" "+exec$+" "+load$
  260 IF print%<4 THEN270 ELSEVDU2:P
RINTfnb$:VDU3:REM if printer on, the
n print program name
  270 *D.
  280 IF copy%>3 THEN Y=Y+1:GOTO320
ELSEIF Y-y%>0 GOTO320
  290 OSCLI"ACCESS "+fn$:REM IF BACK
UP then RENAME and LOCK
  300 OSCLI"RENAME "+fn$+" `."+fnb$
  310 OSCLI"ACCESS `."+fnb$+" L"
  320 UNTIL fn$="          "
  330 IF dir$=" "THEN340 ELSEIF dir%
<37 THEN dir%=dir%+1:A$=n$+"."+MID$(
dir$,dir%,1)+"*":GOTO130
  340 PRINT''"NEXT SERIES?":get$=GET
$:IF get$="Y" OR get$="y" THEN 80ELS
E GOTO 350
  350 END
  360 IF(ERR=17 AND ERL=250)OSCLI"D.
":GOTO 330
  370 IF(ERR=214 AND (ERL=190 OR ERL
=160))THEN330
  380 PRINT ERR,ERL:REPORT
  390 END
  400 DEFPROCread:REM reads characte
rs from the screen (User Manual page
 432)
  410 fn$="":load$="":length$="":exe
c$=""
  420 FOR X=0 TO 8:fn$=fn$+FNREADCH(
X,Y):NEXT
  430 FOR X=16 TO 19:load$=load$+FNR
EADCH(X,Y):NEXT
  440 FOR X=28 TO 33:length$=length$
+FNREADCH(X,Y):NEXT:IF length$="
  " THEN length$="0001"
  450 FOR X=23 TO 26:exec$=exec$+FNR
EADCH(X,Y):NEXT
  460 ENDPROC
  470 DEFFNREADCH(X,Y)
  480 LOCAL A%,LASTX,LASTY,C
  490 LASTX=POS
  500 LASTY=VPOS
  510 VDU31,X,Y
  520 A%=135
  530 C=USR(&FFF4)
  540 C=C AND &FFFF
  550 C=C DIV &100
  560 VDU31,LASTX,LASTY
  570 =CHR$(C)
  580 REM Load program at page=&7000
```

(continued from previous page)

enter the "more than one program" option, the programs are loaded one after the other and stored on to disc.

Again there are OS 1.2 commands, and you get around this the same way as before. Both programs read characters from screen memory so make sure you do not scroll the screen for any reason. Again the maximum length of a file is 22K.

Singing heads

D Chalazonitis of Athens has sent in a program in the vein of the Simon game. When the program is run, you are asked for the volume level, which is in the standard format 0 to 15. At this point four heads appear and start building up a tune one note at a time.

The object of the game is to copy the tune each time a new note is added. So you repeat what has gone on before and add the new note on to the end of the sequence. To copy the heads you use the four keys above the Return key. If the wrong key is pressed, or you are indecisive, the game ends. The sequence gets faster as the game progresses.

The main program is between lines 190 and 340 with the top line of the screen showing the score, high score, current note and total number of notes.

If you are very good you may be able to better Mr Chalazonitis's score of 25. However, there is a game limit of 50 which when reached will start the game again.

Singing heads.

```
    0 REM (c) D.Chalazonitis Sept.'8
3
   10 MODE7:HIMEM=HIMEM-372
   20 *FX4,1
   30 *FX11,0
   40 VDU23;8202;0;0;0;
   50 DIMA(50)
   60 PROCassemble
   70 PROCdata
   80 INPUTTAB(9,9)"INPUT VOLUME (0-
15)"V
   90 IF V<0 OR V>15 THEN GOTO 80 EL
SE V=-V:CLS
  100 PROCLINE(0):PROCLINE(2):PROCLI
NE(23):PROCLINE(24)
  110 PRINTTAB(0,1);CHR$(131);"SCORE
 ";TAB(15,1);"HI-SCORE "
  120 H=0
  130 PROCGR(147,1):PROCGR(146,10):P
ROCGR(145,19):PROCGR(148,29)
  140 F=FALSE:S=0:J=0:C=0:PROCSCORE
  150 ?&74=3
  160 PROCBODY(&22):PROCBODY(&2C):PR
OCBODY(&36):PROCBODY(&40)
  170 ?&74=16
  180 FORN=1TO4:PROCDOWN(N):NEXT
  190 REPEAT
  200 PROCDEL(100):C=C+1
  210 REPEAT A(C)=RND(4):UNTIL A(C)<
>A(C-1)
  220 IF C>20 D=2 ELSE IF C>15 D=3 E
LSE IF C>10 D=4 ELSE D=16-C
  230 FOR J=1 TO C
  240 PROCMOVE(A(J),D)
  250 NEXT
  260 *FX15,0
  270 J=0
  280 REPEAT J=J+1:T=TIME
  290 A=INKEY(400)
  300 IF A=&5B X=4 ELSE IF A=&5F X=3
 ELSE IF A=&8B X=2 ELSE IF A=&8A X=1
 ELSE X=0
  310 IF X<>A(J) OR X=0 F=TRUE ELSE
S=S+J*5:PROCMOVE(X,5)
  320
  330 UNTIL F OR J=C:IF F THEN PROCL
OST
  340 UNTIL F OR C=50
  350 GOTO130
  360 DEFPROCLINE(X)
  370 PRINTTAB(0,X);CHR$(150);STRING
$(38,CHR$(255));:ENDPROC
  380 DEFPROCSCORE
  390 PRINTTAB(7,1);S;TAB(24,1);H;TA
B(32,1);J;" ";TAB(37,1);C;" ":ENDPRO
C
  400 DEFPROCGR(K,N):LOCALL
  410 FOR L=4 TO 22:PRINTTAB(N,L);CH
R$(K);:NEXT:ENDPROC
  420 DEFPROCMOVE(X,D)
  430 PROCUP(X):PROCSCORE:SOUND1,V,X
*28+50,D:PROCDEL(D*5):PROCDOWN(X)
  440 ENDPROC
  450 DEFPROCLOST
  460 IF H<S H=S
  470 PROCSCORE:SOUND1,V,30,10:PRINT
TAB(9,9);CHR$(131);"PRESS SPACE TO P
LAY"
  480 REPEAT UNTIL GET=32
  490 PRINTTAB(9,9);STRING$(30," ");
TAB(7,1);"        ":ENDPROC
  500 DEFPROCBODY(X)
  510 ?&70=&C0:?&71=&7B:?&72=X:?&73=
&7F:CALL SHOW:ENDPROC
  520 DEFPROCUP(X)
  530 ?&71=&7B:?&73=&7C
  540 IF X=4 THEN ?&70=&50:?&72=&A2
  550 IF X=3 THEN ?&70=&3B:?&72=&AC
  560 IF X=2 THEN ?&70=&26:?&72=&B6
  570 IF X=1 THEN ?&70=&11:?&72=&C0
  580 CALL SHOW:ENDPROC
  590 DEFPROCDOWN(X)
  600 ?&71=&7A:?&70=&8C:?&73=&7C:?&7
2=&A2+(4-X)*10:CALL SHOW:ENDPROC
  610 DEFPROCassemble:LOCALN
  620 DIM G% 50
  630 FOR N=0TO2 STEP2
  640 P%=G%
  650 [OPTN
  660 .SHOW LDX&74
  670 .L1 LDY#0
  680 .L2 LDA(&70),Y:STA(&72),Y:INY:
CPY#7:BNE L2
  690 CLC:LDA&72:ADC#40:STA&72:LDA&7
3:ADC#0:STA&73
  700 CLC:LDA&70:ADC#7:STA&70:LDA&71
:ADC#0:STA&71:DEX:BNE L1:RTS:]
  710 NEXT:ENDPROC
  720 DEFPROCDEL(X):LOCALT:T=TIME
  730 REPEAT UNTIL TIME-T>X:ENDPROC
  740 DEFPROCdata:LOCAL N
  750 FOR N=0TO195:N?HIMEM=160:NEXT
  760 RESTORE:N=N-1
  770 REPEAT N=N+1:READ A:IF A>0 N?H
IMEM=A+160
  775 UNTIL A<0
  780 N=83
  790 REPEAT N=N+1:READ A:IF A>0 N?H
IMEM=A+160
  795 UNTIL A<0
  800 ENDPROC
  810 DATA0,88,94,95,93,84,0,72,95,8
5,95,90,95,20
  820 DATA10,95,3,0,3,95,5,0,11,79,9
2,31,7,0
  830 DATA0,0,0,95,0,0,0,0,0,0,95,0,
0,0
  840 DATA0,0,0,95,0,0,0,0,0,0,95,0,
0,0
  850 DATA0,0,0,95,0,0,0,0,0,0,95,0,
0,0
  860 DATA0,0,0,95,0,0,0,0,0,0,95,0,
0,0
  870 DATA0,0,0,95,0,0,0,0,0,0,95,0,
0,0
  880 DATA0,0,0,95,0,0,0,0,0,0,95,0,
0,0
  890 DATA68,84,88,95,84,88,24,1,72,
95,92,95,20,2
  900 DATA0,80,91,3,87,80,0,-1
  910 DATA0,88,94,95,93,84,0,72,95,8
5,95,90,95,20
  920 DATA10,95,15,15,15,95,5,0,11,7
9,95,31,7,0,-1
```

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Music maker

ONE OF THE features of the Commodore 64 is its music synthesiser, but programming it is no easy task. Although setting up the different sounds on each of the three voices is relatively straightforward, playing tunes in real time is tricky.

C J Moore of Wallingford has adapted a program, originally written by C Merten and S Meyer, which is only available in the U.S. It will allow you to compose, edit and save a three-part song. Although written to work with discs, there is no reason why the program should not be modified to work with tape.

There are two programs. The first is the Note Editor and the second is Play A Song, which plays the songs created by the editor.

The Note Editor inputs music using conventional notation. A variety of facilities are provided and they are listed in the menu. Data is saved as straightforward sequential files by the Note Editor but when the song data is loaded back by the second program, it is encoded as two bytes. The first contains details of the note's octave and number, the second contains the note's duration ready for playing back.

Playing the song back requires that the Sid voices are each operated together. It is not really practical in Basic owing to the time delay between consecutive Basic statements. Therefore a machine-code routine has been used, which is stored from location 49630 ($C1DE) onwards. The routine uses the song data in its encoded form.

Several different songs can be loaded into the 64 by the program and then played as required.

Pokes selection for the 64

I am often asked for Pokes to disable different features of the Commodore 64, so a few of my favourites are shown in the table.

Commodore 64 Pokes.

POKE 788,52 — Stop Key disable, also stops TI clock
POKE 788,49 — Stop Key enable
POKE 792,193 — Run/Stop-Restore disable, also disables RS-232
POKE 792,71 — Run/Stop-Restore enable
PRINT CHR$(8) — CBM-Shift disable
PRINT CHR$(9) — CBM-Shift enable
POKE 774,PEEK(65532): POKE 775, PEEK(65533) — List disable total reset
POKE 774,PEEK(790): POKE 775, PEEK(791) — List disable part reset
POKE 650,64 — Key Repeat disable
POKE 650,128 — Repeat on all keys
POKE 650,0 — Repeat on cursor keys
POKE 788,70 — 64 disable!: the only way out is to switch the 64 off and on again.

Note editor.

```
 20 REM       NOTE CODE EDITOR   C.J.MOORE

 35 GOSUB 90: POKE 53280,4:POKE 53281,2
 40 DIM DA(500,3)
 45 C$="C C#D D#E F F#G G#A A#B R-"
 50 GOSUB 90:GOSUB 530
 60 ON MX GOSUB 110,1010,940,740,850,680,
    840
 70 GOTO 50:END

 75 REM       ******* RESPONSE **********
 76 GET A$:IF A$=""THEN 76
 77 Z=-1:IF A$="N"THEN Z=1
 78 IF A$="Y"THEN Z=0
 79 IF Z<0 THEN 76
 80 RETURN

 82 REM       ******PRINT HEADER *********
 90 PRINT"[CLEAR,MAGENTA,RVS]
    ..........NOTE CODE EDITOR..........
    ...[RVOFF,WHITE]";:RETURN

100 REM      ********* LOAD **************
110 GOSUB 90:PRINT"[DOWN3]
    LOAD MUSIC FILE CALLED"
120 PRINT"[DOWN3]........
    [UP]";
125 INPUT"[LEFT17]";F$
130 PRINT"[DOWN3]IS THE FILE [RVS]"F$"
    [RVOFF]  Y/N?"
140 GOSUB 76:IF Z THEN RETURN
150 OPEN 5,8,5,"@0:"+F$+",S,R"
160 INPUT#5,L(1):INPUT#5,L(2)
162 INPUT#5,L(3):INPUT#5,TEMPO
170 FOR V=1 TO 3:FOR I=1 TO L(V)
180 INPUT#5,DA(I,V)
190 NEXT:NEXT:CLOSE 5:RETURN

200 REM      ********* EDIT **************
205 GOSUB 90:PRINT" VOICE "V"  NOTE"N"
    [RVS]TYPE '*' TO EXIT"
207 PRINT"[RVS] NOTE VALUE [RVOFF]"
208 PRINT"    h  h  h  h  h  h  h  h"
209 PRINT"    h  h  h  h  h  h  h  h"
210 PRINT"    h  h  h  h  h  h  h  h
    h  h"
220 PRINT" ⌐  ⌐  ⌐  [RVS] [RVOFF]  [RVS]
    [RVOFF]  [RVS]  [RVOFF]  [RVS]
    [RVOFF]  [RVS]  [RVOFF]  [RVS]
    [RVOFF]  [RVS]  [RVOFF]  [RVS]
    [RVOFF]
    "
230 PRINT" ¯  ¯  ¯  ¯"
240 PRINT"128 96 64  48  32  24  16  12
    8  6  4"
250 PRINT"_____
    ";
260 PRINT"[RVS,CYAN] OCTAVE CODE [RVOFF]"
270 PRINT"       BASS          TREBLE"
280 PRINT"    ___________________________
    _  _  _  _"
290 PRINT"       C-B C-B (MIDDLE C) -B C-
    B C-B"
300 PRINT"OCTAVE= 4   3           2   1
    0"
310 PRINT"_____
    "
312 PRINT"PRESS A KEY.  '*' WILL EXIT TO
    MENU"
313 GET A$:IF A$=""THEN 313
314 IF A$="*"THEN RETURN
315 PRINT"[UP,YELLOW,RVS]
    ENTER NOTE CODES [RVOFF]
    ................."
320 PRINT"NOTE (E,G,  C,F#,REST)? R"
330 PRINT"OCTAVE 0-7  (8,9=END)? 2"
340 PRINT"DURATION 1-255........? 32"
350 PRINT"[UP4]"
360 INPUT"NOTE (E,G,  C,F#,REST)";NT$
370 INPUT"OCTAVE 0-7  (8,9=END)";OC
380 INPUT"DURATION 1-255........";DU
400 PRINT:PRINT"NOTE [RVS]"NT$" [RVOFF]
```

```
    ▲OCTAVE▲[RVS]"OC"[RVOFF]▲LENGTH▲[RVS]
    "DU"[RVOFF]"
410 PRINT"IS▲THIS▲CORRECT?▲Y/N";:GOSUB 76
    :IF Z THEN 205
450 NT$=LEFT$(NT$+"▲▲▲",2):NT=0
460 FOR I=0 TO 11:IF MID$(C$,I*2+1,
    2)=NT$THEN NT=I
470 NEXT
475 IF NT$="R▲"OR NT$="RE"THEN NT=12
480 IF NT<0 OR NT>12 THEN STOP
490 DA(2*N-1,V)=16*OC+NT:DA(2*N,V)=DU
495 IF CO THEN RETURN
500 L(V)=2*N:IF OC<8 THEN N=N+1:SU=SU+DU
    : GOTO 205
510 P(V)=SU:N=1:V=V+1:SU=0
520 IF V<4 THEN 205
522 GOSUB 90:PRINT"▲▲VOICE▲▲▲▲LENGTH▲▲▲▲
    TOTAL▲DURATION"
524 FOR V=1 TO 3:L$=STR$(L(V))
    :P$=STR$(P(V)):K$=STR$(V)
526 PRINT"▲▲▲▲"+K$+"▲▲▲▲▲▲"+L$+"▲▲▲▲▲▲▲"+P$
527 NEXT: PRINT"[DOWN2]INPUT▲TEMPO▲(NO.O
    F▲BEATS/MINUTE)▲?▲100"
528 INPUT"[UP]INPUT▲TEMPO▲(NO.OF▲BEATS/M
    INUTE)▲";TEMPO: TEMPO=INT(920/TEMPO)
529 RETURN

530 REM      ********* MENU *************
540 PRINT"[HOME,DOWN2,RVS]
    ▲▲▲SELECT▲1▲OF▲THE▲FOLLOWING▲OPTIONS
    ▲▲▲▲";
550 PRINT"[RVS]▲▲▲▲BY▲PRESSING▲THE▲INDIC
    ATED▲KEY▲▲▲▲▲▲▲▲";:PRINT:PRINT
560 PRINT"▲[RVS]L[RVOFF]OAD▲A▲MUSIC▲FILE"
    :PRINT
570 PRINT"▲[RVS]A[RVOFF]
    DD▲NEW▲CODE▲TO▲A▲FILE":PRINT
580 PRINT"▲[RVS]C[RVOFF]
    HANGE/CORRECT▲THE▲FILE":PRINT
590 PRINT"▲[RVS]D[RVOFF]
    ISPLAY▲CODE▲ON▲THE▲SCREEN":PRINT
595 PRINT"▲[RVS]P[RVOFF]
    RINT▲CODE▲ON▲PAPER":PRINT
600 PRINT"▲[RVS]S[RVOFF]
    AVE▲THE▲FILE▲ON▲DISC":PRINT
610 PRINT"▲[RVS]F[RVOFF]INISH▲JOB":PRINT
    :PRINT
620 PRINT"▲▲▲▲▲▲▲▲▲▲WHICH?";
630 GET A$:IF A$=""THEN 630
640 MX=0:FOR T=1 TO 7:IF MID$("LOASDFP",
    T,1)=A$THEN MX=T
650 NEXT:IF MX=0 THEN 630
660 RETURN

670 REM      ********* END **************
680 GOSUB 90:PRINT"[DOWN7]
    HAVE▲YOU▲SAVED▲THE▲FILE▲TO▲DISC?"
690 PRINT"[DOWN2]CONTINUE▲Y/N";
700 GOSUB 76:IF Z THEN RETURN
710 PRINT"[CLEAR]":END

730 REM      ********* SAVE *************
740 GOSUB 90:PRINT"[DOWN2]
    NAME▲OF▲FILE▲FOR▲STORING▲MUSIC▲FILE"
742 PRINT"[DOWN3]▲▲▲▲▲▲▲▲▲
    ¯[UP]";
745 INPUT"[LEFT17]";N$
750 PRINT:PRINT"DO▲YOU▲WANT▲TO▲SAVE▲FILE
    ▲[RVS]"N$"[RVOFF]":GOSUB 76
    :IF Z THEN RETURN
780 OPEN 5,8,5,"@0:"+N$+",S,W"
790 PRINT#5,L(1):PRINT#5,L(2)
791 PRINT#5,L(3):PRINT#5,TEMPO
800 FOR I=1 TO 3:FOR J=1 TO L(I)
810 PRINT#5,DA(J,I)
820 NEXT:NEXT:CLOSE 5 :RETURN

830 REM      ******** DISPLAY ***********
840 OPEN 4,4:CMD 4:KP=1
850 T$="VOICE▲NO. ▲NOTE▲&VE▲VALUE▲HEX-BYT
    ES▲TIME":IF KP=1 THEN PRINT T$
855 FOR I=1 TO 34:IF KP=0 THEN GOSUB 90
    :PRINT T$
860 FOR J=1 TO 22:M=J+22*I-22:M=2*M-1:V=1
    :K=M
861 IF M>L(1)THEN K=M-L(1):V=2
862 IF M>L(2)+L(1)THEN K=M-L(1)-L(2):V=3
863 IF M>L(3)+L(2)+L(1)THEN KL=1:GOTO 890
865 N=INT(K/2)+1: IF N=1 THEN SU=0
870 GOSUB 1200:NEXT J
890 IF KP=1 THEN 893
891 PRINT"[RVS]CONTINUE?[RVOFF]";
892 GET A$:IF A$<>"Y"THEN 892
893 IF KL=1 THEN KL=0:GOTO 896
894 NEXT I
896 IF KP=1 THEN KP=0:PRINT#4:CLOSE 4
898 RETURN

900 REM      ********* ADD  ************
940 GOSUB 90:PRINT"[DOWN3]
    START▲AT▲VOICE▲?▲1"
950 INPUT"[UP]START▲AT▲VOICE▲";V
960 PRINT"[DOWN2]▲▲▲▲▲▲AND▲NOTE▲?▲1"
970 INPUT"[UP]▲▲▲▲▲▲AND▲NOTE▲";N
980 PRINT"[DOWN2,RVS]▲ADD▲FROM▲VOICE
    [RVOFF]"V"[RVS]▲▲NOTE[RVOFF]
    "N"▲?▲▲Y/N"
990 GOSUB 76:IF Z THEN RETURN
1000 GOSUB 205:RETURN

1005 REM     ******** CORRECT ***********
1010 GOSUB 90:PRINT"[RVS]
     LENGTH▲(NO.OF▲NOTES)▲OF,"
1012 PRINT"[DOWN]VOICE▲1▲?";L(1)/2
     :INPUT"[UP]VOICE▲1▲";L(1)
     :L(1)=2*L(1)
1013 PRINT"[DOWN]VOICE▲2▲?";L(2)/2
     :INPUT"[UP]VOICE▲2▲";L(2)
     :L(2)=2*L(2)
1014 PRINT"[DOWN]VOICE▲3▲?";L(3)/2
     :INPUT"[UP]VOICE▲3▲";L(3)
     :L(3)=2*L(3)
1020 IF TEMPO=0 THEN TEMPO=9999999
1030 PRINT"[DOWN2]▲TEMPO▲?";
     INT(920/TEMPO)
1031 INPUT "[UP]▲TEMPO▲";TEMPO
     :IF(TEMPO<10)OR(TEMPO>500)THEN 1031
1032 TEMPO=INT(920/TEMPO)
1035 PRINT"[RVS,DOWN]WHICH▲NOTE▲DO▲YOU▲W
     ANT▲TO▲CORRECT?...."
1040 PRINT"[DOWN2]VOICE▲▲▲▲▲▲?▲1"
     :INPUT"[UP]VOICE▲▲▲▲▲▲";V
1050 PRINT"[DOWN]NOTE▲NUMBER?▲1"
     :INPUT"[UP]NOTE▲NUMBER";N:K=2*N-1
1060 PRINT"[DOWN]CURRENT▲VALUES;"
     :GOSUB 1200
1090 PRINT"[DOWN]CHANGE?▲Y/N":GOSUB 76
     :IF Z THEN RETURN
1130 CO=1:GOSUB 205:CO=0
1140 RETURN

1150 REM     ***** HEX CONVERTER ********
1160 X%=X/16:X$=CHR$(48+X%-(X%>9)*7)
     :X%=(X/16-X%)*16
1170 X$=X$+CHR$(48+X%-(X%>9)*7):RETURN

1180 REM     ****************************
1200 OC=INT(DA(K,V)/16):NT=DA(K,V)-16*OC
     :SU=SU+DA(K+1,V):OC$=STR$(OC)
1210 OC$=RIGHT$(OC$,1):NT$=MID$(C$,
```

(continued on next page)

(continued from previous page)

```
      NT$*2+1,2):DU$=RIGHT$("  "+STR$(DA(K
      +1,V)),3)
1220 B$="   ":K$=RIGHT$(B$+STR$(N),3)
      :SU$=RIGHT$(B$+STR$(SU),5)
      :V$=STR$(V)
1230 X=DA(K,V):GOSUB 1160:C1$=X$
      :X=DA(K+1,V):GOSUB 1160:C2$=X$
      :V$=RIGHT$(V$,1)
1240 V$=CHR$(159)+STR$(V)+B$+K$+CHR$(158
      )+B$+NT$+B$+OC$+B$+DU$+CHR$(150)+B$
1250 IF KP=0 THEN PRINT"[RVS]
      "+V$+C1$+B$+C2$+" "+CHR$(152)+" "+S
      U$;
1255 IF KP=1 THEN PRINT V$+C1$+B$+C2$+"
      "+" "+SU$
1257 RETURN
```

Play A Song.

```
20 REM       PLAY A SONG          C.J.MOORE

40 GOSUB 100: POKE 53280,4:POKE 53281,2
    :DIM DA(500,3),F$(20):GOSUB 4000
45 DEF FN HI(V)=INT(V/256)
    :DEF FN LO(V)=INT(V-256*FN HI(V))
60 R=49630:D0=50020:AD=49961:T=49825:NS=0
    :W1=D0
70 GOSUB 120:GOTO 380

90 REM       ******* PRINT HEADER *******
100 PRINT"[CLEAR,MAGENTA,RVS]
    ▲▲▲▲▲▲▲▲▲▲▲▲PLAY A SONG▲▲▲▲▲▲▲▲▲▲▲▲
    ▲▲▲▲[RVOFF,WHITE]":RETURN

110 REM      ********** LOAD **********
120 NS=NS+1
125 GOSUB 100:PRINT:PRINT:PRINT
    :PRINT"LOAD SONG NUMBER"NS
130 PRINT:PRINT:PRINT"▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲
    ▔▔▔▔▔▔▔▔▔▔[UP]"
140 INPUT"[UP]FROM MUSIC FILE";F$(NS)
    :PRINT:PRINT
150 PRINT"[DOWN3]IS THE FILE [RVS]
    "F$(NS)" [RVOFF]  Y/N?"
160 GET A$:IF A$=""THEN 160
170 IF A$<>"Y"THEN 125
180 OPEN 5,8,5,"@0:"+F$(NS)+",S,R"
190 INPUT#5,L(1):INPUT#5,L(2)
210 INPUT#5,L(3):INPUT#5,TEMPO
220 FOR V=1 TO 3:FOR I=1 TO L(V)
230 INPUT#5,DA(I,V)
240 NEXT:NEXT:CLOSE 5:GOSUB 260
245 PRINT"[DOWN3]LOAD ANOTHER SONG  Y/N?"
246 GET A$:IF A$=""THEN 246
247 IF A$="N"THEN RETURN
248 IF A$="Y"THEN 120
249 GOTO 246

250 REM      ********* POKE DATA ********
260 V(1)=W1+7:V(2)=V(1)+L(1)
    :V(3)=V(2)+L(2)
270 POKE W1,FN LO(L(1)): POKE W1+1,
    FN HI(L(1))
280 POKE W1+2,FN LO(L(1)+L(2))
    : POKE W1+3,FN HI(L(1)+L(2))
290 POKE W1+4,FN LO(L(1)+L(2)+L(3))
    : POKE W1+5,FN HI(L(1)+L(2)+L(3))
295 POKE W1+6,TEMPO
300 FOR J=1 TO 3
310 FOR I=1 TO L(J)
320 POKE V(J)+I-1,DA(I,J)
330 NEXT:NEXT:W1=V(3)+L(3)
360 RETURN

370 REM      ******** CHOOSE SONG *******
380 GOSUB 100:PRINT:PRINT
390 FOR I=1 TO NS
400 PRINT"SONG NUMBER [RVS]"I"[RVOFF]
    "F$(I):NEXT
410 PRINT:INPUT"PLAY SONG NUMBER";NC
420 GOSUB 500:PRINT:PRINT
430 PRINT"PLAY ANOTHER SONG?  Y/N"
440 GET A$:IF A$=""THEN 440
450 IF A$="N"THEN GOSUB 100:END
460 IF A$="Y"THEN GOTO 380
470 GOTO 440

480 REM      ********* PLAY SONG ********
500 S=D0+4:IF NC=1 THEN 540
510 FOR K=2 TO NC
520 S=S+7+PEEK(S)+256*PEEK(S+1)
530 NEXT
540 V(1)=S+3:TEMPO=PEEK(S+2)
550 V(2)=PEEK(S-4)+256*PEEK(S-3)+V(1)
560 V(3)=PEEK(S-2)+256*PEEK(S-1)+V(1)
570 FOR J=1 TO 3
580 POKE AD+2*J-1,FN LO(V(J))
590 POKE AD+2*J  ,FN HI(V(J))
600 NEXT:POKE T,TEMPO
610 SYS R: RETURN

620 REM      **** SET UP MACHINE CODE ***
4000 FOR I=49630 TO 50000
4010 READ J: POKE I,J :CK=CK+J:NM=NM+1
4020 NEXT
4030 READ I,J
4040 IF I<>CK OR J<>NM THEN PRINT"DATA E
    RROR":STOP
4050 RETURN

5000 REM     ***** MACHINE CODE DATA ****
5001 DATA 120,173,14,220,41,254,141,14
5002 DATA 220,173,20,3,141,226,194,173
5003 DATA 21,3,141,227,194,169,35,141,4
5004 DATA 220,169,8,141,5,220,173,14,220
5005 DATA 9,1,141,14,220,169,217,141,20,3
5006 DATA 169,194,141,21,3,160,0,162,24
5007 DATA 189,54,195,157,0,212,202,16,247
5008 DATA 169,0,141,95,195,162,2,157,80
5009 DATA 195,202,16,250,162,5,189,42,195
5010 DATA 157,83,195,202,16,247,88,162
5011 DATA 2,142,94,195,189,80,195,240,16
5012 DATA 201,3,208,87,189,13,195,170,189
5013 DATA 58,195,157,4,212,208,72,138,10
5014 DATA 170,189,83,195,133,163,189,84
5016 DATA 195,133,164,177,163,40,76,32
5017 DATA 228,194,177,163,141,90,195,136
5018 DATA 24,165,163,105,2,157,83,195,144
5019 DATA 3,254,84,195,174,94,195,173,90
5020 DATA 195,157,80,195,189,13,195,170
5021 DATA 173,91,195,157,0,212,173,92,195
5022 DATA 157,1,212,189,58,195,9,1,157,4
5023 DATA 212,174,94,195,222,80,195,202
5024 DATA 16,151,169,4,141,95,195,173,95
5025 DATA 195,208,251,240,137,169,0,141,4
5026 DATA 212,141,11,212,141,18,212,169
5027 DATA 8,141,14,220,169,149,141,4,220
5028 DATA 169,66,141,5,220,173,226,194
5029 DATA 141,20,3,173,227,194,141,21,3
5030 DATA 169,1,141,14,220,88,96,173,95
5031 DATA 195,240,3,206,95,195,76,49,234
5032 DATA 141,93,195,41,15,10,168,185,16
5033 DATA 195,141,91,195,200,185,16,195
5034 DATA 141,92,195,173,93,195,74,74,74
5035 DATA 74,168,240,9,78,92,195,110,91
5036 DATA 195,136,208,247,200,96,0,7,14
5037 DATA 149,68,169,72,252,76,161,81,105
5038 DATA 86,140,91,254,96,194,102,223
5039 DATA 108,88,115,52,122,120,129,0,0
5040 DATA 169,193,243,193,47,194,0,0,0,0
5041 DATA 0,0,0,0,0,7,64,9,0,0,0,0,8,64
5042 DATA 149,97,0,0,0,0,32,83,113,0,0,0
5043 DATA 15,0,255
5100 DATA 44153,371
```

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Big factorials

AN IMPRESSIVE demonstration of the power of the Apple comes from Georgios Gallios of Thessaloniki in Greece. He has submitted a generator of factorials which differs from most such generators in that it is not meant purely as an example of recursive programming, but is intended to be useful.

If factorial 300 being 3.06058243*10**614 or factorial 33 being 8,683,317,618,811,886,495,518,194,401,280,000,000 is the kind of fact which does something for you, this is the program to do it with.

```
100  REM  ************************
     ******
110  REM  *** BIG FACTORIAL PROGR
     AM ***
115  REM  *** BY G.GALIOS
          ***
120  REM  ************************
     ******
130  REM
1000  REM  **
1010  REM  ** MAIN PROGRAM **
1020  REM  **
1025  IF INIT = 0 THEN  GOSUB 900
     0
1030  TEXT : HOME : VTAB 4:T1 = 5

1040  HTAB T1: INVERSE : PRINT "
     FIND THE FACTORIAL OF ": NORMAL
     : PRINT : PRINT
1050  PRINT  TAB( T1);"1.SMALL NU
     MBERS": PRINT
1060  PRINT  TAB( T1);"2.BIG NUMB
     ERS (THE ORDER)": PRINT
1070  PRINT  TAB( T1);"3.BIG NUMB
     ERS (ALL THE DIGITS)": PRINT

1080  PRINT  TAB( T1);"4.TERMINAT
     E": PRINT
1085  PRINT
1090  HTAB T1: INVERSE : PRINT "
     SELECT ONE (1-4) ": NORMAL
1100  GET L$:ME =  VAL (L$): IF M
     E < 1 OR ME > 4 THEN 1100
1110  IF ME = 4 THEN  END
1120  ON ME GOSUB 3500,3700,1500:
      REM  CALCULATE FACTORIAL
1130  HOME : VTAB 5: HTAB T1
1140  ON ME GOSUB 6200,6400,6000:
      REM  DISPLAY RESULTS
1142  IF SL = 1 THEN T1 = TE
1145  PR£ 0: PRINT
1150  PRINT : PRINT : HTAB T1:
      INVERSE : PRINT "PRESS A KEY
      TO CONTINUE": NORMAL
1155  GET L$
1160  GOSUB 1900: REM  SELECT DIS
     PLAY OR PRINTER
1170  PR£ SL
1175  IF SL = 1 THEN TE = T1:T1 =
     1
1180  GOTO 1130
1500  REM  ** BIG NUMBERS (ALL DI
     GITS)
1510  GOSUB 2500
1520  PRINT : GOSUB 1750
1530  HOME : VTAB 3: HTAB 13
1540  GOSUB 2620: PRINT : PRINT
1550 NM = 3:CF = 0
1560  IF INIT <  > 0 THEN  GOSUB
     7000
1570 F(1) = 1
1580  FOR C = 2 TO NN
1590 H =  INT (C / 100)
1600 DH = C - H * 100
1610 T =  INT (DH / 10)
1620 U = DH - T * 10
1625  VTAB 5
1630  HTAB 18: INVERSE : PRINT "
     HTU ": NORMAL
1640  HTAB 19: PRINT H;T;U: PRINT

1650  PRINT  TAB( T1);"YOU SEE TH
     E INTERMEDIATE RESULTS": PRINT
      TAB( T1);"IN REVERSE ORDER"
     : PRINT
1660  INVERSE : PRINT " ";C - 1;"
      ": NORMAL : PRINT
1670 J = 1:EN = H: GOSUB 2000
1680 J = 2:EN = T: GOSUB 2000
1690 J = 3:EN = U: GOSUB 2000
1700  GOSUB 4000: GOSUB 3000
1705  IF C < FL THEN 1730
1710  IF C > LN THEN 1730
1715  PR£ 1: PRINT : GOSUB 6500: PR£
     0
1730  NEXT C
1735 MN = NM
1740  RETURN
1750  REM  **
1755  PRINT
1760  PRINT  TAB( T1);"DO YOU WAN
     T TO PRINT THE": PRINT
1770  PRINT  TAB( T1);"INTERMEDIA
     TE RESULTS (Y/N) ": GOSUB 18
     00: IF L$ <  > "Y" THEN  RETURN

1775  PRINT : PRINT
1780  HTAB T1: INPUT "PRINT RESUL
     TS FROM ";FL: PRINT : HTAB T
     1 + 14: INPUT "TO ";LN
1790  RETURN
1800  REM  ** (Y/N) ?
1810  GET L$: IF L$ <  > "Y" AND
     L$ <  > "N" THEN 1810
1820  RETURN
1900  REM  ** DISPLAY OR PRINTER
1910  HOME : VTAB 6:T1 = 9
1920  HTAB T1 + 5: INVERSE : PRINT
      " OPTIONS ": NORMAL : PRINT

1930  PRINT  TAB( T1);"1.DISPLAY
      RESULTS": PRINT
1940  PRINT  TAB( T1);"2.PRINT RE
     SULTS": PRINT
1950  PRINT  TAB( T1);"3.RETURN T
     O MAIN MENU": PRINT : PRINT
     : PRINT
1960  HTAB T1: INVERSE : PRINT "
     SELECT ONE (1-3) ": NORMAL
1970  GET L$:SL =  VAL (L$) - 1: IF
     SL < 0 OR SL > 2 THEN 1970
1980  IF SL = 2 THEN  POP :SL = 0
     : GOTO 1000
1990 T1 = 5: RETURN
2000  REM
2010  REM   ** MULTIPLICATION ROU
     TINE **
2020  REM
2040 Y = 0
2060  FOR I = 1 TO NM
2080 Y = Y + F(I) * EN
2100 Y1 =  INT (Y / 10)
2120 Y2 = Y - Y1 * 10
2140 A(J,I) = Y2
2160 Y = Y1
2200  NEXT I
2300  RETURN
2500  REM  ** INPUT NUMBER
2510  HOME : VTAB 7:T1 = 5
2520  HTAB T1: PRINT "TYPE IN THE
      NUMBER ";
2530  INPUT "";L$:NN =  VAL (L$):
      IF NN <  = 0 THEN  PRINT  CHR$
     (7): GOTO 2510
2550  RETURN
2600  REM  ** RUNNING MESSAGE
2610  HOME : VTAB 10: HTAB 12
2620  INVERSE : PRINT " WAIT IS R
     UNNING ": NORMAL
2650  RETURN
3000  REM
3010  REM  ** SUM ROUTINE **
3020  REM
3040 SY = 0
3060  FOR I = 1 TO NM
3080 SY = SY + A(1,I) + A(2,I) +
     A(3,I)
3100 S1 =  INT (SY / 10)
3120 S2 = SY - S1 * 10
3140 F(I) = S2
3150  PRINT F(I);" ";
3160 SY = S1
3180  NEXT I
3190  IF (F(NM - 2) <  > 0 OR F(N
     M - 1) <  > 0 OR F(NM) <  >
     0) THEN NM = NM + 3
3200  RETURN
3500  REM  ** SMALL NUMBERS
3510  GOSUB 2500: REM  INPUT NUMB
     ER
3520  GOSUB 2600: REM  RUNNING
3530 N = 1
3540  FOR I = 1 TO NN:N = N * I: NEXT
     I
3550  RETURN
3700  REM  ** BIG NUMBERS (THE OR
     DER)
3710  GOSUB 2500: REM  INPUT
3720  GOSUB 2600
3730 NZ = 0
3740  FOR I = 1 TO NN:NZ = NZ +  LOG
     (I): NEXT I
3750 NX = NZ /  LOG (10):ND = NX -
      INT (NX)
3790  RETURN
4000  REM
4010  REM  ** CHANGE A(1,I) AND A
     (2,I) MATRIXES **
4020  REM
4040  FOR I = 1 TO NM - 2
4060 IA = NM + 1 - I
4080 A(1,IA) = A(1,IA - 2)
4100 A(2,IA) = A(2,IA - 1)
4120  NEXT I
4140 A(1,2) = 0:A(1,1) = 0
4160 A(2,2) = A(2,1):A(2,1) = 0
4300  RETURN
5000  REM
5010  REM  ** NULL MATRIX ROUTINE
      **
5020  REM
5040  FOR I = 1 TO MN
5060 A(J,I) = 0
5080  NEXT I
5100  RETURN
6000  REM  ** PRINT BIG NUMBERS (
     ALL DIGITS)
6060 CF = 0:AS = NM - ( INT (NM /
     3) * 3)
6070  PRINT NN;"!=";
6080  FOR I = NM TO 1 STEP  - 1
6100  IF (CF = 0 AND F(I) = 0) THEN
     6120
6105 ZX = NM + 1 + AS - I
6115 CF = 2: PRINT F(I);
6116  IF I = 1 THEN 6120
6117  IF (ZX -  INT (ZX / 3) * 3 =
     0) THEN  PRINT ",";
6120  NEXT I
6125  PRINT
6130  RETURN
6200  REM  ** PRINT SMALL NUMBERS

6210  PRINT NN;"!=";N
6220  RETURN
6400  REM  ** PRINT BIG NUMBERS (
     THE ORDER)
6410  PRINT NN;"!=";10 ^ ND;"*10^
```

(continued on opposite page)

Mastermind

A variation on the Post Office game of pen and paper days, this program from Guy Dean of Edinburgh offers graphics elements to deduce, rather than numbers. The six shapes varied across four columns make an interesting change. Only six tries are allowed for each selection, which guarantees at least some lost games while still permitting logic to triumph most of the time.

(continued from previous page)

```
      "; INT (NX)
6420  RETURN
6500  REM  PRINT INTERMEDIATE RES
      ULTS
6505 CF = 0:AS = NM - ( INT (NM /
      3) * 3)
6510  PRINT C;"!=";
6520  GOTO 6080
7000  REM
7010  REM
7020  REM
7040 J = 1: GOSUB 5000
7060 J = 2: GOSUB 5000
7080 J = 3: GOSUB 5000
7100  FOR I = 1 TO MN
7120 F(I) = 0
7140  NEXT I
7200  RETURN
9000  REM
9010  REM  ** INITIALISATION **
9020  REM
9030 ME$ = " WAIT IS RUNNING "
9040  HOME : VTAB 10: HTAB 13: INVERSE
      : PRINT " INITIALIZING ": NORMAL

9050 INIT = 11
9060  DIM A(3,300): DIM F(300)
9090  RETURN
```

Mastermind.

```
 10  REM  ***  MASTERMIND  ***
 20  REM  *** BY GUY DEAN  ***
 30  REM  ***   26/7/84    ***
 100  REM

LOAD IN SHAPE TABLE

 110  GOSUB 10000
 120  POKE 232,16: POKE 233,64
 200  REM

SET VARIABLES

 205  CLEAR
 210  DIM M(4),P(4)
 250  GOSUB 40000: REM  INSTRUCTIO
      NS
 300  REM

DRAW BOARD

 310  HOME : HGR
 320  HCOLOR= 3
 330  FOR C = 10 TO 25
 340  HPLOT 50,C TO 115,C
 350  NEXT
 360  FOR C = 1 TO 6
 370 Z = C * 20 + 10: DRAW 7 AT 60
      ,Z + 5: DRAW 7 AT 75,Z + 5: DRAW
      7 AT 90,Z + 5: DRAW 7 AT 105
      ,Z + 5
 380  DRAW 7 AT 125,Z: DRAW 7 AT 1
      35,Z: DRAW 7 AT 125,Z + 10: DRAW
      7 AT 135,Z + 10
 390  HPLOT 50,Z + 15 TO 145,Z + 1
      5
 400  NEXT
 410  HPLOT 50,0 TO 50,145: HPLOT
      145,0 TO 145,145
 420  HPLOT 50,0 TO 145,0
 430  FOR C = 1 TO 6: DRAW C AT C *
      14 + 181,150: NEXT
 500  REM

GET SETUP

 510  FOR C = 1 TO 4
 520 M(C) =  INT ( RND (1) * 6) +
      1
 530  NEXT
 600  REM

GET PLAYER CHOICE

 610  VTAB 21: HTAB 28: PRINT "1 2
       3 4 5 6"
 615 G = G + 1
 620  VTAB 22: PRINT "GUESS ";G
 630  FOR C = 1 TO 4
 640  VTAB 23: PRINT "ENTER SHAPE
      FOR POSITION ";C;"?";: GET P
      $
 645 P(C) =  VAL (P$)
 650  PRINT
 655  IF P(C) < 1 OR P(C) > 6 THEN
       GOTO 640
 660  HCOLOR= 0: DRAW 7 AT C * 15 +
      45,G * 20 + 15
 670  HCOLOR= 3: DRAW P(C) AT C *
      15 + 45,G * 20 + 13
 680  NEXT
 800  REM

CHECK ANSWERS

 805 S = 0:P2 = 0:PO = 0:FF = 0: FOR
      C = 1 TO 4:MF(C) = 0: NEXT
 810  FOR C = 1 TO 4
 820  IF P(C) = M(C) THEN P(C) = 0
      :MF(C) = 1:FF = 8:S = S + 1:
       GOSUB 20000
 830  NEXT
 840  FOR C = 1 TO 4
 850  FOR X = 1 TO 4
 855  IF P(X) = 0 OR MF(C) = 1 THEN
      870
 860  IF P(X) = M(C) THEN P(X) =  -
      1:FF = 9: GOSUB 20000:MF(C) =
      1
 870  NEXT
 880  NEXT
 1000  REM

CHECK IF WON

 1010  IF S <  > 4 THEN 1110
 1020  HOME : VTAB 22: PRINT "WELL
       DONE YOU HAVE WON!!"
 1030  GOTO 30000
 1100  REM

START AGAIN

 1110  IF G < 6 THEN 610
 1120  HOME : VTAB 22: PRINT "  BA
      D LUCK YOU LOST!"
 1130  PRINT "  BUT HERE ARE THE A
      NSWERS"
 1140  GOTO 30000
 9999  REM

SHAPE TABLE DATA

 10000  FOR C = 16400 TO 16624
 10010  READ D
 10020  POKE C,D
 10030  NEXT
 10040  SCALE= 1: ROT= 0
 10050  RETURN
 11000  DATA  9,0,20,0,46,0,72,0,
      98,0,124,0,150,0,176,0
 11005  DATA  185,0,204,0,27,63,31
      ,10,45,45,21,63,63,63,46,45,
      45,53,63,63,63,14,45,45
 11010  DATA  21,27,63,31,2,0,63,6
      3,63,46,45,45,53,63,63,63
 11020  DATA  46,45,45,53,63,63,63
      ,46,45,45,53,63,63,63,6,0
 11030  DATA  27,59,27,10,41,45,17
      ,27
 11040  DATA  63,31,10,45,45,21,59
      ,63,63,42,45,45,53,63,63,63
 11050  DATA  6,0,27,59,27,10,41,4
      5,17,59,63,63,42,45,45,53
 11060  DATA  59,63,63,10,41,45,17
      ,27,59,27,2,0,27,27,59,46
 11070  DATA  45,9,17,27,59,63,10,
      41,45,17,59,63,27,10,9,41
 11080  DATA  53,63,27,27,2,0,27,2
      7,27,10,9,9,17,63,63,63
 11090  DATA  46,45,45,53,63,63,63
      ,14,9,9,17,27,27,27,2,0
 11100  DATA  59,23,45,53,63,55,41
      ,21,0,27,27,19,9,9,49,63
 11110  DATA  27,51,45,41,21,27,63
      ,23,9,13,17,0,27,27,19,9
 11120  DATA  9,17,31,27,19,9,9,21
      ,27,31,23,9,13,17,0,0
 11130  DATA  0
 20000  REM

DISPLAY CLUES

 20010 PO = PO + 1
 20020 Z = G * 20 + 10
 20025 P2 = PO
 20030  IF PO > 2 THEN Z = G * 20 +
       20:P2 = PO - 2
 20040  HCOLOR= 0: DRAW 7 AT P2 *
       10 + 115,Z
 20050  HCOLOR= 3: DRAW FF AT P2 *
       10 + 115,Z - 1
 20060  RETURN
 30000  REM

DISPLAY ANSWERS

 30010  HCOLOR= 0
 30020  FOR C = 10 TO 25
 30030  HPLOT 51,C TO 115,C
 30040  NEXT
 30045  HCOLOR= 3
 30050  FOR C = 1 TO 20
 30055  HCOLOR= 0
 30060  FOR X = 1 TO 4
 30070  DRAW M(X) AT X * 15 + 45,1
       7
 30080  NEXT X
 30081  FOR XX = 1 TO 5:VV =  PEEK
       ( - 16336): NEXT
 30085  HCOLOR= 3
 30087  FOR X = 1 TO 4
 30090  DRAW M(X) AT X * 15 + 45,1
       7
 30100  NEXT X
 30105  NEXT C
 30110  PRINT "PLAY AGAIN? (Y/N) "
       ;: GET A$
 30120  IF A$ = "Y" THEN  RUN
 30130  IF A$ = "N" THEN  END
 30140  GOTO 30110
 40000  REM

INSTRUCTIONS

 40010  TEXT : HOME
 40020  INPUT "INSTRUCTIONS (Y/N)
       ";A$
 40030  IF A$ <  > "Y" THEN  RETURN

 40035  HOME
 40040  SPEED= 100
 40045  PRINT "   MASTERMIND - BY
       DEANSOFT"
 40050  PRINT "   ----------------
       --------"
 40060  PRINT : PRINT : PRINT "THE
       OBJECT OF THE GAME IS TO TR
       Y AND","DISCOVER THE 4 SHAPE
       S WHICH THE"
 40070  PRINT "COMPUTER HAS HIDDEN
       . TO DISCOVER THESE","4 SHAP
       ES YOU MAKE A GUESS AS TO WH
       AT"
 40080  PRINT "THEY MIGHT BE THEN
       THE COMPUTER WILL","GIVE YOU
        SOME CLUES ON THE RIGHT HAN
       D"
 40090  PRINT "SIDE OF THE BOARD."
       : PRINT "A SMALL TICK MEANS
       THAT ONE OF YOUR","FOUR SHAP
       ES IS CORRECT BUT IN THE "
 40100  PRINT "WRONG PLACE.": PRINT
       "A BIG TICK MEANS THAT ONE O
       F THE FOUR","SHAPES IS CORRE
       CT AND IN THE RIGHT"
 40110  PRINT "PLACE."
 40120  PRINT "YOU HAVE SIX GOES T
       O GUESS THE FOUR","SHAPES."
 40130  PRINT : PRINT "   GOOD LUC
       K."
 40140  SPEED= 255: PRINT "PRESS A
       NY KEY TO CONTINUE"
 40150  GET A$: RETURN
```

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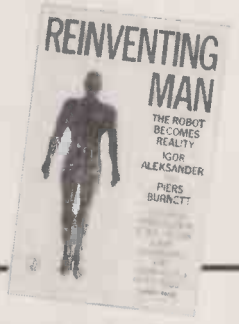

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Type Ahead

A UTILITY that will sit in page 6 until required is a type-ahead buffer from Frank O'Dwyer of Dublin. It works whether you are running another program or not — except some machine-language programs — and the buffer holds about three lines.

Type Ahead becomes part of the operating system and immune to Reset, unless you Poke 9,0 first. Type Ahead turns itself off during time-critical operations such as saving and loading, and turns itself on afterwards.

The only limitation is a small one. If you hold a key down for a long time while the system is busy doing something else, this is dealt with by the auto-repeat routine instead of Type Ahead's interrupt routine. This makes it jump the queue and it does not go into the right place in the buffer.

To see the routine in action, press Ctrl-1, the standard Hold key on the Atari. Type a couple of lines, and nothing appears on the screen. Press Ctrl-1 again and the characters will then be typed to the screen — a nice, ghostly effect.

Type Ahead.

```
10 FOR X=1536 TO 1536+186:READ B:POKE X,B:
NEXT X:X=USR(1536)
1000 DATA 104,169,54,141,8,2,169,6,141
1010 DATA 9,2,169,1,133,2,169,6,133
1020 DATA 3,169,2,133,9,169,0,141,52
1030 DATA 6,141,53,6,169,255,141,252,2
1040 DATA 169,139,141,40,2,169,6,141,41
1050 DATA 2,169,1,141,26,2,96,0,0
1060 DATA 152,72,173,9,210,205,242,2,208
1070 DATA 5,173,241,2,208,32,173,9,210
1080 DATA 201,159,208,10,173,255,2,73,255
1090 DATA 141,255,2,176,15,32,110,6,141
1100 DATA 242,2,169,3,141,241,2,169,0
1110 DATA 133,77,169,48,141,43,2,104,168
1120 DATA 104,64,172,52,6,200,192,69,208
1130 DATA 2,160,0,204,53,6,240,13,140
1140 DATA 52,6,136,192,255,208,2,160,68
1150 DATA 153,187,6,96,72,152,72,173,252
1160 DATA 2,201,255,208,29,172,53,6,204
1170 DATA 52,6,240,21,185,187,6,141,252
1180 DATA 2,238,53,6,173,53,6,201,69
1190 DATA 208,5,169,0,141,53,6,169,1
1200 DATA 141,26,2,104,168,104,96
```

Faster CSaving and CLoading

The dedicated cassette recorder used with the Atari certainly solves most of the problems users of other micros have with saving and loading programs. One drawback is that the output is always around 600 baud, which was fine in 1979 but is a bit slow by today's standards. In practice, however, the Atari can vary its own baud rate to cope with different tapes, and in theory it can cope with input baud rates between 300 and 1,400.

Robert Breeds of Swindon has supplied a machine-code routine — Poked in using Basic Data statements, as usual — which allows you to set any baud rate you wish. Obviously with a higher speed you save both time and tape.

The listing maks a boot tape which sits in page 6, where there is free memory not used by the ROM cartridges. Enter the listing and save a copy in case of typing errors. The first five lines check the data statements and flag any mistakes, so just ensure the last number in each line of data is correct. Then insert a blank tape in the cassette deck and run the program.

The boot tape can then be loaded in the usual way by holding down the Start key while turning on the machine. Once it has loaded and the Ready prompt appears, type

Print Fre(0)

The result should be 494 bytes less than usual. You can now type in or load programs normally, but when you CSave or List "C: to the cassette, output will be at 800 baud.

You can set your own baud rate as follows

HI = 3495.7/BAUD
LOW = (HI – INT(HI) * 256
POKE 2283,LO:POKE 2284,INT(HI)

If you press System Reset, the baud rate reverts to 800. To disable the fast baud routine, Poke 9,0 and press Reset. To re-enable it, Poke 9,2 and press Reset. Mr Breeds adds that the highest reliable baud rate is, in practice, about 880.

Faster CSaving and CLoading.

```
1 NO=0:N1=1:ADDR=(PEEK(106)-8)*256:X=NO:TO
TAL=X:LINE=10:GRAPHICS NO:TRAP 6
2 READ NUM:IF NUM<256 THEN TOTAL=TOTAL+NUM
:POKE ADDR+X,NUM:X=X+N1:GOTO 2
3 IF NUM<>TOTAL THEN ? "ERROR, LINE:";LINE
:END
4 LINE=LINE+N1:TOTAL=NO:IF LINE<14 THEN X=
NO
5 GOTO 2
6 RESTORE :X=1536:C=NO:HI=ADDR/256:LO=ADDR
-INT(HI)*256:POKE 203,LO:POKE 204,HI
7 READ A:IF A<256 THEN POKE X,A:X=X+N1:GOT
O 7
8 C=C+N1:IF C<3 THEN 7
9 ? "DATA CORRECT":? :? "Press PLAY and RE
C on recorder, press RETURN":X=USR(1536):E
ND
10 DATA 216,104,162,16,169,3,157,66,3,169,
8,157,74,3,169,128,157,75,3,169,68,157,68,
3,169,6,2479
11 DATA 157,69,3,32,86,228,169,11,157,66,3
,165,203,157,68,3,165,204,157,69,3,169,0,1
57,72,3,2576
12 DATA 169,2,157,73,3,32,86,228,169,12,15
7,66,3,76,86,228,67,58,155,1827
13 DATA 0,4,0,7,27,7,169,60,141,2,211,169,
238,133,14,141,231,2,169,8,1733
14 DATA 133,15,141,232,2,24,96,162,0,189,2
6,3,201,67,240,5,232,232,232,208,2440
15 DATA 244,189,27,3,133,212,189,28,3,133,
```

(continued on next page)

(continued from previous page)

```
213,169,219,157,27,3,169,8,157,28,2311
16 DATA 3,160,15,177,212,153,219,8,136,16,
248,169,141,141,221,8,169,7,141,222,2566
17 DATA 8,169,117,141,225,8,169,7,141,226,
8,169,4,141,236,8,169,94,141,235,2416
18 DATA 8,173,128,235,162,23,201,3,208,2,2
40,2,162,35,142,237,8,96,166,61,2292
19 DATA 157,0,4,230,61,160,1,224,127,240,1
,96,169,252,32,248,7,169,0,133,2311
20 DATA 61,96,173,137,2,48,8,160,1,169,60,
141,2,211,96,166,61,240,10,142,1984
21 DATA 127,4,169,250,32,248,7,48,236,162,
127,169,0,157,0,4,202,16,250,169,2377
22 DATA 254,32,248,7,76,149,7,133,64,165,2
0,24,105,25,170,169,255,141,31,208,2283
23 DATA 169,0,160,240,136,208,253,141,31,2
08,160,240,136,208,253,228,20,208,232,198,
3429
24 DATA 64,240,11,138,24,105,8,170,228,20,
208,252,240,211,32,239,7,152,96,173,2618
25 DATA 37,228,72,173,36,228,72,96,141,255
,3,169,85,141,253,3,141,254,3,169,2559
26 DATA 87,141,2,3,169,0,141,9,3,169,131,1
41,8,3,169,3,141,5,3,169,1497
27 DATA 253,141,4,3,169,96,141,0,3,169,0,1
41,1,3,173,237,8,141,6,3,1692
28 DATA 160,128,140,3,3,165,62,141,11,3,16
9,1,133,66,173,235,8,141,4,210,1956
29 DATA 173,236,8,141,6,210,32,104,228,160
,13,173,11,3,48,2,160,150,162,0,2020
30 DATA 169,213,141,38,2,169,8,141,39,2,16
9,1,120,32,92,228,169,1,141,23,1898
31 DATA 3,88,169,52,141,2,211,173,23,3,208
,251,24,173,4,3,133,50,109,8,1828
32 DATA 3,133,52,173,5,3,133,51,109,9,3,13
3,53,32,143,8,76,190,8,169,1486
33 DATA 1,133,48,32,104,228,160,0,132,49,1
32,59,132,58,177,50,141,13,210,133,1992
34 DATA 49,165,58,240,252,169,199,37,16,13
3,16,141,14,210,162,6,169,0,157,1,2194
35 DATA 210,202,202,16,249,96,173,11,3,48,
5,169,60,141,2,211,32,169,8,169,2176
36 DATA 0,133,66,164,48,140,3,3,96,169,0,1
41,23,3,96,75,239,141,7,213,1760
37 DATA 239,117,7,39,240,74,239,76,65,239,
0,94,4,23,0,1456
```

Trapped!

```
10 DIM A$(40),B(49),N$(10),N1$(10),N2$(10)
,A(4,4):OPEN #1,4,0,"K:":P=0:O=0
12 GOSUB 700
15 ? "PLEASE ENTER YOUR NAMES ":? :? "WHO
WILL PLAY O'S ";:INPUT N1$:? "WHO WILL PLA
Y X'S ";:INPUT N2$
18 SETCOLOR 1,0,13:SETCOLOR 2,9,4:SETCOLOR
 4,11,4:GO=0:R=0:RESTORE :A$="WHICH CROSS
WILL YOU TAKE ":?
20 ? CHR$(125):FOR Z=0 TO 49:READ X:B(Z)=X
:NEXT Z:POSITION 16,2:? "TRAPPED":POSITION
 16,3:? "********"
30 POSITION 14,7:FOR Z=0 TO 11:? CHR$(B(Z)
);:NEXT Z
40 FOR Y=8 TO 14 STEP 2:POSITION 14,Y:FOR
Z=12 TO 38:? CHR$(B(Z));:NEXT Z:NEXT Y
45 POSITION 14,16:FOR Z=12 TO 26:? CHR$(B(
Z));:NEXT Z
50 FOR Z=39 TO 49:? CHR$(B(Z));:NEXT Z
60 FOR Z=0 TO 24 STEP 2:X=INT(Z/5):Y=Z-X*5
:A(X,Y)=88:NEXT Z
70 FOR Z=1 TO 23 STEP 2:X=INT(Z/5):Y=Z-X*5
:A(X,Y)=79:NEXT Z
80 POSITION 15,5:? "A B C D E"
90 FOR Z=1 TO 5:POSITION 12,6+Z*2:? Z:NEXT
 Z
93 POSITION 3,8:? N1$:? :? "  IS 'O'":POSI
TION 3,14:? N2$:? :? "  IS 'X'"
95 POSITION 27,11:? P;" WINS TO O":POSITIO
N 27,14:? Q;" WINS TO X"
100 FOR X=0 TO 4:FOR Y=0 TO 4:POSITION 15+
2*X,8+2*Y:SOUND 0,0,9,15:? CHR$(A(X,Y)):SO
UND 0,0,0,0:NEXT Y:NEXT X
101 IF R=1 THEN GOSUB 290
102 R=1:IF GO=0 THEN N$=N1$:GOTO 105
103 IF GO/2=INT(GO/2) THEN N$=N2$:T=2:GOTO
 105
104 N$=N1$:T=1
105 POSITION 13,19:? N$;"'S TURN        "
110 POSITION 6,21:? A$;:GET #1,X:IF X>64 A
ND X<70 THEN 130
120 POSITION 13,22:? "INVALID INPUT";:GOSU
B 900:? CHR$(156):GOTO 110
125 REM ### TYPE INVALID INPUT IN INVERSE
130 GET #1,Y:IF Y<49 OR Y>53 THEN 120
135 K=X-65:L=Y-49
140 IF GO=0 THEN GOTO 500
150 IF T=1 THEN 180
160 IF A(K,L)=88 THEN 200
170 POSITION 9,22:? "YOU MUST MOVE A CROSS
";:GOSUB 900:? CHR$(156):GOTO 105
175 REM ### TYPE YOU...CROSS IN INVERSE
180 IF A(K,L)=79 THEN 200
190 POSITION 9,22:? "YOU MUST MOVE A NOUGH
T";:GOSUB 900:? CHR$(156):GOTO 105
195 REM ### TYPE YOU...NOUGHT IN INVERSE
200 IF EX=K THEN 230
210 IF EY=L AND ABS(EX-K)=1 THEN 240
220 POSITION 6,22:? "YOU CAN'T MOVE THAT C
OUNTER":GOSUB 900:? CHR$(156):GOTO 105
225 REM ### TYPE YOU...COUNTER IN INVERSE
230 IF ABS(EY-L)<>1 THEN 220
240 GO=GO+1:A(EX,EY)=A(K,L):A(K,L)=32:EX=K
:EY=L:POSITION 29,7:? "MOVE ";GO-1:GOTO 10
0
290 IF GO/2=INT(GO/2) THEN J=88:GOTO 300
295 J=79
300 TRAP 310:IF A(EX+1,EY)=J THEN RETURN
310 TRAP 320:IF A(EX-1,EY)=J THEN RETURN
320 TRAP 330:IF A(EX,EY+1)=J THEN RETURN
330 TRAP 335:IF A(EX,EY-1)=J THEN RETURN
335 IF J=88 THEN P=P+1:GOTO 340
338 Q=Q+1
340 FOR Z=0 TO 11 STEP 1/12:POKE 755,6:SOU
ND 1,Z*Z*2.1,10,Z:POKE 755,2:SOUND 0,Z*15,
8,15-Z:NEXT Z
350 SOUND 0,0,0,0:SOUND 1,0,0,0
360 POSITION 12,19:IF N$=N1$ THEN ? N2$;"
IS TRAPPED!!!":GOTO 390
370 ? N1$;" IS TRAPPED!!!"
390 POSITION 8,21:? CHR$(156);CHR$(127);N$
;" HAS WON THE GAME":POSITION 7,22:? "WOUL
D YOU LIKE ANOTHER ";
395 POP :GET #1,J:IF J=89 THEN 18
400 ? CHR$(125):? :? "BYE BYE":CLOSE #1:EN
D
500 IF A(K,L)=88 THEN 525
510 POSITION 9,22:? "YOU MUSE TAKE A CROSS
";:GOSUB 900:? CHR$(156);:GOTO 110
520 REM ### TYPE YOU...CROSS IN INVERSE
525 FOR Z=1 TO 8:SOUND 0,13,10,13:NEXT Z:S
OUND 0,0,0,0
530 EX=K:EY=L:A$="WHICH COUNTER WILL YOU M
OVE ":GO=GO+1:A(K,L)=32:POSITION 15+K*2,8+
L*2:? " ":GOTO 102
700 ? CHR$(125):? CHR$(127);CHR$(127);"TRA
PPED":? CHR$(127);CHR$(127);"********"
710 ? :? "  TRAPPED IS A GAME OF SKILL FOR
 TWO":? :? "PEOPLE AND IS PLAYED ON A 5 BY
 5 GRID."
720 ? "ONE PERSON MOVES O'S THE OTHER X'S.
":? :? "'O' SETS THE GAME BY REMOVING AN '
X'":?
730 ? "FROM THE BOARD.":? :? " PLAY BEGINS
 BY 'O' MOVING ONE OF HIS ":? "IMMEDIATELY
 ADJACENT PEGS INTO THE"
740 ? :? "SPACE. PLAYERS TAKE TURNS MOVING
 ONE":? :? "OF THEIR PEGS INTO THE NEW SPA
CE.":?
745 ? "HIT ANY KEY TO CONTINUE ";:GET #1,Z
748 REM ### TYPE HIT...CONTINUE IN INVERSE
750 ? CHR$(125):? :? "PEGS MAY BE MOVED IN
 ANY DIRECTION":? :? "EXCEPT DIAGONALLY.":
?
760 ? "A PLAYER WINS WHEN HIS OPPONENT IS"
:? :? "UNABLE TO MOVE,TRAPPED!!":?
770 ? " WHEN ENTERING GRID REFERENCES ALWA
YS":?:? "TYPE THE LETTER FIRST":? :? :RET
URN
900 FOR Z=1 TO 4:? CHR$(253);:NEXT Z:RETUR
N
1000 DATA 17,18,23,18,23,18,23,18,23,18.5,
155
1010 DATA 124,32,124,32,124,32,124,32,124,
32,124,155,127,127,30,1,18,19,18,19,18.19,
18,19,18,4,155
1020 DATA 26,18,24,18,24,18,24,18.24,18.3
```

Trapped!

We have not had a game in Atari Open File for ages, but now David Klein of Henley-on-Thames has provided one. It runs on any 16K Atari, and the instructions are in the listing — see lines 700 to 770.

Lines 1 to 100 initialise the game and draw the board. Lines 100 to 230 check the move is legal. Lines 240 to 330 make the move, and check for a win. Lines 335 to 440 hold the winning routine. Lines 1000 to 1020 hold the data for the board.

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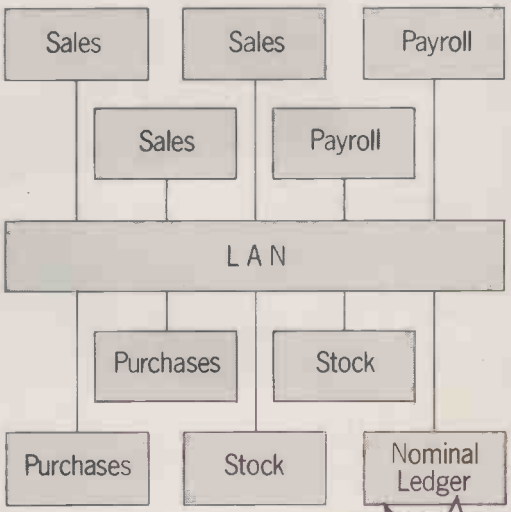

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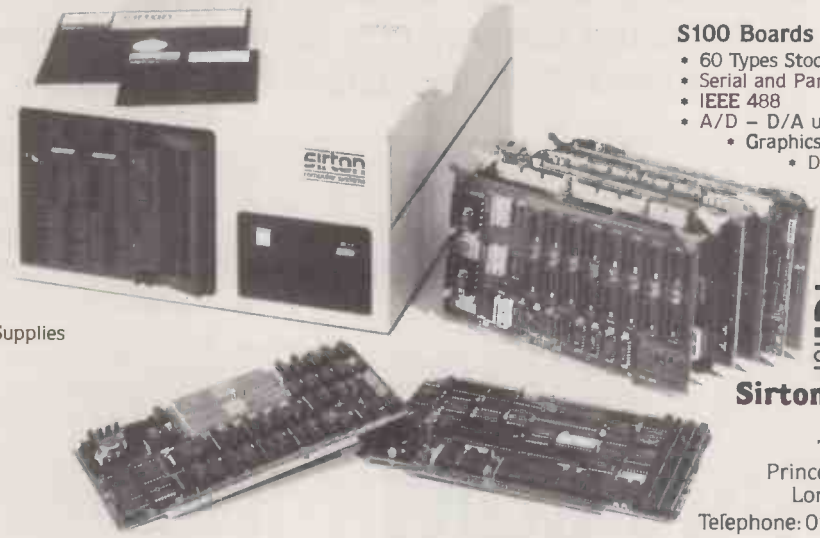

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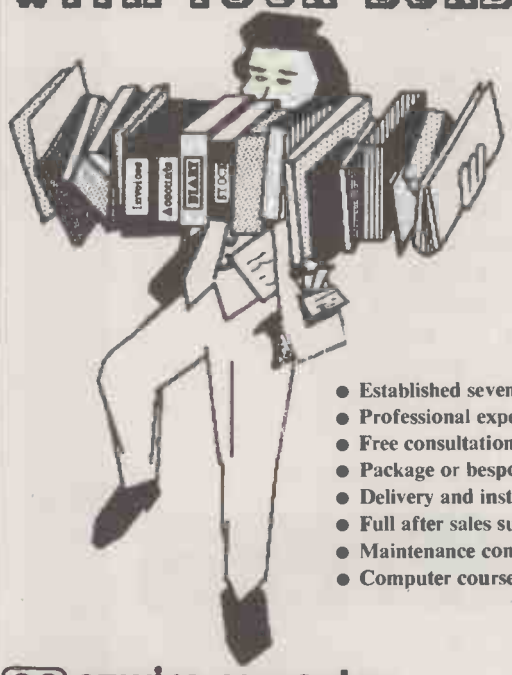

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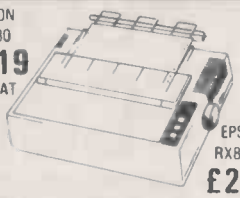

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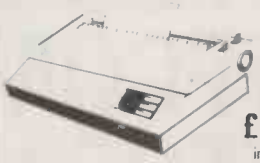

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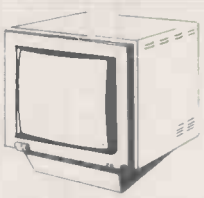

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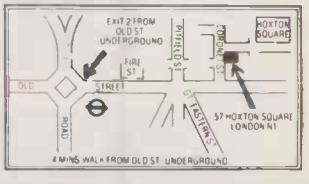

● Circle No. 215

Universal calendar

WE RECEIVE quite a number of calendar programs for this page but Universal Calendar by A M Tucker of Dorchester is one of the best and most comprehensive. It is the first I have seen which takes into account the introduction of the Gregorian calendar into England into September 1752, with the consequent loss of 11 days from the calendar.

Universal calendar.

```
    1 REM  UNIVERSAL CALENDAR
        © A.M.Tucker, Charminster.

  10 DATA 6,13,205,66,14,201: LE
T cl=USR "a": FOR n=0 TO 5: READ
 a: POKE cl+n,a: NEXT n
  20 LET f=0: LET p=0: LET d=1:
LET m=1
  30 CLS : PRINT TAB 7;"UNIVERSA
L CALENDAR"''"  (1) Days between
 dates","  (2) Days of the week
","  (3) Dates at stated interval
s"
  40 PRINT "  (4) Phase of the m
oon","  (5) Biorhythms","  (6) E
aster Day (from 325)","  (7) Cal
endar for month"
  50 PRINT #0;TAB 5;"Select from
 1 to 7"
  60 PAUSE 0: IF CODE INKEY$<49
OR CODE INKEY$>55 THEN GO TO 60
  70 PRINT AT p+1,5;" ": LET q=0
*USR cl
  80 LET p=VAL INKEY$: PRINT AT
p+1,5;"*": PRINT AT 14-3*(p>2 AN
D p<6),0;: IF p<6 THEN GO TO 120
  90 IF p=6 THEN INPUT "Enter ye
ar:- ";y: GO SUB valid: GO TO 40
0-310*f
 100 CLS : INPUT "Enter month (n
o): ";m;": year: ";y: GO SUB val
id: IF f THEN GO TO 100
 110 PRINT AT 2,9;m$(m);" ";y: L
ET d=1: GO SUB 920: GO TO 150
 120 INPUT "Enter ";"starting "
AND p=3;"date";" (1)" AND p=1;"
of birth" AND p=5;":- "'"day:";d
;"; month:";m;"; year:";y
 130 GO SUB valid: IF f THEN GO
TO 120
 140 GO SUB 900: GO TO 150+20*(p
=1 OR p=5)+650*(p=3)
 150 LET c=7+22.530589*(p=4): LE
T a=a+8*(p=4)
 160 LET v=INT ((a/c-INT (a/c))*
c+.5): GO TO 280+20*(p=4)+200*(p
=7)
 170 INPUT "Enter date (2):- " A
ND p=1;"Date of reading:- " AND
p=5;"day: ";d;"; month:";m;"; ye
ar:";y
 180 GO SUB valid: IF f THEN GO
TO 170
 190 LET b=a: GO SUB 900: LET b=
ABS (a-b): IF p=1 THEN PRINT ''I
AB 3;"Days between dates: ";b: G
O TO prog
 199 REM     BIORHYTHMS
 200 PRINT '': FOR m=1 TO 3: LET
 a=18+m*5: LET x=b/a-INT (b/a)
 210 LET v=INT (SIN (x*2*PI)*10+
.5): LET l(m)=a*8: LET k(m)=(INT
 (x*a+.5)-d+1)/a
 220 PRINT x$(m)," " AND v>=0;"
" AND ABS v<10;v: NEXT m: GO SUB
 1000
 230 FOR n=0 TO 240: FOR m=1 TO
3: LET h=k(m)+n/l(m): LET h=(h-I
NT h)*240+1
 240 PLOT n+4,a(h): IF a(h)=35 T
HEN PRINT AT 17,n/8; PAPER 6;z$(
m)
 250 NEXT m: NEXT n: GO TO prog
 279 REM    DAY of the WEEK
 280 LET v=v+7*NOT v: PRINT d$(v
): GO TO prog
 299 REM    PHASE of the MOON
 300 PRINT "New moon" AND (v<2 O
R v>=29);"First quarter" AND v>1
 AND v<14;"Full moon" AND (v=14
OR v=15);"Last quarter" AND v>15
 AND v<29
 310 IF g THEN GO TO prog
 320 GO SUB 1000: LET q=d-v-1+29
*(d-v<2): IF q<0 THEN LET q=0
 330 IF q<3 THEN PRINT AT 16,q+2
8;l$(1)
 340 FOR n=1 TO 4: LET x(n)=q+7*
(n-1)-28*(q+7*(n-1)>30)
 350 BRIGHT 1: IF x(n)>27 THEN P
RINT AT 16,x(n)-28; INVERSE (n>2
);l$(n)
 360 PRINT AT 16,x(n); INVERSE (
n>2);l$(n)
 370 NEXT n: BRIGHT 0: GO TO pro
g
 399 REM    EASTER ALGORITHMS
 400 LET h=(y/19-INT (y/19))*209
 410 LET c=INT ((INT (y/100)+1)*
.75)
 420 LET e=(h+INT ((INT (y/100)*
8+13)/25)-c+38+8*j)/30
 430 LET e=(e-INT e)*30
 440 LET n=46-e-(e=24+(h>110))
 450 LET n=n+30*(n<23): LET b=(n
+INT (y*1.25)-c)/7
 460 LET n=INT (n+5.5-(b-INT b)*
7)+3*j
 470 PRINT ''"Easter Sunday:- ";
n-31*(n>31);" ";m$(3+(n>31));CHR
$ 8;CHR$ 8;CHR$ 8;y: GO TO prog
 499 REM   CALENDAR for MONTH
 500 LET v=v*2+14*NOT v
 510 FOR n=2 TO 14 STEP 2: LET b
=13+n-v: LET t=14: PRINT AT n+2,
3;d$(n/2);
 520 FOR i=b TO 70+b STEP 14: LE
T a=i+22*g*(i>15): IF a>73-(w+x+
z)*2 THEN GO TO 540
 530 PRINT TAB t;f$(a TO a+1);
 540 LET t=t+3: NEXT i
 550 PLOT 24,148-8*n: DRAW INK 5
;231,0: NEXT n
 560 PRINT #0;"   To see menu pr
ess any key": PAUSE 0: CLS : GO
TO 30
 599 REM MONTH FLAGS/VALID DATE
 600 LET f=0: LET g=(y=1752 AND
m=9): LET j=(y<1753): LET w=(m=2
)+(m=4)+(m=6)+(m=9)+(m=11): LET
x=(m=2)
 610 LET z=x*(y<>INT (y/4)*4 OR
(y=INT (y/100)*100 AND y<>INT (y
/400)*400 AND NOT j))
 620 LET dn=31-w-x-z: IF q THEN
RETURN
 700 IF d<1 OR d>dn OR m<1 OR m>
12 OR NOT y OR (y<325 AND p=5) O
R (g AND d>2 AND d<14) THEN LET
f=1: PRINT #0;"Invalid date; ple
ase reenter": PAUSE 50
 710 RETURN
 799 REM   DATES AT INTERVALS
 800 INPUT "No. of days between
dates? - ";b
 810 INPUT "How many times? - ";
c
 820 LET q=1: FOR n=1 TO c: LET
d=d+b: LET k=(a<640162)
 830 LET a=a+b*k: LET d=d+11*(a>
=640162)*k
 840 LET m=m+(d>dn): LET d=d-dn*
(d>dn)
 850 IF m>12 THEN LET m=m-12: LE
T y=y+1+(y=-1)
 860 GO SUB 600: IF d>dn THEN GO
TO 840
 870 GO SUB 900: NEXT n: GO TO p
rog
 899 REM  PRINT DATE/CALCULATE
 900 PRINT "  ";" " AND d<10;d;"
 ";m$(m, TO 3+(m>4 AND m<8));","
```

(continued on next page)

(continued from previous page)

```
  AND (m<5 OR m>7);" ";y,
  910 IF q THEN RETURN
  920 LET y1=y: LET y=y+(y<0): LE
T e=y*365:. LET y=y-(m<3)
  930 LET a=e+INT (y/4)-(INT (INT
  (y/100+1)*.75)-13)*(NOT j)+31*m
-44+d-INT (.4*m+2.3)*(m>2)
  940 LET a=a+11*(a<640162)
  950 LET y=y1: RETURN
1000 PLOT 4,19: DRAW 242,0: PRIN
T AT 19,0; OVER 1;"+++++++++++++
++++++++++++++++++++++++++++++++
1099 REM  INITIALISE
1100 RESTORE 1110: DIM a(241): D
IM k(3): DIM l(3): DIM x(4): DIM
  d$(7,11): DIM m$(12,9): DIM x$(
3,12): LET z$="PEI": LET l$=CHR$
  143+CHR$ 138+CHR$ 143+CHR$ 138
1110 DATA "Sunday","Monday","Tue
sday","Wednesday","Thursday","Fr
iday","Saturday": FOR n=1 TO 7:
READ d$(n): NEXT n
1120 DATA "January","February","
March","April","May","June","Jul
y","August","September","October
","November","December": FOR n=1
 TO 12: READ m$(n): NEXT n
1130 LET x$(1)="Physical": LET x
$(2)="Emotional": LET x$(3)="Int
ellectual"
1140 LET f$="                  1 2 3
4 5 6 7 8 910111213141516171819202
0212223242526272829303031"
1150 FOR n=0 TO 240: LET a(n+1)=
SIN (n/120*PI)*16+19: NEXT n
1160 LET prog=50: LET valid=600:
 GO TO 20
```

Number formatter.

```
    1 REM UNIVERSAL INPUT ROUTINE

    2 REM © Barrie Fairest,Scilly

    3 REM     X & Y determine the
print position. Length of C$ can
be altered.     Exit value is AA.
    4 REM  Delete & decimal point
are accepted. Entry ends when C$
 is full or 'ENTER' is pressed.

    5 CLS : LET X=9: LET Y=15: LE
T C$="******": LET CL=LEN C$: LE
T A$="": PRINT AT X,Y;C$
   10 PRINT AT 19,0;"          ENTER
 YOUR   FIGURES       ": PAUSE 2:
LET B$=INKEY$: LET BC=CODE B$: L
ET A$=A$+B$: LET AL=LEN A$: IF B
$="" THEN GO TO 10
   11 IF BC=12 THEN LET AL=AL-2:
IF AL>=0 THEN GO TO 19
   12 IF AL<0 THEN LET AL=0: GO T
O 19
   13 IF AL>=1 AND BC=13 THEN LET
 AL=AL-1: LET A$=A$( TO AL): GO
TO 16
   14 IF BC<46 OR BC>57 OR BC=47
THEN LET AL=AL-1: LET A$=A$( TO
AL): GO TO 18
   15 IF BC<>13 THEN BEEP .2,25
   16 PRINT AT X,Y;A$: IF AL<CL A
ND BC<>13 THEN GO TO 10
   17 BEEP .2,40: GO TO 30
   18 PRINT AT 19,0; FLASH 1;"  I
NVALID ENTRY. PLEASE REPEAT  ":
PAUSE 100: GO TO 10
   19 LET A$=A$( TO AL): PRINT AT
 X,Y;A$;"*": LET B$="": BEEP .3,
-10: GO TO 10
   20 REM ******************** REM

   30 CLS : IF AL<1 THEN LET A$="
0"
   31 LET AA=VAL A$: PRINT "Exit
value (AA) is ";AA
```

Number formatter

A short routine by Barrie Fairest from the Isles of Scilly allows a formatted input of a specified number of digits, and returns the value of the input. It could be very valuable in educational programs and others when the end-user is not familiar with computers.

Conversions.

```
    10 REM CONVERSIONS

            by M.Coombes (3/84)

    15 LET ev=0
    20 BORDER 0: PAPER 0: INK 7: C
LS
    30 PRINT AT 2,10; INK 2; PAPER
  6;"CONVERSIONS"
    40 PRINT : FOR f=1 TO 9
    50 READ a,b,a$,b$: PRINT INK 6
;TAB 3;a$; INK 5;" to "; INK 6;b
$'TAB 3; INK 6;b$; INK 5;" to ";
  INK 6;a$
    60 NEXT f
    70 FOR f=4 TO 21: PRINT AT f,0
; INK 1; PAPER 6;CHR$ (f+93): NE
XT f
    80 PRINT AT 21,0; INK 6;#0;"Pl
ease press key which"'"correspon
ds to conversion"'"required..."
    90 LET i$=INKEY$: LET i=CODE i
$-96
   100 IF i>0 AND i<19 THEN BEEP .
2,20: GO TO 120
   110 GO TO 90
   120 LET z=i: IF i/2=INT (i/2) T
HEN LET z=i-1: LET ev=9
   130 RESTORE : FOR f=1 TO (z/2)+
.5
   140 READ a,b,a$,b$: NEXT f
   150 CLS
   160 LET x$=a$: LET y$=b$
   170 IF ev=9 THEN LET x$=b$: LET
 y$=a$
   180 PRINT AT 20,0;"Enter number
 of ";x$;"..."
   190 INPUT n: BEEP .1,20
   200 LET ans=n*a
   210 IF ev=9 THEN LET ans=n*b
   220 CLS
   230 PRINT AT 7,2; INK 6;n;" ";x
$;AT 9,0; INK 4; BRIGHT 1;"= ";
INK 6; BRIGHT 0;ans;" ";y$
   240 BEEP .1,10: BEEP .1,20
   250 PRINT AT 14,2;"PRESS ANY KE
Y TO RUN AGAIN..."
   260 IF INKEY$="" THEN GO TO 260
   270 BEEP .2,20: RUN
1000 DATA 2.54,.3937,"Inches","C
entimetres",.3048,3.281,"Feet","
Metres",.9144,1.094,"Yards","Met
res",1.609,.6214,"Miles","Kilome
tres",.0929,10.76,"Square feet",
"Square metres",.4047,2.471,"Acr
es","Hectares",4.546,.22,"Gallon
s","Litres",28.35,.03527,"Ounces
","Grams",.4536,2.205,"Pounds","
Kilograms"
```

Conversions

Michael Coombes of Newport has sent in a program for the 16K Spectrum which can convert a wide range of imperial measurements to their metric equivalent, and vice-versa.

When the program is run, a list of possible conversions is displayed. The user then selects the required conversion by pressing the corresponding key. When the metric or imperial measurement is entered, it is converted and the result displayed.

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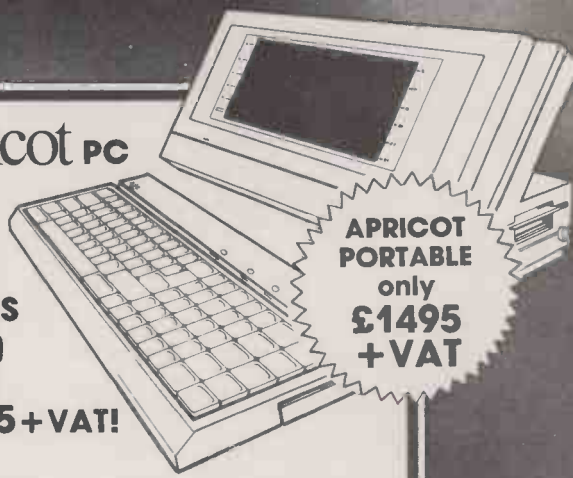

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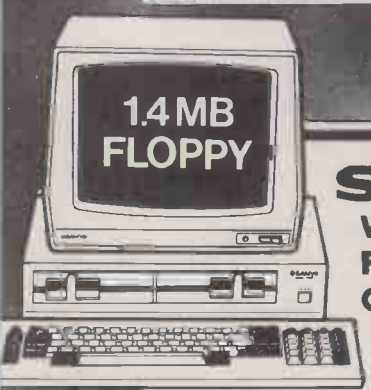

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Curvefit

GRAEME SOUTHWOOD and Robert Duncan both of Melksham, Wiltshire have sent in a program which offers three methods of representing data in a visual manner. Called Curvefit, it allows the user to fit a curve to a set of data points found either on disc or as input directly from the keyboard. The three methods are: least-squares fitting, polynomial fittings and cubic-spline fitting.

Each method has its merits and disadvantages. Least-squares fitting is easy to calculate and has good predictive capabilities but does not interpolate every point. Polynomial fitting interpolates every point but is impractical for large amount of data and highly oscillatory. Cubic-splines fitting interpolates every point and gives a good indication of function shape, but due to its stepwise nature it is not easy to use the curve for prediction.

The program was written on a Research Machines 380Z with Basic SG2 5.0L* which is high resolution and enables a printer dump of the graphics screen to be included. The dump routine is valid only for printers that are type 3 according to RML classification. Users with other printer types should consult their manuals.

Using the dump line

CALL"DUMP",0,0,319,191

causes a correctly orientated dump but this does not fit on the printer in its normal mode, so put SWB switches 5 and 6 into the On position. This reduced printing size enable two dumps to be placed on one sheet of printer paper.

```
10 REM              C U R V E F I T
20 REM              ***************
30 REM
40 REM        (c) 1984 by Rob Duncan
50 REM            & Graeme Southwood
60 REM
70 X$="x"
80 NP=50:GP=INT(NP/2):DIM D(NP,2),M
(NP,NP+1),C(NP)
90 DEF FNX(X)=300*(X-LX)/(GX-LX)+9.
5
100 DEF FNC(X)=X*X*X
110 DEF FNH(A)=D(A+1,1)-D(A,1)
120 DEF FNG(I)=2*(FNH(I)+FNH(I-1))
130 DEF FNF(A)=D(A+1,2)-D(A,2)
140 DEF FNB(I)=6*(FNF(I)/FNH(I)-FNF
(I-1)/FNH(I-1))
150 DEF FNS(X)=FNT(X)+FNU(X)
160 DEF FNT(X)=C(A-1)/6/FNH(A)*FNC(
(D(A+1,1)-X))+C(A)/6/FNH(A)*FNC((X-
D(A,1)))
170 DEF FNU(X)=(D(A+1,2)/FNH(A)-C(A
)*FNH(A)/6)*(X-D(A,1))+(D(A,2)/FNH(
A)-C(A-1)*FNH(A)/6)*(D(A+1,1)-X)
180 DEF FNY(Y)=140*(Y-LY)/(GY-LY)+5
.5
190 GOTO 400
200 DATA 318,0,318,190,0,190,0,0
210 CALL"RESOLUTION",0,2
220 GRAPH 1
230 PUT12
240 RESTORE 200
250 FOR I=1 TO 4
260 READ X,Y
270 CALL"LINE",X,Y,3
280 NEXT I
290 A$="CURVEFIT"
300 CALL"CHARSIZE",2,2
310 CALL"STPLOT",25,160,VARADR(A$),
2
320 CALL"PLOT",0,150:CALL"LINE",318
,150
330 CALL"PLOT",175,150:CALL"LINE",1
75,190
340 CALL"CHARSIZE",1,1
350 O$="No.of points:"+STR$(N)
360 CALL"STPLOT",190,178,VARADR(O$)
,3
370 CALL"STPLOT",190,167,VARADR(N$)
,3
380 CALL"STPLOT",190,156,VARADR(M$)
,3
390 RETURN
400 GOSUB 210:REM  MENU BORDER

410 REM    DATA ENTRY MENU
420 PLOT 10,40,"Data Entry Menu"
430 PLOT 10,32,"1. Take data from a
 disc file."
440 PLOT 10,25,"2. Input data from
keyboard."
450 PLOT 10,18,"9. End program."
460 PLOT 10,10,"Choose your option.
 1,2 or 9"
470 A$=GET$()
480 IF NOT(A$="1" OR A$="2" OR A$="
9") THEN GOTO 470
490 IF A$="1" THEN GOTO 650
500 IF A$="9" THEN GOTO 3430
510 REM   DATA ENTRY VIA KEYBOARD
520 M$="Data:Keyboard"
530 GOSUB 210
540 PLOT 2,40,"The maximum number o
f data points is 50"
550 PLOT 5,30,"Input data as reques
ted."
560 PLOT 5,20,"Finish by entering '
ZZZ'."
570 T=1
580 IF T>NP THEN PLOT 5,10,"NO MORE
 ROOM FOR POINTS":N=NP:GOTO 820
590 INPUT"next X value ",D$
600 IF D$="ZZZ" OR D$="zzz" THEN N=
T-1: GOTO 820
610 D(T,1)=VAL(D$)
620 INPUT"next Y value ",D(T,2)
630 T=T+1
640 GOTO 580
650 M$="Data:Disc file"
660 GOSUB 210
670 PLOT 6,40,"Please give FULL fil
e specification"
680 PLOT 6,32,"eg:        A:NAME.DAT
"
690 PLOT6,25,"
    "
700 INPUT"The File Spec : ",A$
710 IF A$=""THEN GOTO 400
720 IF NOT LOOKUP (A$) THEN PLOT 6,
25,"FILE NOT FOUND...try again":DEL
AY=GET(200):GOTO 690
730 OPEN£10,A$
740 INPUT£10,N
750 FOR I=1 TO N
760 INPUT£10,D(I,1)
770 INPUT£10,D(I,2)
780 NEXT I
790 CLOSE£10
800 PLOT 6,15,"Data Input Complete"
810 DELAY=GET(200)

820 REM    OPTIONS ONE
830 GOSUB 210
840 PLOT 12,40,"Data Manipulation M
enu."
850 PLOT 12,30,"1. Display data."
860 PLOT 12,27,"2. Amend a single v
alue."
870 PLOT 12,24,"3. Add a point."
880 PLOT 12,21,"4. Delete a point."
890 PLOT 12,18,"5. Enter ALL new da
ta or END."
900 PLOT 12,15,"6. Dump data to a d
isc file."
910 PLOT 12,9,"7. Go on to next men
u."
920 PLOT 12,3,"Choose your option.
 1 to 7"
930 A$=GET$()
940 IF A$="1" THEN GOSUB 1020
950 IF A$="2" THEN GOSUB 1130
960 IF A$="3" THEN GOSUB 1260
970 IF A$="4" THEN GOSUB 1330
980 IF A$="5" THEN GOTO 400
990 IF A$="6" THEN GOSUB 1430
1000 IF A$="7" THEN GOTO 1560
1010 GOTO 820


1020 REM   DISPLAY
1030 F=0
1040 CALL"RESOLUTION",0,2:GRAPH 0:P
UT12
1050 PRINT"Point","X Value","Y Valu
e"
1060 FOR A=1 TO N
1070 PRINT A,D(A,1),D(A,2)
1080 NEXT A
1090 IF F=1 THEN RETURN
1100 PRINT:PRINT"Press any key to c
ontinue":PRINT
1110 B$=GET$()
1120 RETURN


1130 REM       AMEND
1140 F=1
1150 GOSUB 1040
1160 PRINT
1170 INPUT"Amend which point (Numbe
r only):",W$:W=VAL(W$):IFW$=""THEN
RETURN
1180 IF W<>INT(W) OR W<1 OR W>N THE
N GOTO 1170
1190 INPUT"Change X or Y value ",B$
1200 IF NOT(B$="X"OR B$="x"OR B$="y
"OR B$="Y") THEN 1190
1210 PRINT"The NEW value for ";B$;W
1220 INPUT M
1230 IF B$="x"OR B$="X" THEN D(W,1)
=M ELSE D(W,2)=M
1240 GOSUB 1020
1250 RETURN


1260 REM    ADD A NEW DATA CPO
1270 GOSUB 210
1280 IF N=NP THEN PRINT"No room for
 another point ":RETURN
1290 N=N+1
1300 INPUT"The new X value ",D(N,1)
1310 INPUT"The new Y value ",D(N,2)
1320 RETURN


1330 REM      Delete a point
1340 F=1
1350 GOSUB 1040
1360 PRINT
```

```
1370 INPUT"Delete which point (Numb
er only):",T$:T=VAL(T$):IF T$=""THE
N RETURN
1380 IF T<>INT(T) OR T<1 OR T>N THE
N GOTO 1370
1390 D(T,1)=D(N,1)
1400 D(T,2)=D(N,2)
1410 N=N-1
1420 RETURN



1430 REM      Dump data to disc
1440 GOSUB 210
1450 PLOT 3,40,"Please give FULL fi
le specification"
1460 PLOT 6,32,"eg:        A:NAME.DA
T"
1470 INPUT"The File Spec : ",B$
1480 CREATE£10,B$
1490 PRINT£10,N
1500 FOR A=1 TO N
1510 PRINT£10,D(A,1)
1520 PRINT£10,D(A,2)
1530 NEXT A
1540 CLOSE£10
1550 RETURN



1560 REM        Lenjam Sort ROUTINE
1570 G=INT(N/2)+1
1580 FOR A=1 TO N-G
1590 IF D(A,1)>D(A+G,1)THEN B=D(A,1
):D(A,1)=D(A+G,1):D(A+G,1)=B:B=D(A,
2):D(A,2)=D(A+G,2):D(A+G,2)=B
1600 NEXT A
1610 IF G<>1 THEN G=INT((G+1)/2):GO
TO 1580



1620 REM    THIS IS WHERE IT ALL ST
ARTS
1630 REM      MENU
1640 GOSUB 210
1650 PLOT 24,40,"Fitting Options"
1660 PLOT  16,33,"1. Least Squares
Fit"
1670 PLOT  16,30,"2. Polynomial Fit
"
1680 PLOT  16,27,"3. Cubic Splines
Fit"
1690 PLOT  16,21,"4. Data Manipulat
ion Menu"
1700 PLOT 16,12,"Choose your option
. 1 to 4"
1710 A$=GET$()
1720 IF A$="1" THEN 1770
1730 IF A$="2" THEN 1970
1740 IF A$="3" THEN 2160
1750 IF A$="4" THEN 820
1760 GOTO 1710
1770 REM        LEAST SQUARES
1780 N$="Least Squ:"
1790 GOSUB 210
1800 INPUT"The highest power of X:"
,P
1810 IF P<>INT(P) OR P<1 OR P>GP TH
EN ?"Power of x is too high.":GOTO
1800
1820 N$=N$+"x^"+RIGHT$(STR$(P),LEN(
STR$(P))-1)
1830 CALL"STPLOT",190,167,VARADR(N$
),3
1840 PLOT 20,24,"Function of order
"+STR$(P)
1850 R=P+1
1860 GOSUB 3360
1870 FOR A=1 TO N
1880 FOR B=1 TO P+1
1890 FOR C=1 TO P+1
1900 M(B,C)=D(A,1)^(B+C-2)+M(B,C)
1910 NEXT C
1920 M(B,P+2)=D(A,2)*D(A,1)^(B-1)+M
(B,P+2)
1930 NEXT B,A
1940 GOSUB 2590
1950 GOSUB 2760
1960 GOTO2860
1970 REM      POLYNOMIAL FITTING
1980 N$="Polynomial"
1990 GOSUB 210
2000 FOR A=1 TO N-1
2010 IF D(A,1)<>D(A+1,1) THEN NEXT
A:GOTO 2050
2020 PLOT 21,40,"The data is not va
lid"
2030 PLOT 22,32,"for a polynomial f
it"
2040 DELAY=GET(500):GOTO 1620
2050 R=N
2060 GOSUB 3360
2070 FOR A=1 TO N
2080 FOR B=1 TO N
2090 M(A,B)=D(A,1)^(B-1)
2100 NEXT B
2110 M(A,N+1)=D(A,2)
2120 NEXT A
2130 GOSUB 2590
2140 GOSUB 2760
2150 GOTO2860
2160 REM      CUBIC SPLINE
2170 N$="Cubic Splines"
2180 GOSUB 210
2190 FOR A=1 TO N-1
2200 IF D(A,1)<>D(A+1,1) THEN NEXT
A:GOTO2240
2210 PLOT 21,40,"The data is not va
lid"
2220 PLOT 18,30,"for a Cubic Spline
 fit"
2230 DELAY=GET(500):GOTO 1620
2240 R=N-2
2250 GOSUB 3360
2260 FOR A=1 TOR-1
2270 M(A,A)=FNG(A+1)
2280 M(A+1,A)=FNH(A+1)
2290 M(A,A+1)=FNH(A+1)
2300 M(A,R+1)=FNB(A+1)
2310 NEXTA
2320 M(R,R)=FNG(R+1)
2330 M(R,R+1)=FNB(R+1)
2340 GOSUB 2590
2350 GOSUB 2760
2360 GX=-1E30:GY=GX:LX=-GX:LY=LX
2370 FOR A=1 TO N
2380 IF D(A,1)>GX THEN GX=D(A,1)
2390 IF D(A,2)>GY THEN GY=D(A,2)
2400 IF D(A,1)<LXTHEN LX=D(A,1)
2410 IF D(A,2)<LYTHEN LY=D(A,2)
2420 NEXTA
2430 CALL"PLOT",FNX(LX),FNY(0),1
2440 CALL"LINE",FNX(GX),FNY(0)
2450 CALL"PLOT",FNX(0),FNY(LY)
2460 CALL"LINE",FNX(0),FNY(GY)
2470 FOR A=1 TO N
2480 CALL"STPLOT",FNX(D(A,1))-3,FNY
(D(A,2))-3,VARADR(X$),3
2490 NEXT A
2500 FOR A=1 TO N-1
2510 FOR X=D(A,1)TOD(A+1,1)STEP(GX-
LX)/200
2520 IF FNS(X)>GY OR  FNS(X)<LY THE
N GOTO 2540
2530 CALL"PLOT",FNX(X),FNY(FNS(X)),
2
2540 NEXTX,A
2550 FOR A=1 TO N
2560 CALL"STPLOT",FNX(D(A,1))-3,FNY
(D(A,2))-3,VARADR(X$),3
2570 NEXT A
2580 GOTO 3260



2590 REM    ROW OPerations
2600 FOR I=1 TO R-1
2610 BIG=0
2620 FOR J=1 TO R+1
2630 IF ABS(M(I,J))>1E3 THEN BIG=1
2640 NEXT J
2650 IF NOT BIG THEN 2700
2660 FOR J=1TO R+1
2670 M(I,J)/1E3
2680 NEXT J
2690 GOTO 2610
2700 FOR J=I+1  TO R
2710 K=M(J,I)/M(I,I)
2720 FOR L=1 TO R+1
2730 M(J,L)=M(J,L)-K*M(I,L)
2740 NEXT L,J,I
2750 RETURN



2760 REM     ECHELON  *******
2770 C(R)=M(R,R+1)/M(R,R)
2780 FOR I=R-1 TO 1 STEP -1
2790 S=0
2800 FOR J=I+1 TO R
2810 S=S+M(I,J)*C(J)
2820 NEXT J
2830 C(I)=(M(I,R+1)-S)/M(I,I)
2840 NEXT I
2850 RETURN
2860 REM        Graphics ONE
2870 GOSUB 210
2880 GOSUB 3080



2890 REM    RANGE IN LX,LY,GX,GY
2900 CALL"PLOT",FNX(LX),FNY(0),1
2910 CALL"LINE",FNX(GX),FNY(0)
2920 CALL"PLOT",FNX(0),FNY(LY)
2930 CALL"LINE",FNX(0),FNY(GY)
2940 FOR A=1 TO N
2950 CALL"STPLOT",FNX(D(A,1))-3,FNY
(D(A,2))-3,VARADR(X$),3
2960 NEXT A
2970 FOR X=LX TO GX STEP (GX-LX)/30
0
2980 Y=0
2990 FOR A=1 TO R
3000 Y=C(A)*X^(A-1)+Y
3010 NEXT A
3020 CALL"PLOT",FNX(X),FNY(Y),2
3030 NEXT X
3040 FOR A=1 TO N
3050 CALL"STPLOT",FNX(D(A,1))-3,FNY
(D(A,2))-3,VARADR(X$),3
3060 NEXT A
3070 GOTO 3260
3080 REM        FIND RANGE
3090 LX=D(1,1):GX=D(N,1)
3100 LY=1E20:GY=-LY



3110 REM  SCAN POINTS
3120 FOR I=1 TO N
3130 IF D(I,2)>GY THEN GY=D(I,2)
3140 IF D(I,2)<LY THEN LY=D(I,2)
3150 NEXT I
3160 REM      SCAN FUNCTION
3170 FOR I=LX TO GX STEP (GX-LX)/20
3180 Y=0
3190 FOR J=1 TO R
3200 Y=C(J)*I^(J-1)+Y
3210 NEXT J
3220 IF Y>GY THEN GY=Y
3230 IF Y<LY THEN LY=Y
3240 NEXT I
3250 RETURN



3260 REM       OPTIONS AFTER PLOTTI
NG
3270 INPUT"Do you want a hard copy
:",Q$
3280 IF Q$<>"y" AND Q$<>"Y"THEN GOT
O 1620
3290 CALL"PRINTER",2:PRINTER3
3300 CALL"PATSIZE",2,2
3310 S$="0100":CALL"SHADING",1,VARA
DR(S$)
3320 S$="1010":CALL"SHADING",2,VARA
DR(S$)
3330 S$="1111":CALL"SHADING",3,VARA
DR(S$)
3340 CALL"DUMP",0,0,319,191,1



3350 GOTO 3260
3360 REM This Clears M() each time
3370 REM
3380 FOR A=1TOR
3390 FOR B=1TOR+1
3400 M(A,B)=0
3410 NEXT B,A
3420 RETURN
3430 REM The End
```

PRINTERS

DOT MATRIX

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

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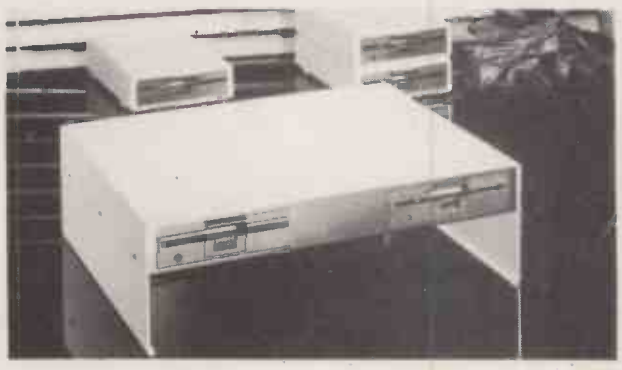

These drives are supplied ready cased with all the necessary cables formatting program and User Guide
There are some very useful utilities included on formating disc e.g.

* DISASSEMBLER: This is 6502 machine code disassembler
* DUP: To copy and rename a file on disc
* FORMAT: Formating progam for 40 & 80 tracks
* FREE: This utility provides a disk usage analysis
* MDUMP: Enables you to display and modify any part of BBC memory
* MERGE: Merge a number of text files into one file
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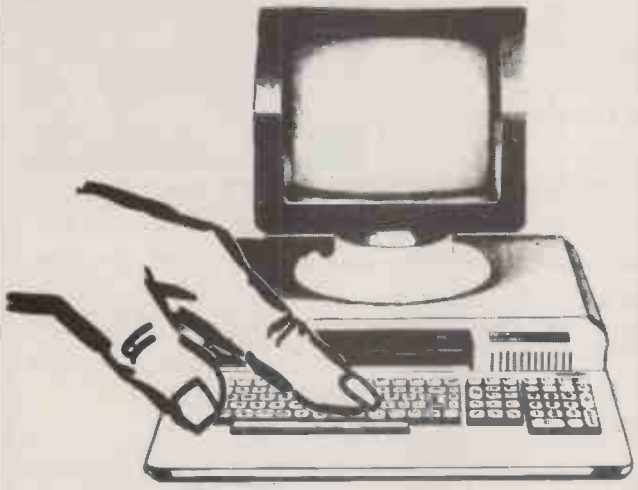

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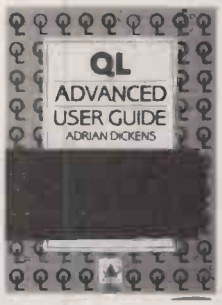

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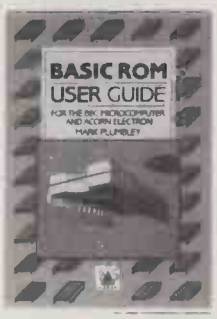

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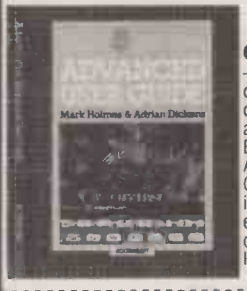

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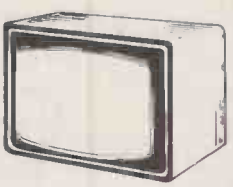

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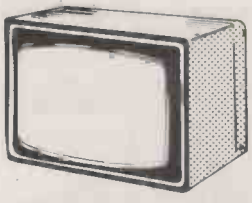

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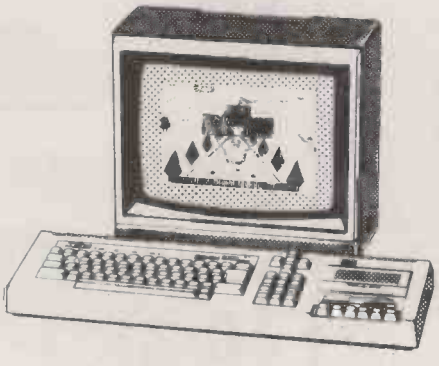

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Discovering Unix

Peter van der Linden selects some of the literature available to help users of two powerful sets of software.

THE UNIX operating system is still an undiscovered treasure-trove to many in the computer world. Unix had an obscure genesis as a hobby project deep within a private research laboratory. This was followed by a 10-year gestation period before it became widely available. The overwhelming majority of microcomputer software now has a half-life measured in months, but Unix is plainly here to stay. This year its modest and brilliant authors, Ken Thompson and Dennis Ritchie, were given the ultimate computer science accolade of the Turing Award. Unix, alone among operating systems, runs on computer hardware from Amdahl, to Zilog. It has become the standard against which other operating systems are measured. One indication of its popularity is the abundance of Unix books which are now available.

Starting with Unix by Peter Brown is a good book aimed primarily at helping novices to make effective use of Unix. The book is in two parts: the first aims to explain some of the underlying ideas behind Unix, while the second and much longer part is more of a guide to using the system. Both parts of the book succeed well. Little or no computer background is assumed. All the facilities which cognoscenti take for granted such as files directories and time-sharing are explained clearly by drawing comparisons with non-technical objects from everyday experience.

Unix for Users by Chris Miller and Roger Boyle covers the standard introductory material with fluency. The typeface of the book indicates that camera-ready copy was produced directly by a Unix system and output on something like a Versatec printer. This has the major advantage of permitting examples to be incorporated directly and accurately into the text, as well as reducing production costs.

Some might find the style rather dry since it does not purport to entertain, merely to inform. Others will welcome the omission of West Coast flimflam. *Unix for Users* is a reasonable book to have by your side for your first few weeks with Unix, although it would have benefitted from some better accompanying graphics. It is aimed at end-users rather than applications programmers, since it seeks to explain the "what" rather than the "how" or "why".

Another introductory text is *Unix: the book* by Mike Banahan and Andy Rutter. It starts with the very first principles of logging on, and then progresses fluidly to broader material. The light but knowledgeable style is easy to follow. The first chapter gives some unexpected though useful advice on distinguishing a true Unix expert from a know-all terminal freak: "Pick your guru carefully, like a horse. Go for one with an alert expression, bright eyes and a quiet voice. Bags under the eyes, a glazed expression and an unwashed appearance are signs to beware of."

Ambitious

Unix: the book is very much a guide to the parts of Unix most likely to be encountered by novice users. As might be expected from its ambitious title it occasionally makes somewhat startling claims, such as the statement that programs running under one version of Unix will run under all versions without any changes. This is more likely to be true for Unix than elsewhere, but it falls somewhat short of being an absolute truth.

Rather more of an expert's book is *The Unix Programming Environment* written by Brian Kernighan and Rob Pike, Kernighan being the person who coined the term Unix back in 1970. It is priced at a rather hefty £17.95, but certainly deserves a place in the library of any professional Unix programmer. Kernighan and Pike have written as much about the software tools philosophy embodied in Unix as about Unix *per se*. They definitely reach the parts that other Unix books cannot reach. Nothing is swept under the carpet as being too difficult to discuss, which happens in most of the introductory-level books reviewed here.

Another book written by an acknowledged expert for other would-be experts is *The Unix System*. The author, Steve Bourne, wrote one of the two major shells available under Unix. Less wide-ranging than Kernighan and Pike's book, Bourne has restricted the material to that usually covered in a standard introduction. There are chapters on getting started, editing, the C language document preparation, the shell and so on. As might be expected, the chapter on the shell is particularly well presented. There is also a small section on using the system debuggers, something which is so difficult that lesser authors often omit it altogether. It would have been nice to see more included on UUCP and Unix networking in general. The major achievement of this text is to prove that good computer scientists are not necessarily good authors.

Introducing the Unix System by Henry McGilton and Rachel Morgan is a fairly lengthy introduction at 556 pages. However, the book includes a good index and a useful bibliography of other Unix-related material. This book is the most comprehensive of all the works reviewed here, covering such diverse topics as system management, four popular editors, text formatting, the C shell and, of course, the elementary utilities. The authors' enthusiasm is reflected in the helpful tutorial style of the book. It closes

with the immortal advice "Above all have lots of fun with your Unix system (we do!)". This book will probably appeal most to people who are presently new to Unix, but think that they may eventually become the system administrator, and want just one book to help them along the way.

The title of Ann Lomuto and Nico Lomuto's book *A Unix Primer* is somewhat misleading since they are primarily concerned with document preparation, to the exclusion of other material. The Lomutus have divided the book into three sections, covering elementary, intermediate and advanced editing. The hardback edition is reasonably priced at £13.55, and this book will be of most interest to people whose use of Unix is restricted to word processing.

A well-designed book with helpful and witty drawings is *Unix Primer Plus*, written by Mitchell Waite, Donald Martin and Stephen Prata. Fairly lengthy at over 400 pages, and priced at £16.95, the book covers all the standard material in a gentle and user-friendly manner. There are tear-off reference cards for Unix and two of the system editors, plus an appendix comparing CP/M and Unix. Experts will probably prefer a book which proceeds at a faster pace.

A Practical Guide to the Unix System by Mark Sobell is apparently intended for people with some computer experience but little or no Unix expertise. The great diversity of different founts used in the text is a confusing distraction rather than an aid. About one-third of the book consists of a summary description of the various utility programs on the system. The manner in which this is presented makes it an unnecessary duplication of easily found reference material. However, the chapter on the NROff text processor is well thought-out, and it is good to see a separate chapter devoted to each of the Bourne and the C shells. There is an appendix on Xenix but it is disappointingly brief at two and a half pages. Overall, there are better books on the market.

Most of the books mentioned are intended as elementary introductions. One text which goes well beyond this is Kaare Christian's *The Unix Operating System*. Priced at £15.50, this book represents the best all-round value for programmers. The author has a wealth of practical experience which is evident in the rich range of examples given. The diagrams and pictures are excellent. The chapter on the system kernel contains much material which is not easily available elsewhere.

The Unix Operating System is highly recommended to people who are already familiar with an existing operating system and and do not need an entire chapter discussing the principles of logging on. It will be of most interest to people who want to probe some of the implementations of Unix.

Finally, it is interesting to note that the cover illustration of *The Unix Operating System* is a landscape photograph taken from one of the *Star Trek* films. A note at the back of the book explains that it was produced by graphics software running on Unix. Now that's certainly something you will not see a CP/M system used for.

A Practical Guide to the Unix System by Mark G Sobell. Published by The Benjamin/Cummings Publishing Company Inc., 428 pages. ISBN 0 8053 8910 5

A Unix Primer by Ann Lomuto and Nico Lomuto. Published by Prentice-Hall, 239 pages, £13.55. ISBN 0 13 938886 9

Introducing the Unix System by Henry McGilton and Rachel Morgan. Published by McGraw-Hill, 556 pages, £15.25. ISBN 0 07 04 5001 3

Starting with Unix by Peter Brown. Published by Addison-Wesley, 221 pages, £7.95. ISBN 0 201 13233 9

The Unix Operating System by Kaare Christian. Published by Wiley-Interscience, 318 pages, £15.50. ISBN 0 471 89052 9

The Unix Programming Environment by Brian W Kernighan and Rob Pike. Published by Prentice-Hall Inc., 357 pages, £17.95. ISBN 0 13 937681 X

The Unix System by S R Bourne. Published by Addison-Wesley, 351 pages, £12.95. ISBN 0 201 13791 7

Unix for Users by C D F Miller and R D Boyle. Published by Blackwell Scientific Publications Ltd, 210 pages, £6.95. ISBN 0 632 01182 3

Unix Primer Plus by Mitchell Waite, Donald Martin and Stephen Prata. Published by Howard W Sams 414 pages, £16.95. ISBN 0 672 22028 8

Unix: the book by M Banahan and A Rutter. Published by Sigma Technical Press, 266 pages. ISBN 0 905 104 21 8

Lotus lifelines

One of the newest and most successful micro spreadsheet packages, Lotus 1-2-3 has already been made obsolete by its successor, Symphony, from the Lotus Development Corporation. Symphony is the software you may have seen advertised with a picture of Bing Crosby crying, because Lotus says Symphony will sell more discs than Bing ever did — though I doubt that it will.

So named because of its integration of three popular functions — spreadsheets, graphs and data management — the Lotus 1-2-3 package has a great many existing users who will not write off their investment in time, money and education quite so easily. Several recently published books are available to the user community. None of the books are bargains — the least expensive of them costs £12.95.

The foreword to Julie Bingham's book *1-2-3 Go!* claims boldly that "you will not merely read this book, you will experience it". While I appreciate attempts to introduce Californian humour into an otherwise dry subject, I read the book through carefully and can report that it was in no sense an experience. However, it is a competent and well-presented book which explains the subject matter in an orderly progression. Although the price of £12.95 is expensive considering it is a paperback, it represents the best value of

(continued on next page)

(continued from previous page)

all the Lotus 1-2-3 books reviewed here.

1-2-3 At Work by Tom and Nancy Cain is distinguished by its clear text layout and excellent diagrams. Starting from first principles, the authors proceed in easy stages from the elementary commands to the more sophisticated features of Lotus 1-2-3. There are two chapters on keyboard macros, plus an entire section at the back entitled "Introducing 1-2-3 applications to the user". Because of its great depth of coverage, this book will appeal particularly to non-specialists who have been given the job of introducing micros within a company.

1-2-3 Revealed written by Dan Shaffer is a no-nonsense look at Lotus 1-2-3 packed with a wealth of practical experience. The only minor quibble here is that Shaffer has tried to reproduce some diagrams from photographs of VDU screens. While this promotes accuracy, it is a pity that the pictures are sometimes a little fuzzy. However, the other diagrams and line drawings are clearer and very helpful. *1-2-3 Revealed* will be of interest to spreadsheet users who already have a grasp of the basics and want a book which gets into more advanced material fairly rapidly.

Two very similar books are *The Power of Lotus 1-2-3* and *The Power of Financial Calculations for Lotus 1-2-3*, both written by Robert E Williams. Both texts demonstrate the use of Lotus 1-2-3 through specific application examples. The first book presents 10 chapters, showing the keystrokes needed for maintaining a stock portfolio, balancing a chequebook: production scheduling, inventory reporting and so on. Actually, most people have an automatic device for balancing a chequebook; a bank.

The financial calculations book has 22 chapters showing templates for calculating loan needs, simple interest, compound interest, net present values, future values, bond yields, some statistical formulae and one or two other models. The texts are essentially recipe books for those who are unable or unwilling to write their own applications. They would be useful only to someone in need of one or more of the applications described.

Finally, it is not at all clear why *Accounting with Lotus 1-2-3* by Kaz Ochi and Pat Hughes has been released to the British market. It purports to list the keystrokes needed for some accounting applications. However, the book was written for the U.S. market and has not been revised for the different British conventions. For instance, the suggested payroll package would be useless. Furthermore, anyone trying to handle accounting functions with a spreadsheet is applying the wrong tool for the job. There are severe limitations on audit trails, security, backups, and so on. Not recommended, and overpriced at £19.95.

1-2-3 At Work by Tom and Nancy Cain. Published by Prentice-Hall, £14.50. ISBN 0 835 952 27 4

1-2-3 Go! by Julie E Bingham. Published by Addison-Wesley, 271 pages, £12.95. ISBN 0 201 13047 5

1-2-3 Revealed by Dan Shaffer. Published by Prentice-Hall, £16.45. ISBN 0 835 952 36 3

Accounting with Lotus 1-2-3 by Kaz Ochi and Patrica J Hughes. Published by Wadsworth Electronic Publishing Co., 276 pages, £19.95. ISBN 0 534 03038 6

The Power of Financial Calculations for Lotus 1-2-3 by Robert Williams. Published by Prentice-Hall International, 166 pages, £13.45. ISBN 0 13 6876 90 0

The Power of Lotus 1-2-3 by Robert Williams. Published by Prentice-Hall International, 178 pages, £13.45. ISBN 0 13 687525 4

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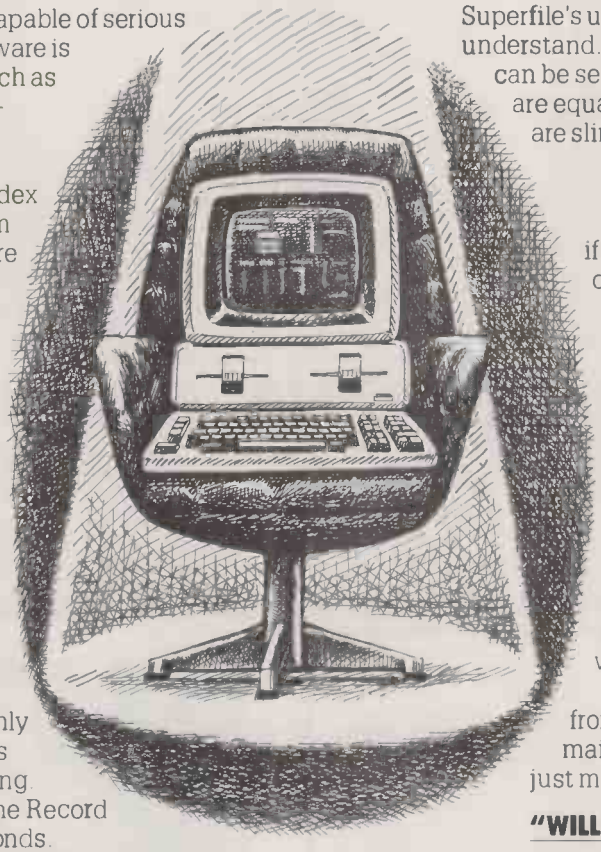

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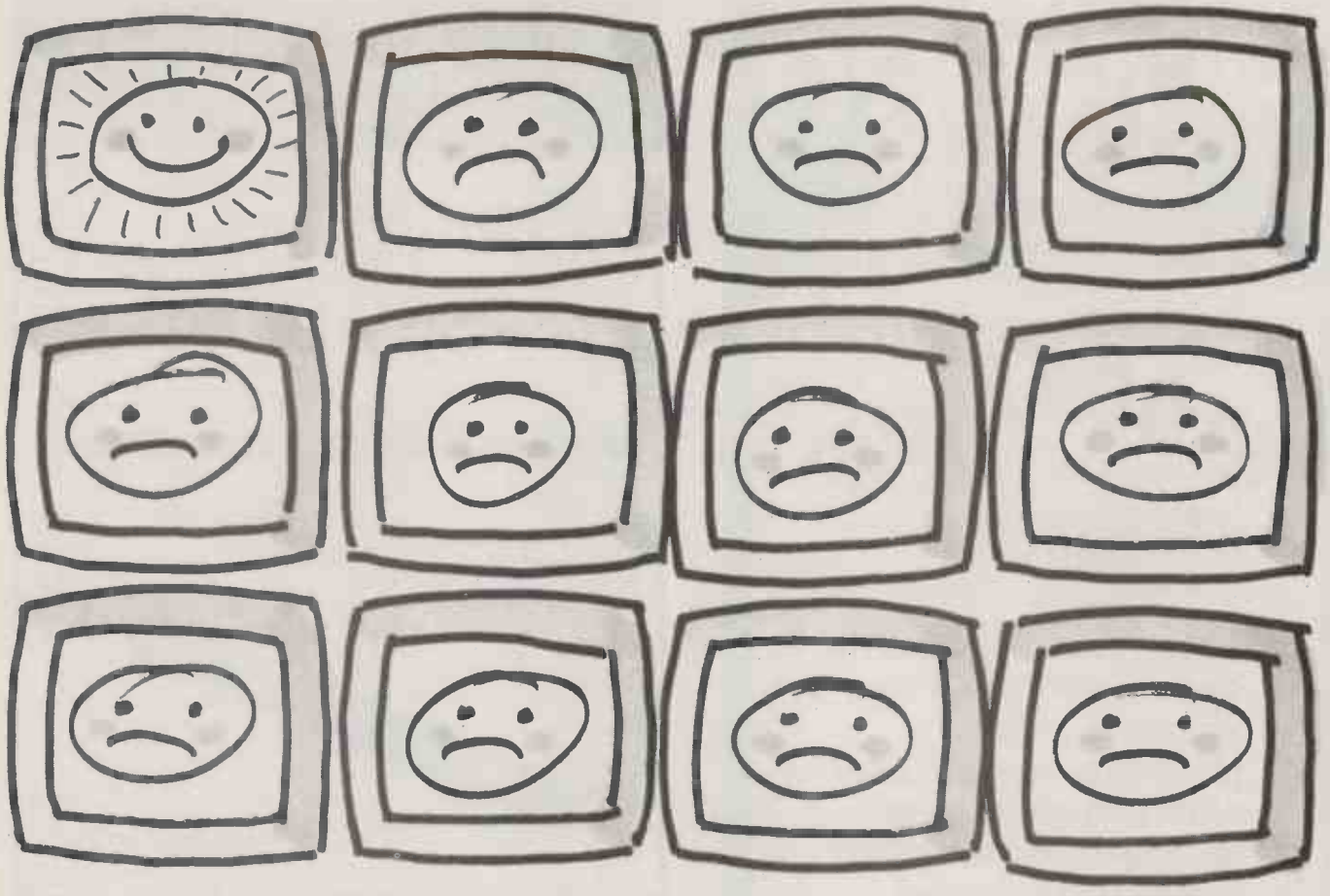

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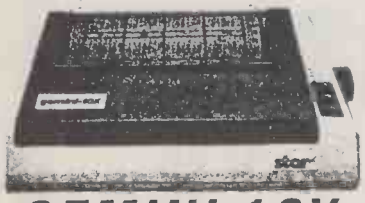

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A practical solution

Paul Caswell suggests ways of prevent computing in schools becoming a disappointing theoretical dirge.

STRANGE as it might seem, many independent schools eschew computing examinations. I am not thinking of laggards who have not yet woken up to the modern world but rather of those you would count among the leaders in school practical microelectronics. Some of them have purpose-built centres stuffed with equipment, yet find the GCE examinations at best irrelevant and at worst a hindrance. Several, like Brighton College, run no GCE courses as such, but simply permit pupils who wish to do so to take, say, the AO-level off their own bat in the Lower Sixth.

Critics of the examinations claim that they are too theoretical, outside the reasonable experience of their target age group, and almost antediluvian. Examiners' reports appear to agree that the result is a poor general standard yet an easy passage, with little or no formal tuition, for pupils who have soaked in the practical subject. The situation is rather like that of the foreign pupils who sit O-levels in their own language and pass because they know the language, though not in the manner intended by the examiners.

Unsuitable

Perhaps the examination boards and the schools are inevitably on different wavebands, GCE being simply not designed for such a rapidly developing practically based subject. Or perhaps it is that the theoretical side of computing is not suitable for examination at school level.

A further difficulty, as we see it, is to target the pupil who we would advise to take a GCE Computing course were we to run such a thing. It may appear trendy to offer a GCE course, but is it sensible to counsel any GCE pupil to take it? At present, the answers seem mostly negative.

What then is the role of computing in secondary education? What will we do with the thousands of pounds worth of hardware in our school? Keyboard familiarity and play is certainly not relevant now that increasing numbers of pupils — 42 percent in our school census last February — have computers at home.

Perhaps we should get back to asking just what computing actually is: simply a modern method for solving certain sorts of information problem. The key word is "problem". An analogy is the car, which is right for solving certain sorts of journey problem. Neither represents a universal answer for every such problem. However, the difficulty at school is that most pupils have not encountered problems to which a computer is the most effective solution: friends' phone numbers, for example, are better stored in a diary.

Problem solving

But is not the same situation true of much secondary mathematics? Do we not artificially create problems for the pupils to solve and so learn the next process in mathematics? This suggests an approach to computing in schools: we should tackle the practical solution of a series of complete problems, using theory to support the practical rather than the practical to demonstrate theory.

Of course, it is the function of the teacher to pose each problem so that it takes the pupil's understanding just that little bit further forward. But it is essential that each problem does require a computer for its optimum solution. It may be that a standard package, such as a word processor in ROM, is indicated and these must be available.

We should not set out like a language teacher to teach Basic or computer science studies *per se*. Almost the worst thing a school can do on getting its first few machines is to immediately start offering a GCE course. Instead, we should set out to solve complete problems and take on board whatever language and techniques are required to the purpose.

One of the most absurd tasks I saw set recently was to copy the program

```
10 MILK = 24
20 PRINT"A PINT OF MILK COSTS";
30 PRINT MILK
```

and then to edit line 10 to a value 21. This is absurd not because the object looks trivial or something you do not really want to achieve in practice, but because given the problem the program is supposed to solve, there is absolutely no advantage to using a computer in its solution.

To conclude, a brief list of some of the problems that might be considered:

- Use the word processor to write a short essay on, say, school dinners. Appoint an editor and have a separate group working on a different story, compile the front page of a house magazine with, for example, tabulated sports results shaped to fit on A3 page.
- Compile a table of squares/square roots/sines or the like to five decimal places similar to the three- or four-figure tables you use in mathematics classes, or a Haversine table such as nautical navigators might use.
- Fibonacci numbers; simulations to approach π experimentally; statistical analysis such as linear regression or contingency tables.
- Hero's iteration to find the square root: discuss when and how to end the iteration.
- Sorting lists of numbers then strings. Demonstrate a machine-code sort on an identical algorithm to see how much faster it can be. Follow with a shuffle and demonstrate that a shuffled list is truly random.
- Frequency table of the total scores obtained in theory, using nested loops, and by experiment

  RND(6) + RND(6) + . . .

  when several dice are thrown together.
- Become house DP manager for invitations, circular letters, etc., using Silicon Office to file the necessary records and do the necessary word processing.
- Solve the puzzle

  SEND + MORE = MONEY

  in Basic, then in assembler.

Naturally, there are many more such problems and it would be instructive for readers to send in ones they have found most help. But the criteria are that the problem should not only advance the pupils' understanding but that use of the computer is essential to the best solution.

Paul Caswell is Head of Computing at Brighton College.

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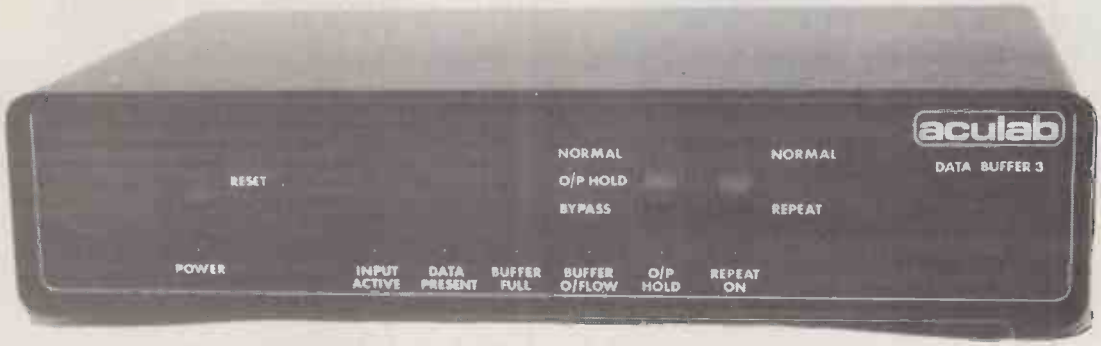

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★★★★★PLUS★★★★★

£2,500 Spending Money

★★★★★PLUS★★★★★

The 10 Runners-Up each get a

£100 Voucher

To spend in any Spectrum Group appointed dealer store anywhere in the UK!

Pick up an entry form from your local Spectrum dealer now - No purchase required!

New Products!

MSX

Goldstar . . . £239.99
Canon V20 . £279.95
Sanyo MPC-100
. . . . . £299.95

Rotronics Wafa Drive
. . . . . £129.95
ZX Spectrum +
. . . . . £179.95
Timex 2040 printer
. . . . . £77.50
Microvetic Monitor for the QL . £275.00

MICRO UPDATE

Spectrum's own computer guide, published by the experts for YOU.

It's packed with illustrations and descriptions of just about everything you're likely to meet in home micro hardware, add-ons and accessories. Plus there's information on current software, and hints and tips from experts about home computing.

Call in to your local Spectrum dealer and get YOUR copy - It's great!

Just Arriving - the amazing value-for-money

Goldstar MSX

Very limited Quantities!

Yes-the exciting new world of MSX computing is now here, and with the superb new Goldstar MSX micro, from Spectrum It's at a sensational low price too!

MSX micros are made to a standard specification-but some things do vary and that's where the Goldstar comes out on top. It's POWERFUL-a full 64K of user RAM, 32K of ROM AND a 16K video RAM. The sixteen vivid colours and eight octaves of sound make it a great games player's micro, and a powerful Z-80A processor to take on a world of home office tasks.

But it's the price tag that's really special-just £239.99, a lot less than most of the others. Take a look at the superb Goldstar MSX at your local Spectrum dealer NOW!

- General purpose MSX micro
- Powerful 64K user RAM
- 32K ROM, 16K video RAM
- Hi-resolution colour graphics
- Full typewriter keyboard and cursor controls

SENSATIONAL VALUE
£239.99

New! Canon V20 MSX

A64K MSX micro with 32K ROM and 16K video RAM. All the benifits of standardised MSX software, 8-octave sound and super colour graphics.

SPECTRUM PRICE
£279.95

Not all stores carry every advertised item, please phone before making a journey - prices correct at time of going to press E&OE

spectrum CHARGE CARD

Up to £1000 Instant Credit

- There's up to £1,000 worth of Instant Credit available on a Spectrum Chargecard. See your local SPECTRUM dealer for written details (UK mainland only) Typical APR -29.8%

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Sensational New Products

Rotronics Wafadrive
for the ZX Spectrum

At last - a versatile, flexible twin data drive for the ZX Spectrum! The Wafadrive features twin 128K drives that take the compact wafers (choose from 16K, 64K or 128K sizes) - The dual drive means professional-style ease of use, with easy copying of files or whole wafers. There are no cables to connect - and there's RS232 PLUS Centronics ports to take a host of extra peripherals. For super reliability, the tape has been designed for extra long life and top data integrity. And it's incredible value-for-money!

Plus! FREE Softeks Special Writer - an excellent word processor program.

SPECTRUM PRICE

£129.95

Just arriving the super new ZX Spectrum+

Here's the brand new Spectrum micro. The 'Plus' boasts a new, professional typewriter-action keyboard, plus all the Spectrum's top selling features like powerful 48K RAM, 8 colours, 10-octave sound and full compatibility. AND you get a super 80-page User Guide PLUS SIX FREE SOFTWARE PACKAGES - unbeatable value-for-money!

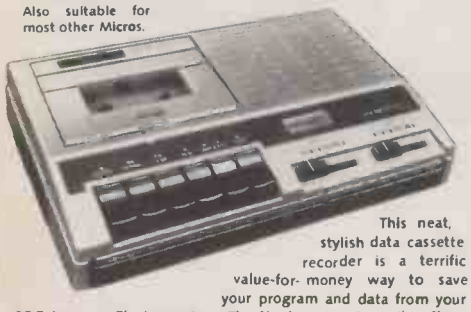
SPECTRUM PRICE

£179.95

Super Value Shado Add-Ons

Shado
BBC Compatible Data Recorder

Also suitable for most other Micros.



This neat, stylish data cassette recorder is a terrific value-for- money way to save your program and data from your BBC Acorn or Electron micro. The Shado connects easily, offers reliable and consistent performance and features a Tape Position indicator for easier data access.

SPECTRUM PRICE

£32.50

Commodore 64
Compatible Data Recorder

Directly compatible with the Commodore 64 and VIC-20 micros, this excellent data recorder eliminates the problems of using ordinary cassette recorders - at a top value price too!

SPECTRUM PRICE

£34.97

Shado Joysticks
for the BBC

SPECTRUM PRICE

Designed as direct replacements for the Acorn originals, these superfast joysticks (connected to the Analogue port) feature much improved hand action with sprung response. L & R are identified by the colour of the fire buttons.

£16.95 per pair

Blank Data Cassettes

C12 Standard Data Cassette..... £0.50
C15 Standard Data Cassette..... £0.58
C15 Computatape Reel to Reel Cassette.... £0.75

Spectrum Computer Centres have no connection whatsoever with the ZX-Spectrum Computer manufactured by Sinclair Research Ltd.

Computer Dealers

or prospective dealers. If you would like to know more about becoming a SPECTRUM APPOINTED DEALER on an exclusive area basis please write to Bob Cleaver, Spectrum Group PLC, Hunting Gate, Hitchin, Herts SG4 0TJ Tel (0462) 37171

More from Spectrum...

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Micro Dealers UK's Top 50

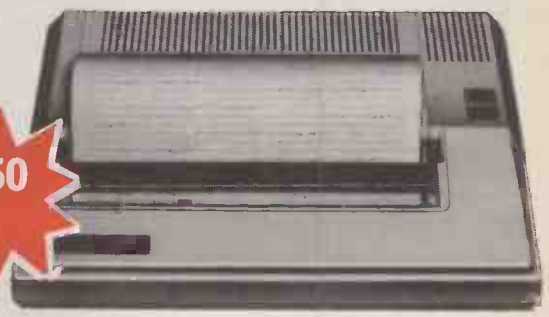
Britain's No.1 Software Chart

Elite	Acornsoft	BBC	£14.95
Beachead	Access	Spectrum	£7.95
Sherlock	Melbourne House	Spectrum	£14.95
Daley Thompson's Decathlon	Ocean	Spectrum	£6.90
NEW Jet Set Willy	Software Projects	CBM 64	£7.95
Summer Games	Quicksilva	CBM 64	£14.95
Pitfall II	Activision	CBM 64	£9.99
Zaxxon	Synsoft	CBM 64	£9.95
Braxx Bluff	Micromega	Spectrum	£6.95
Havoc	Dynavision	CBM 64	£9.95
Zim Sala Bim	Melbourne House	CBM 64	£9.95
Kentilla	Micromega	Spectrum	£6.95
Kokotoni Wilf	Elite	Spectrum	£5.95
Daley Thompson's Decathlon	Ocean	CBM 64	£7.90
World Cup 64	Artic	CBM 64	£6.95
NEW Deuce ex Machina	Automata	Spectrum	£15.00
Hampstead	Melbourne House	Spectrum	£9.95
3D Grand Prix	Software Invasion	BBC	£9.95
NEW Combat Lynx	Durell	Spectrum	£8.95
Battle for Midway	PSS	Spectrum	£9.99
Mr Robot	Beyond	CBM 64	£8.95
High Noon	Ocean	CBM 64	£7.90
Decathlon	Activision	CBM 64	£9.99
Aztec	Beyond	CBM 64	£8.95
Ankh	Beyond	CBM 64	£8.95
NEW Quo Vadis	The Edge	Spectrum	£9.95
Stunt Bike	Ocean	CBM 64	£6.90
Psytron	Beyond	CBM 64	£8.95
NEW Flak	Funsoft	CBM 64	£9.95
Jack & the Beanstalk	Thor	CBM 64	£6.95
Dark Star	Design Design	CBM 64	£7.50
Zombi Zombi	Quicksilva	Spectrum	£6.95
NEW Sub Hunter	Micromart	Spectrum	£6.95
NEW Boulder Dash	State Soft	CBM 64	£8.95
Strangeloop	Virgin	Spectrum	£6.95
The perils of Willy	Software Projects	VIC 20	£6.95
NEW Nato Commander	Microprose	CBM 64	£9.95
Falcon Patrol 2	Virgin	CBM 64	£7.95
NEW Snookie	Funshot	CBM 64	£9.95
NEW Halls of the Things	Design Design	CBM 64	£8.50
NEW Pyjamarama	Micro Gen	Spectrum	£6.95
NEW Pystraxx	The Edge	Spectrum	£7.95
Toy Bazarre	Activision	CBM 64	£9.99
NEW Sorcerer of Clamorgue Castle	Adventrure International	Spectrum	£9.95
Enduro	Activision	Spectrum	£7.99
NEW Mine Shaft	Durell	BBC/Electron	£6.95
Strontium Dog	Quicksilva	CBM 64	£7.95
Full Throttle	Micromega	Spectrum	£6.95
Lords of Midnight	Beyond	Spectrum	£9.95
Twin Kingdom Valley	Bug-Byte	Spectrum	£7.95

Sensational value for money!

Timex 2040

Thermal Printer for the SPECTRUM 48K



SPECTRUM PRICE **£77.50**

This top-value thermal dot matrix printer is designed especially for use with the Spectrum 48K computer. With a print rate of 80cps on no-ribbon thermal paper and a maintenance-free life, plus 80 dpi graphics capability, the 2040 really is a terrific buy at our low price!

Includes **FREE! Roll of Thermal Paper**

Super Value!

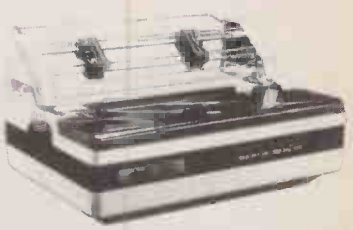
Juki 6100

Daisy wheel printer

● Dalsywheel printing ● 20cps (av. 18cps Shannon Text) ● 10/12/15 or Proportional character spacing ● Bi-directional friction-feed ● Tractor feed or cut paper ● Centronics as standard; RS232C optional ● 2K byte print buffer

SPECTRUM PRICE **£399**

Quendata



Just look at this for value - a true daisy-wheel printer offering top quality printing at a remarkably low price. Print speed is 18/20cps, uni- or bi-directional printing (depends on software), variable pitch.

SPECTRUM PRICE **£289.95**

Tractorfeed optional extra

Other Printer Bargains

SEIKOSHA		GP100VC VIC 20/64	£199.95	BROTHER	
GP50A	£99.95	Friction Feed GP100/250X	£28.75	HR-5	£159.95
GP50S Spectrum	£99.95	EPSON		HR-15	£458.85
GP500A	£179.95	FX80	£503.70	EP-44	£249.95
GP550A	£299.00	RX80T	£286.35	SMITH CORONA	
GP100A MkII	£199.95	RX80FT	£327.75	D100	£286.35

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Superb value and Service in Business Computers from selected Spectrum Stores Nationwide

Sanyo 550/555

Among the very best value in personal computers is the excellent Sanyo 550/555 Series. They feature high performance, 16-bit CPU that runs on MS/DOS, with a RAM that's expandable up to 256K bytes. The 550 has one 160K byte 5¼" floppy disk drive while the 555 has dual drives for professional flexibility. There's a choice of superb hi-resolution Colour or B&W Monitors too (not included). Both come with a comprehensive package of business software, and a very special free maintenance offer. - Take a look at these superb micros at Spectrum NOW!

Sanyo 550
Monitor Extra
SPECTRUM PRICE
£749
Excluding VAT.

Sanyo 555
Monitor Extra
SPECTRUM PRICE
£990
Excluding VAT.

Plus Free!

On-site service contract worth £175

Spectrum give you peace of mind with your new computer! There's a twelve month on-site service contract, worth £175, ABSOLUTELY FREE when you buy either a Sanyo 550/555 computer or an Apricot F1E/F1.

Plus Free Business Software.

Both the Sanyo and Apricot computers come complete with a superb pack of comprehensive business software worth hundreds of pounds. The packs contain virtually everything you're likely to need to get the very best from your computer -from Day one!

SEE YOUR NEAREST SPECTRUM BUSINESS COMPUTER STOCKIST FOR DETAILS OF BOTH OFFERS.

Monitor as illustrated extra

Apricot F1/F1E System

These stylish new personal computers are among the best of the new generation of business micros. Powerful and versatile, the F-1 features a standard 256K OF RAM (expandable to 768K), with a 16-bit 8086 CPU running MS-DOS and Concurrent CP/M. That's backed up by a built-in 3¼" floppy disk drive providing 720K on double-sided disks (you can add another floppy or Winchester drive later). The economical F1E has a 128K RAM and a single-sided 360K disk drive -with the same 92-key professional infra-red keyboard on the F1. And don't forget - when you buy from Spectrum you get the assurance of our trained, expert staff to help and advise you!

F1E
SPECTRUM PRICE **£970**
F1
SPECTRUM PRICE **£1095**
Excluding VAT. Monitor extra

Your local Spectrum Business Computer Stockist

Aberystwyth **Aberdata Ltd**
Accrington **P.V.Tubes**
Alfreton **Gordon Harwood**
Bexhill-On Sea **Computerware**
Bognor Regis **Bits & Bytes**
Bromley **Computers Today**
Canterbury **Jones Computers Ltd**
Chelmsford **Maxton Hayman**
Crawley **Gatwick Computer Services**
Darlington **McKenna & Brown**
Epsom **The Micro Workshop**
Exmouth **Open Channel**
Guernsey **Gruts**
Hull **Computer Centre**
Ipswich **Brainwave Micros Ltd**
Kidderminster **Central Computers**
London NW11 **Computers Inc.**
London **Devron**
London SE1 **Vic Odden**
London SE9 **Square Deal**
London N14 **Logic Sales**
Lowestoft **John Wells Limited**
Liverpool **Hargreaves**
Luton **Terry-More Photo**
Morpeth **Telerents (Northern)**
Norwich **Norwich Camera Centre**
Norwich **Fastview**
Nuneaton **Micro City**
Potters Bar **Software Agents Ltd**
Rainham **Microway Computer**
Seven Oaks **Ernest Fielder**
Shrewsbury **Computerama**
Sittingbourne **Computers Plus**
Southampton **L.T.C. Ltd**
St Austell **A B & C Computers**
Stevenage **D.J Computers**
Thetford **Thetford C.B & Micro**
Walsall **New Horizon Computer**
Watford **SRS Microsystems Ltd**
West Bromwich **Bell & Jones**
Whitehaven **P.D.Hendren**
Wigan **Wildings**
Woking **Harpers Computers**
York **York Computer Centre**

See our address page for full addresses and phone Numbers

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Spectrum's Top 20 Best Sellers

The pick of the best in micro computing - every month from Britain's No. 1 computer specialists.

C15 Standard Data Cassette	£0.58
Commodore 64 Computer	£229.00
Commodore 1541 Single Disc Drive	£229.00
Commodore 1701 Colour Monitor	£230.00
Currah Micro Speech Synthesizer for Spectrum	£29.95
DK Tronics Dual Port Kempston Comp.	£13.00
DK Tronics Spectrum Light Pen	£19.95
DK Tronics Spectrum Keyboard	£45.00
Kempston Centronics I/face (E Promtype)	£55.00
RAM Turbo	£22.95
Rotronics Wafadrive (Floppy Tape)	£129.95
Sanyo CTP 3132 14' CTV	£199.95
Shado BBC Compatable Data Recorder with lead	£32.50
Sinclair ZX Spectrum 48K	£129.95
Spectravideo Quickshot MKII	£11.95
Stonechip Programmable Joystick Interface	£24.95
Supersaver 20/64 Cassette Recorder	£34.95
Timex 2040 Thermal Printer for ZX Spectrum	£77.50
Vixen 16K switchable RAM pack (3,8,11,16K)	£34.95
ZX Microdrive (Floppy Tape Cartridge)	£49.95

This list is alphabetical

New! Microvitec Monitor for the QL

Microvitech's 'Cub' monitor is probably the best monitor you can buy for the new QL computer. This stylish new monitor is designed around a superior medium-resolution/high contrast tube that gives outstanding focus and 'viewablility'. Highly efficient electronics give low-power consumption - and, of course, there's a full 12 month Warranty. And the 'Cub' is superbly finished in an attractive, QL-style black casing . . . at a super value Spectrum price.

SPECTRUM PRICE £275

Super value-for-money Package Deals

(while stocks last!)

BBC Model B
with 5 Games & Data Recorder
£399.99

Commodore 64
with joystick, C2N, 4 Games program
£249.99

Commodore MPS801 Printer
with FREE 2000 sheets paper
£230.00

Commodore 16
with Data Recorder, Intro to Basic & Games Software
£139.99

Commodore SX64
with MPS801, 3 Business Programs
£799.00

Atari 800XL
with 4 Atari Games
£199.99

Spectrum 48K
with 6 Program pack
£129.99

Sinclair Interface 1
with Microdrive & program cartridges
£199.99

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There's a Spectrum near you...

AVON

BATH Software Plus, 12 York St
Tel: (0225) 61676
WESTON-S-MARE K & K Computers,
32 Alfred St Tel: (0934)419324

BEDFORDSHIRE

DUNSTABLE Dormans 7-11 Broad Walk
Tel: (0582) 65515
LEIGHTON BUZZARD The Computer Ctr
at Milton Keynes Music, 17 Bridge St
Tel: (0525)376622
LUTON Terry-More, 49 George St.
Tel: (0582) 23391/2

BERKSHIRE

BRACKNELL Computer Centre, 44 The
Broadway. Tel: (0344) 427317
NEW! WINDSOR Gadgets 30 Peascod
Str., Tel: (07535) 67211
SLOUGH MU Games and Computers 245
High St. Tel: (0753) 21594

BUCKINGHAMSHIRE

BLETCHLEY Rams Computer Centre,
117 Queensway. Tel: (0908) 647744
CHESHAM Reed Photography & Comp-
uters, 113 High St. Tel: (0494) 783373

CAMBRIDGESHIRE

CAMBRIDGE K P Computers Ltd 19/20
Market St. Tel: (0223) 312240
(Open 6 Days)
HUNTINGDON T.S.C. Electronics, 3 All
Saints Passage, High St.
Tel: (0480) 411579
PETERBOROUGH Ptrbrgh Communications,
91 Midland Rd. (0733) 41007

CHANNEL ISLANDS

GUERNSEY Gruts, 3-5 The Pollett,
St Peter Port. Tel: (0481) 24682
JERSEY Audio & Computer Centre.
7 Peter St, St Helier. Tel: (0534) 74000

CHESHIRE

ALTRINCHAM Mr Micro 28 High St.
Tel: (061) 941 6213
NEW! CHESTER Computer Link 21 St
Warburgh St Tel: (0244) 316516
CREWE Microman Unit 2,
128 Nantwich Rd. Tel: (0270) 216014
ELLESMERE PORT RFR Computers, 1
Pooltown Rd. Whitby. Tel: 051 356 4150
STOCKPORT Wilding Ltd.
1 Little Underbank Tel: (061) 480 3435
WARRINGTON Wildings, 111 Bridge St
Tel: (0925) 38290
WIONES Computer City, 78 Victoria Road
Tel: (051) 420 3333
WILMSLOW Swift of Wilmslow, 4-6 St
Annes Parade. Tel: (0625) 526213

CLEVELAND

MIDDLESBOROUGH McKenna & Brown,
206 Linthorpe Rd. Tel: (0642) 222368

CORNWALL

ST AUSTELL A B & C Computers, Duchy
House, 6 Lower Aylmer Sq.
Tel: (0726) 67337
TRURO Truro Micro Ltd, Unit 1, Bridge Ho.,
New Bridge St. Tel: (0872) 40043

CUMBRIA

BARROW-IN-FURNESS Barrow Computer
Centre. 2/4 The Mall. Tel: (0229) 38353
CARLISLE The Computer Shop, 56-58
Lowther St. Tel: (0228) 27710
PENRITH Penrith Communications,
14 Castlegate. Tel: (0768) 67146
Open Mon-Fri till 8pm
WHITEHAVEN P D Hendren 15 King St.
Tel: (0946) 2063

DERBYSHIRE

ALFRETON Gordon Harwood 69-71 High
St. Tel: (0773) 832078
CHESTERFIELD The Computer Centre,
14 Stephenson Place Tel: (0246) 208802
NEW! NEW MILLS New Mills Micro
Centre 388 Market Street,
Tel: (0663) 47332

DEVON

EXETER Seven Counties (Computers) Ltd.,
7 Paris Street. Tel: (0392) 211211
EXMOUTH Open Channel, 30 The Strand.
Tel: (0395) 264408
PLYMOUTH Syntax Ltd., 76 Cornwall
St. Tel: (0752) 28705
TIVERTON Actron Micro Computers,
37 Bampton St. Tel: (0884) 252854

DORSET

BOURNEMOUTH Lansdowne Computer Ctr
1 Lansdowne Crescent. Tel: (0202) 20165
NEW! DORCHESTER Seven Counties
Cptrs. 20 High Street East
Tel: (0305) 66022
NEW! POOLE Lansdowne Cptr Centre
14 Arndale Centre Tel: (0202) 670901

DURHAM

DARLINGTON McKenna & Brown,
102 Bondgate. Tel: (0325) 459744

ESSEX

BASILDON Godfrey's 28-32 East Walk.
Tel: (0268) 289379
BASILDON Godfrey's Computer Centre,
5 Laindon Main Centre Laindon.
Tel: (0268) 416747
NEW! CANVEY ISLAND Tower Radio
Ltd. 43 High Str., Tel: (0268) 682211
CHELMSFORD Maxton Hayman Ltd.,
5 Broomfield Rd. Tel: (0245) 354595
COLCHESTER Brainwave 51 Head St.
Tel: (0206) 561513
GRAYS H Reynolds. 79 Orsett Rd.
Tel: (0375) 5948
ILFORD Woolfmans, 76 Ilford Lane.
Tel: (01) 478 1307
SOUTHEND Computer Centre 332 London
Rd. Tel: (0702) 337161

HAMPSHIRE

BASINGSTOKE Fisher's, 2-3 Market
Place. Tel: (0256) 22079
PORTSMOUTH (Waterlooville)G B
Microland, London Rd., (Opp. Co-op)
Tel: (0705) 259911
SOUTHAMPTON L.T.C. Ltd., 112 East St.,
Tel: (0703) 333958/24703
WINCHESTER Winchester Camera &
Computer Centre. 75 Parchment St.
Tel: (0962) 53982

HEREFORD

HEREFORD Melgray Hi-Tech Ltd., 53/54
Commercial Str., Tel: (0432) 275737

HERTFORDSHIRE

HITCHIN GK Photographic & Computers,
68A Hermitage Rd., Tel: (0462) 59285
POTTERS BAR The Computer Shop,
197 High St. Tel: (0707) 44417
ST ALBANS (Herts) Clarks Computer
Centre 14-16 Hollywell Hill.
Tel: (0727) 52991
STEVENAGE D J Computers, 11 Town
Square. Tel: (0438) 65501
WATFORD SRS Microsystems Ltd., 94 The
Parade, High St. Tel: (0923) 26602
WELWYN GARDEN CITY D J Computers, 40
Fretherne Rd., Tel (07073) 28435/28444

HUMBERSIDE

BEVERLEY Computing World, 10 Swaby's
Yard Dyer Lane. Tel: (0482 881831
GRIMSBY R C Johnson Ltd., 22 Friargate,
Riverhead Centre. Tel: (0472) 42031
HULL The Computer Centre,
26 Anlaby Rd. Tel: (0482) 26297

ISLE OF MAN

DOUGLAS T H Colebourn Ltd.,
57-61 Victoria St. Tel: (0624) 3482

ISLE OF WIGHT

COWES Beken & Son. 15 Bath Rd.
Tel: (0983) 297181

KENT

BECKENHAM Supa Computers Ltd., 425
Croydon Rd., Tel: (01) 650 3569
BROADSTAIRS Video Vision 19/20 Willow
Court, St. Peters Park Road Tel: (0843)
63284 (No Early Closing Day)
BROMLEY Computers Today 31 Market
Square Tel: (01) 290 5652
CANTERBURY Ctbury Computer Centre 56/
57 Palace St. Tel: (0227) 62101
DOVER Kent Photos & Computers, 4 King St.
Tel: (0304) 202020
GRAVESEND Marshalls Computers &
Cameras, 3 Windmill St. Tel: (0474) 65930
RAINHAM Microway Computers Ltd., 39
High St. Medway Towns.
Tel: (0634) 376702
SEVENOAKS Ernest Fielder Computers,
Dorset St. Tel: (0732) 456800
SITTINGBOURNE Computers Plus, 65 High
St. Tel: (0795) 25677
NEW! TUNBRIDGE WELLS Modata
Computers Ltd. 28-30 St Johns Rd.
Tel: (0892) 41555

LANCASHIRE

ACCRINGTON PV Computers,
104 Abbey St. Tel: (0254) 36521/32611
PRESTON Wilding's, 49 Fishergate.
Tel: (0772) 556250

LEICESTERSHIRE

MARKET HARBOROUGH Harborough Home
Computers, 7 Church St.
Tel: (0858) 63056

LONDON

E6 Percivals, 85 High St. North, East Ham.
Tel: (01) 472 8941
E17 Erol Computers Ltd., 125 High Street
Walthamstow Tel: (01) 520 7763
EC1 Pedro Computer Services Ltd., 47
Clerkenwell Road Tel: (01) 251 8635
EC2 Devron Computer Centre, 155 Moorgate
Tel: (01) 638 3339/1830
N14 Logic Sales, 19 Broadway, The Bourne,
Southgate. Tel: (01) 882 4942
N20 Castlehurst Ltd. 1291 High Rd.
Tel: (01) 446 2280
NW4 Da Vinci Computer Store, 112 Brent
St., Hendon Tel: (01) 202 2272
NW11 Computers Inc., 86 Golders Green Rd.
Tel: (01) 209 0401/0279
SE1 Vic Odden's 6 London Bridge Walk.
Tel: (01) 403 1988
SE9 Square-Deal, 373-375 Footscray Rd.,
New Eltham. Tel: (01) 859 1516
SE15 Castlehurst Ltd., 152 Rye Lane,
Peckham Tel: (01) 639 2205
SW16 Buffer Micro Shop, 310 Streatham
High Rd. Tel: (01) 769 2887
W1 Computers of Wigmore St., 104 Wigmore
St. Tel: (01) 935 2452
W1 Sonic Foto & Micro Centre, 256
Tottenham Court Rd. Tel: (01) 580 5826
NEW! W1 Ramsons 4 Edgware Rd.,
Tel: (01) 724 2373

GREATER MANCHESTER

BOLTON Wilding Ltd., 23 Deansgate.
Tel: (0204) 33512
MANCHESTER Lomax Ltd., 11 St Mary's
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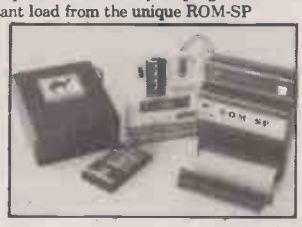

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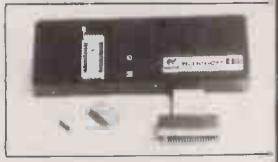

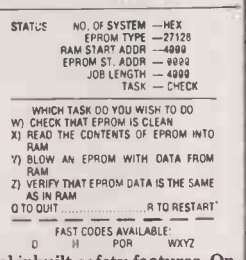

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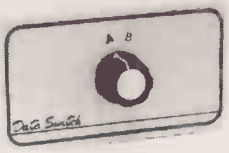

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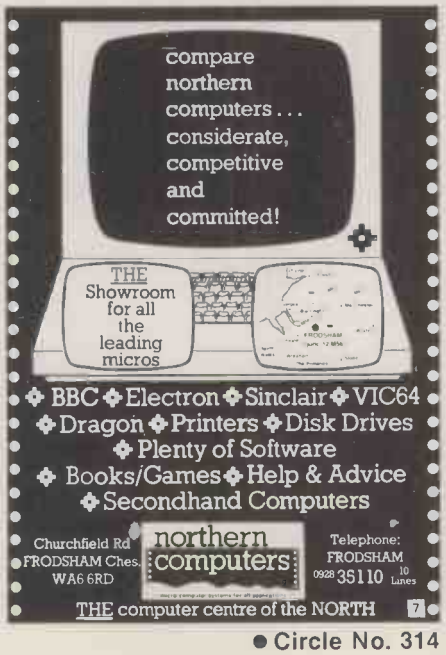

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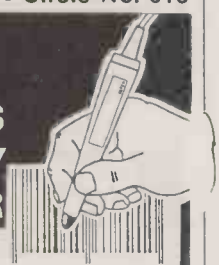

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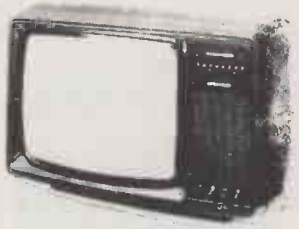

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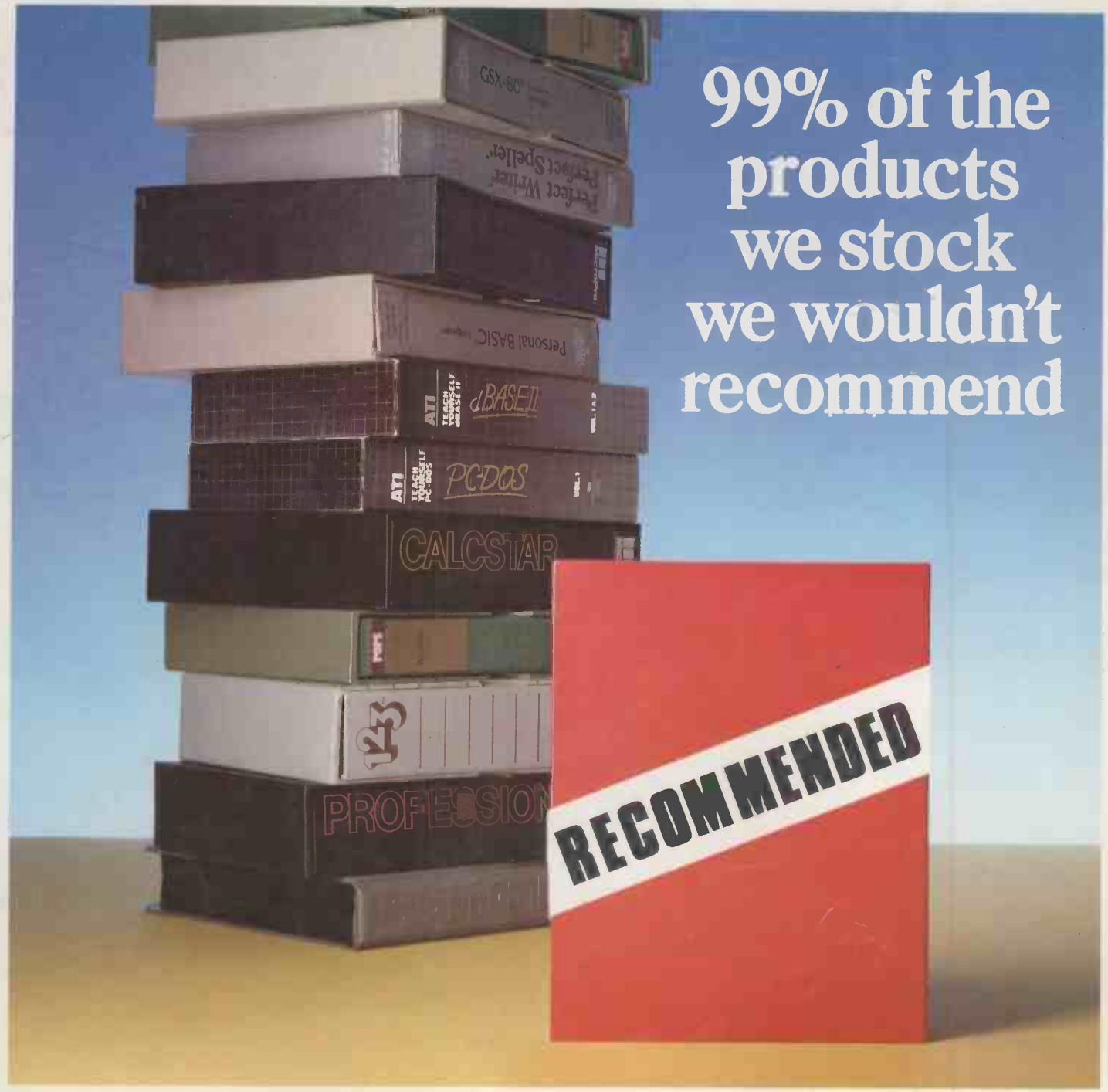

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