Practical Computing

80p May 1983 Volume 6 Issue 5

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A fast one

FIVE microcomputer firms have just had their wrists slapped by the Advertising Standards Authority, as complaints about their advertising have been upheld.

Acorn and Sinclair ran into the problem of incompatible peripherals. Unfortunately not all cassette recorders work with the ZX-81, and not all television sets work with the Atom. As no company can test every product on the market, it is not surprising if this kind of difficulty crops up.

Rank Xerox encountered a different snag. The company offered a free cassette on microcomputing to people who tried out the 820, but two London stores failed to supply it.

More interesting cases were those involving Olivetti, Dragon and misleading comparisons. Olivetti used a comparison chart giving £2,395 as the price for the M-20, but did not make it clear that the colour version in the advert cost more. Dragon ran into a RAM problem. The claim that its 32K of memory made it twice as powerful as its competitors fell before the 48K — and cheaper — Spectrum.

Comparisons are not always odious, but they are certainly dangerous. The Spectrum was itself launched with a leaflet containing a comparison chart in which a number of figures were wrong. Later editions revealed new figures as corrections were made. Mistakes are all too easy to make. As a magazine, we publish comparison tables ourselves and know that with the best will in the world misinformation and misprints are impossible to exclude. Correcting a chart is like debugging assembler. Maybe worse.

Another danger is not always so obvious. That is, when you compare your micro with others, you make a rod for your own back. Olivetti's powerful TV advertising for the M-20 shows six identikit businessmen sitting in front of different micros. They program the computers to select the best machine according to speed, memory size, graphic ability and "bit power". Then — surprise, surprise — each machine picks the Olivetti M-20 as the best one.

This is patently ridiculous, of course. As any half-way knowledgeable person knows, the answer was fed into the machine as part of the program and data. Computers do not think. Exactly the same answer would result from doing the calculation on the back of an envelope or with an abacus.

However, the mere fact that the advertisement is ludicrous is not the main point. What is interesting is that two of the latest micros we have seen probably beat the Olivetti on its own terms. Feed information on the Orion and Sage IV into an Olivetti, ask it to choose the best micro according to the same criteria and, in our estimation, the answer will not be Olivetti. We hereby challenge Olivetti to prove us wrong.

The Orion is tested in this issue. It is a true 16-bit 8086-based machine and runs the Benchtests on average over 50 percent faster than the speedy M20. Yet Benchtests and other trivial exercises are of little real help in choosing a computer. In the real world other criteria are far more important. Is software available? How good is the service back-up? Will all the data entered be obsolete next week when the manufacturer changes the operating system? These really important things do not seem to appeal to advertising types who want to present a dynamic, thrusting image of their machine.

Many of the same criteria also apply in the small microcomputer market. Enticing claims are often made for new micros, and often they do not live up to them. The Oric's "professional" keyboard and the Lynx's 48K RAM — but with only 14K free to Basic — are cases in point. Again, software, service and continuity are actually more important.

All those people out there making boring CP/M crates that run standard applications packages might like to know that they have our support.

5 Years ago...

"I get people coming in who are interested in writing expensive software. I want to stamp out that sort of thing—I'm writing ledger programs I want to sell for £50. Fundamentally I believe that software is overpriced but it depends on the number of copies you sell. If you have an integrated ledger at £50 you will have a hundred sales almost as a matter of course.

"We just cannot support more than a tiny fraction of the customers out there. So we try to attract programmers—not just coders but people who know business—to install systems and in some cases write applications software.

"As packages become available they will probably make their money by selling hardware we will let them have at a discount. We foresee one-man turnkey system houses.

"I'm beginning to develop a network of people on this activity—the one thing that I am trying to instil into them all is that very shortly they will be making their margins from installing systems and not from writing software."

John Burnett,
South West Technical Products.

Government patronage

RECENTLY Her Majesty's Treasury, through its subsidiary the Central Computer and Telecommunications Agency, issued a list of 12 microcomputer manufacturers or distributors from which it will purchase microcomputers on behalf of government departments. The CCTA expects to spend some £12 million with the 12 companies over the next year.

The Computer Retailers Association has considered the list supplied by the CCTA. There are some glaring exceptions and some surprising entries. However, no list is going to please everybody and there is very little point in debating whether this or that microcomputer should have been included, or why another was missed out.

The CRA, however, does take very strong exception to the manner in which the CCTA make this selection. They consider it totally inequitable that a government department should issue a list of preferred microcomputers, to the detriment of those retailers, distributors and manufacturers who were excluded from the list. From Mrs Thatcher down, the government is supposed to be helping business, particularly small ones such as a number of our members, to exist in the depression. By publicising an approved list the government will, it is true, have assisted 12 manufacturers and their retailers, but only to the detriment of hundreds of others.

By selecting 12 microcomputers out of the whole industry, the CCTA is by inference saying that these machines are better than those which they did not select, thus computer retailers who are selling the lucky chosen machines have an obvious advantage over those who are not. This appears to us to be totally unfair and inequitable.

In reply to the objection of the CRA, the CCTA state that they do not operate an "approved microcomputer list." This statement, say the CRA, is total nonsense for the following two reasons.

In getting to a short list the CCTA was supposed to have contacted every microcomputer company in England and the Continent. Those that responded were sent certain information. The procedure continued to a short list of 45 companies and from there to the ultimate short list of 29. These companies were invited to tender. The sifting process, therefore, was thorough. In other words, to all intents and purposes the entire industry was examined. To do this, the CCTA went out on what they called a "safari" which means that a number of CCTA employees travelled to the factories or head offices of the short-listed companies and examined their ability to produce and support microcomputers. This procedure took over a year and one assumes around a half dozen people. The important fact to be drawn from this first point is that the CCTA examined, and examined thoroughly, the industry as a whole.

The second important point is what the CCTA were looking for. In the heading of the relevant document, they rather carefully avoid the use of the words "specification". Instead it is called an "operational requirement". It is good that this is so because the "operational requirement" is so loose, broad and wide, that in the main it would cover pretty well any microcomputer of any standing produced in the Common Market. The one exception to this is the third of the three categories stated in the Operation Requirement document, namely the one which refers to government requirements in the scientific area. Even here, however, the net is very broad in mesh.

The first two categories are ridiculously broad. Pretty well the only substantive requirement of category 1 is that the machine should have 32K on board. Category 2 is, as the document says, required to have "more stringent requirements than category 1". This time we have to have 56K of RAM, plus a hard disc.

At very considerable expense and in a very thorough manner, the Treasury carried out an assessment of the entire industry. As a guideline for that assessment they used, to say the least, a very broad requirement. At the end of that assessment they publish a list of 12 machines, so it must follow that the lucky manufacturers of those machines, are, in the eyes of the Treasury, manufacturers of the best machines in the industry. So whether the CCTA likes it or not, they have issued an approved list. Computer retailers representing distributors and manufacturers who are not on the list are at a very considerable disability, as are their principals.

The CRA maintain that, if the CCTA wish to follow the formula which they have done, then they should have issued a very tight specification which reflected the usage of their customer government departments. It would then be available to them to say that the list is one that is approved only for their particular usage and night well not be appropriate to the general public. With such a stance, the CRA would not complain. The present method which the CCTA, for some unknown reason, like to call a competition is nothing less than the stamp of approval by a very powerful and monied government department.

A J Harding,
Computer Retailers Association Ltd,
c/o Molimerx Ltd,
Bexhill-on-Sea,
East Sussex.

● **The new CCTA list includes micros from ACT, Apple, Casu, Comart, Dec, Digital Microsystems, Future Technology, ICL, Logica VTS, Midlectron, Torch and Videcom. Casualties from the previous list are Commodore, Research Machines, Tame, Equinox, Wilkes, Zilog and BMG. The CCTA estimate 2,000 systems worth £8,000 each will be ordered in the next year.**

Gilt complex

THIS PROGRAM published on page 155 of the February 1983 issue is, of course, easily convertible to run on other machines such as the BBC Micro. However, it does contain a serious error in the arithmetic.

Line 600 multiplies the Flat Rate by the Tax Rate, whereas of course what is required is the amount left over after tax. It should read:

```
600 NY(I) = SF(I)*(100 – BT)/
100 + SG(I)
```

This gives net redemption yield in the eight percent range as expected, instead of a ridiculous three percent odd.

The VDU design in the same issue is a beauty.

A H Jones,
Wokingham,
Berkshire.

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.

Bashing Boris

WHAT A SHAME that Boris Allan's article "Axioms and assumptions" in the March issue was spoilt by his — to put it politely — unorthodox views on mathematics. His suggestion that an axiom is a self-evident proposition must have made mathematicians up and down this country cringe. His statement that

$$(A+B)+C = A + (B+C)$$

is not a self-evident truth but the associative law of addition would have had them hard-pressed to keep a straight face.

Dr Allan's own example shows the fallacy of his argument: Euclid's final axiom of his geometry concerns parallel lines. It asserts that, given a line and any point not on the line, precisely one line parallel to the original line may be drawn. It is so far from being a self-evident truth that many centuries were spent actually trying to disprove it.

Furthermore, if you replace it by a different axiom — for example, that many parallel lines, or even none at all, may be drawn through the point, we may still have a consistent

(continued on next page)

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geometry. The surface of the Earth, for example. What Boris Allan asserts to be a self-evident truth is, in fact, sometimes false.

To suggest that 1 + 1 = 2 is the "most primitive of all axioms" is quite ludicrous. You can add 1 and 1 to the two inputs of an EOr logic gate and the answer is zero. Furthermore, Dr Allan claims once again that there is no distinction between mathematical induction and scientific induction. His source for this rather astonishing statement seems to be the works of Popper — yet Popper himself draws a clear distinction between the two. In *Conjectures and Refutations* page 12, footnote 7, he writes: "This, to be valid, must of course be a syllogism of perfect or complete induction (complete enumeration of instances); and ordinary induction ... is just a weakened and invalid form of this valid syllogism."

Mathematical induction is precisely a complete enumeration of instances. Gödel's proof certainly does demonstrate the existence of theorems which can be neither proven nor disproven (and furthermore, there is no particular constructive method for determining in advance whether this is the case); it most certainly does not imply that no theorem can be proven or that no program may be correct.

I challenge Dr Allan to find fault in the totally trivial Basic program.

```
1 END
```

If he can find a computer that does not include the word End as part of its language, it is obviously not using Basic.

Carl Zetie,
Cambridge.

Boris Allan replies: Carl Zetie seems to be unable to appreciate that my views, while not the orthodoxy which suggests that truth appears out of an equation, are not that uncommon among aware mathematicians. I do not see how giving an OED definition of "axiom" means that I necessarily agree with that definition. In fact, in discussing the associative axiom I emphasise that the axiom is not a self-evident truth. In the text I quoted, the associative axiom is proved from more primitive axioms: my discussion then showed that an axiom could not be treated as self-evidently true. When I suggest, correctly, that

1 + 1 = 2

is the most primitive of all axioms, I assumed that mathematicians — and tyro mathematicians — were capable of acting like people: to see that it is contradicted by an XOr gate is to use distorting spectacles. Mr Zetie wears the same spectacles when he imagines he can completely — *completely*, note — enumerate an example of mathematical induction. All I ask is for a complete enumeration of an example of the mathematical induction that Mr Zetie knows. Carl Zetie does not understand Gödel's proof in number theory but that is too complex for a short reply. The program

```
1 END
```

is not correct, for it does not work on a ZX-81, and what sort of program is it in any case?

Induction course

IT IS NOT CLEAR who is more confused about induction, Carl Zetie — see January issue, page 7 — or Boris Allan. Mr Zetie misses out an essential step in the argument. It should be: If X has a property and we can show it for any n, if n has the property then n + 1 has the property.

Now we do not have to cast around for different meanings of the word "induction" to explain why mathematical induction works and scientific induction does not. It is merely that in the case of mathematical induction we have an effective means of moving from one number to the next. We can be sure in this case of having exhausted the possibilities. Not so with scientific induction. To say merely that "induction is induction" is to say nothing interesting at all.

K M Helme,
Cranfield,
Bedford.

MicroMark's VisiCalc

AS THE PROFESSIONAL trainer on MicroMarks's Learn VisiCalc seminar I welcome your comments on our training — One-day VisiCalc, February 1983.

Like yourself our delegates invariably appreciate the short cuts and accelerated learning resulting from a busy but enjoyable day. Perhaps is is worth mentioning that people also welcome the four opportunities for hands-on practice and the structured exercises. I have designed these to stand alone as a subsequent learning resource, even in the absence of a machine.

Lastly, could I ask you to point out that my name is Smith, not Stokes as in the article.

But then, our typical delegate gets so engrossed ....

Philip Smith,
Wargrave,
Berkshire.

BBC graphics

IN NOVEMBER 1982 issue you had an article on using the BBC Micro as a graphics terminal. I have found two mistakes in the listing. Line 150 should read:

```
150 LOOP LDA & 16:STA
    CONTROL:START COM
```

Line 180 and 215 should read:

```
LDA &56:STA CONTROL:STOP
    COM
```

I hope that this may be useful to some of your readers.

I have used your programs as a basis of connecting a BBC Model B to a Research Machine 380-Z to use it to store BBC programs. Working at 9,600 baud it is eight times faster than cassette. I would be grateful if you would consider whether you would like to write an article on this along with the software for both ends. It may be useful for many schools as the standard machines are the 380-Z and the BBC.

Martin P Cornwall,
Buckingham.

● As owners of both a 380-Z and BBC Model B we want this program too. Send it in!

Pet Rems

THE BUG encountered by R J Dowling — Feedback, July 1982 — and the reader called Let. mid$.chr$rant — Feedback October 1982 — when using their Commodore systems in the Business mode can be easily remedied. When entering Rem statements which include alphabetical characters they should enclose these in quote marks, for example:

```
5 REM "by R J Dowling"
```

This should solve the problems.

O B Walton,
High Wycombe,
Buckinghamshire.

Odd quirks

YOUR RECENT modest changes — editorial and letters at the front, small ads at the back — have improved the already excellent magazine. The presentation of the Open File pages by a contributor who clearly knows his stuff and has even taken the trouble to improve readers' listings is particularly good — although I would like to be able to get to the Tandy page with one access to the Contents page, bypassing the Open File page.

(continued on page 13)

NEW!

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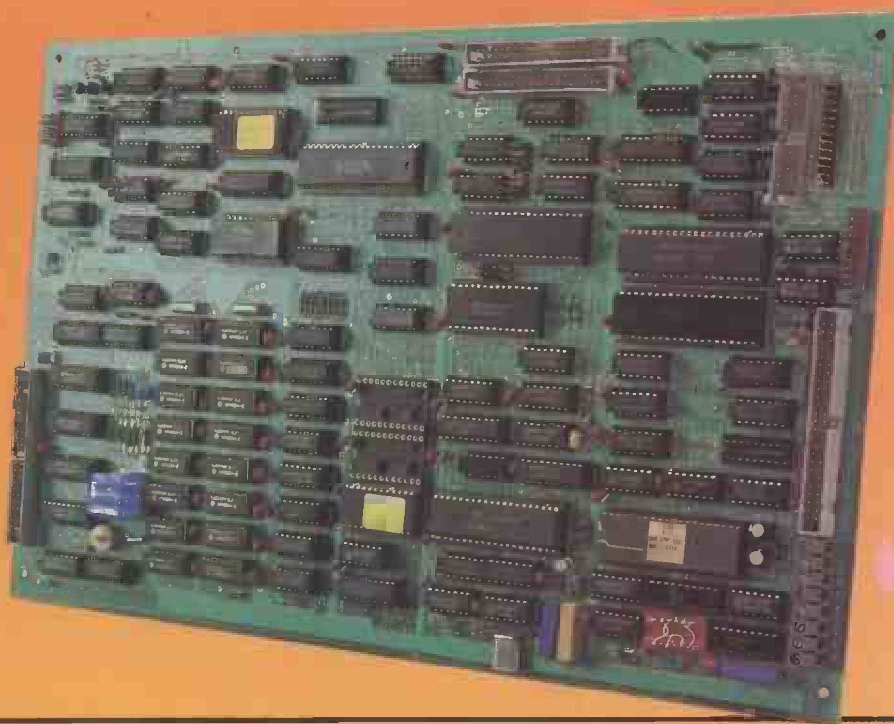

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Front

Low profile metal enclosure to house MICRONIX 80HD board, two half height 5¼" floppies (⅔ height floppies optional), a switch mode power supply for the complete system. The panels have cutouts for floppies, connectors and a fan (as illustrated). Thoughtfully constructed for easy accessibility. Cover and base grey/beige. Frame dark brown.

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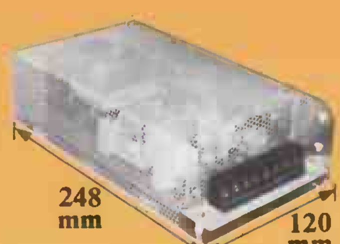

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57 PCO 0583

● Circle No. 105

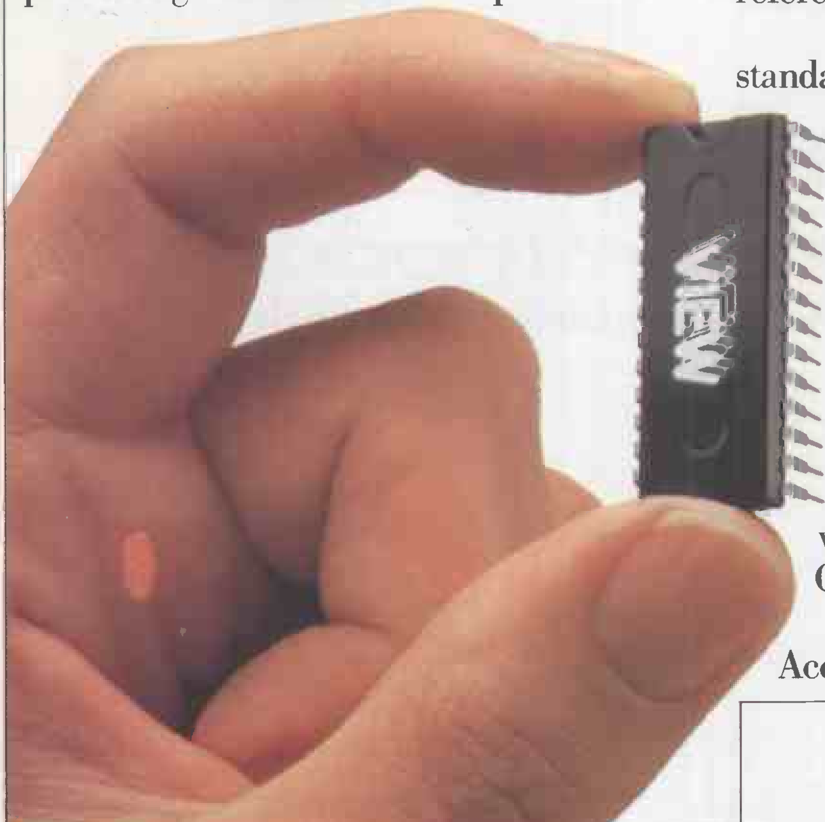
A two-minute operation turns your BBC Micro into the heart of a word processor.

VIEW is a software program from Acornsoft (the software division of Acorn Computers Ltd., who designed and built the BBC Micro) that enables you to use your BBC Micro, together with a printer, as a fully operational word processor.

View is supplied as a Rom chip that can easily be fitted to your BBC Micro by your local dealer, in a painless two-minute operation.

Then, once installed, you only have to switch on and View is operating immediately. (You can easily switch back to normal computing with a single command.)

Also included in the View package are two special books: 'Into View,' that takes you by easy stages through all the word processing commands and explains the many ways in which View can help you, and the 'View Guide,' which provides a quick reference to all View facilities.



You'll find that View is, by any standards, a thoroughly professional system, yet still surprisingly simple for the beginner to master.

The 'Spark-Jet Printer' shown in the photograph is the ideal choice of printer for your word processing application. Extremely quiet, it offers high resolution graphics from monitor or T.V. screen and is available now from dealers.

If you'd like more information, write to Acornsoft, 4a Market Hill, Cambridge CB2 3NJ.

Or, for details of your local Acornsoft dealer, phone 01-200 0200.

ACORNSOFT

● Circle No. 106

(continued from page 8)

Your hardware and software reviews are usually both practical and informative.

In the light of all this excellence, the trivial nature of the review of the Lynx in the February issue is painfully apparent. It reads as if the machine was borrowed for half a day, for three hours of which the photographers had the case off while the reviewer read the manual.

If two of the "odd quirks" of the Basic are single-character variable names and an inability to use arrays of more than one dimension "without resorting to confusing programming gymnastics", you can hardly describe it in the same breath as a sensible entry to the world of computing.

As for the comments about the keyboard, it's a bit like reviewing a car by saying it has wonderful ergonomic fingertip switches but what a pity you can't dip the lights.

Finally, thank you for the extremely clear and helpful description of the differences between eight, eight/16, and 16/32-bit concepts in the supplement.

The fiction is usually rubbish but Monkeynuts was very enjoyable rubbish. Keep up the good work, your magazine has no rivals.

Wilfred Lewsey,
Coaley,
Dursley,
Gloucestershire.

● **The Lynx review was done, as you surmise, in a hurry. As you will appreciate, micros often arrive later than expected.**

The Lynx has many annoying features, especially its failure to scroll when listing, slowness when listing or drawing graphics, and the incredibly inconvenient — not to say stupid — position of the Return key. Nonetheless our reviewer Bill Bennett says, "I stand by my review. The Lynx is good value and a machine I would like to own myself. True, there are weaknesses, but show me a micro that has none."

Illegible listings

I HAVE a BBC Micro and naturally am most appreciative of the coverage your magazine gives to this machine and its software. However, there was a listing in the March issue — BBC Sounds, pages 126-8 which was dreadful. I simply could not read it, and with computer programs it either has to be 100 percent correct or forget it.

Could you do something about this lack of print quality? This is not in umbrage. I'm still buying your monthly journal, but it would be nice not to have to write letters like this.

Many thanks for the excellent work you do in covering the micro world — and not just BBC Micro.

J F Fenlon
Dublin,
Ireland.

● **Apologies for the goof. We listed the program from a cassette supplied by the author, and it was good. We were a lot more upset than you by the final results. If you check other listings in the March issue, they should all be much better than this. Rest assured, we are continually working to improve the quality.**

Definitions

I LIKED Chris Naylor's "Monday Morning Computing" in your March issue, but surely the nicest dictionary definition of recursion is the one due to the late Stanley Gill:

RECURSION: see Recursion.

H J Gawlik,
Muir of Ord,
Ross-shire.

Commercial software

THE LETTER in the March Feedback from Mr S Zetie of Maidenhead, Berkshire initially annoyed me. For the past three years, I and a very small team have been putting together a computer system in a manufacturing company based solely on the "great toys" mentioned by Mr Zetie.

Briefly the system as it stands at the moment consists of 16 users, each having access if and when required to the same information held on a total of 96Mbyte of Winchester disc. Back-up is provided by ½in. magnetic tape. Twin floppies and a matrix printer complete the configuration.

Apart from using WordStar, SuperCalc and a couple of other ready-mades, all major systems and programming is performed by ourselves. Applications include stock control and

(continued on next page)

(continued on previous page)

auditing, schedules, shop-floor data collection, forward load, mail shots, costing, variance analysis, reps' expenses, a rudimentary materials forecast, plus a variety of other applications. The computer within Beaver's is used as a tool, just as a CNC machining centre is a tool. It is dangerous unless properly understood and used.

I now feel that Mr Zetie was in fact asking for assistance. If he would care to contact me, my colleagues and I would be delighted to show him what can be achieved with a mixture of foresight, luck, knowledge, management support and, above all, determination.

Peter Wapshott,
Beaver Machine Tool Sales Ltd,
Beaver Works,
Sweet Briar Road,
Norwich,
Norfolk NR6 5AJ.

Calculating pi

I USE an Apple II, and whenever I need pi I use

4 *ATN(1).

As far as I can tell, this is almost totally accurate for microcomputers and easy to remember and type.

R A Fairthorne — Feedback, March issue — is doing it the hard way. Dividing three odd million by one and bit million is rather cumbersome to say the least.

S Mehew,
Strathaven,
Lanarkshire

PI accurate to at least nine places is

ln10691/462

where ln is the natural logarithm.

I D Moseley,
London E6

MicroAPL

I READ with interest your supplement to the March issue of *Practical Computing* on 16-bit microcomputers.

I was disappointed that you did not mention our company, MicroAPL Limited, anywhere in your publication. We are one of the first manufacturers of 16-bit micros — our Spectrum was launched in 1981, and the first installation was in November of that year.

We at MicroAPL specialise in the application of the programming language APL to microcomputers, as our name suggests. To this end we supply five ranges of APL microcomputers. Four of them are 16-bit: the Spectrum and its portable version the Scorpion is manufactured at our Nine Elms factory in London, while Wicat and Sage ranges are U.S. manufactured.

All these systems are based on the Motorola 68000 processor, now recognised as the most powerful of the 16-bit generation. They also share a MicroAPL enhanced implementation of the APL interpreter APL.68000, which was developed in a joint project between MicroAPL and The Computer Company. Phil VanCleave author of APL.68000 and a successful eight-bit interpreter is a U.S.-based director of MicroAPL Limited.

Jan Bateman,
MicroAPL Limited,
London.

DOS writer

HAVING recovered from the excitement of seeing my first published program, DOS writer on page 14 of the March issue, I realised that some errors had appeared in the listing.

In Line 290, the –2 should be –1. The Exec file writer routine does not work correctly but I believe that it will with the following alterations. Delete Line 1200 and alter line 1210 to read:

```
1210 IF X$ = CHR$(34) THEN
     A$ = A$ + CHR$(34) +
     "; CHR$(34);" +
     CHR$(34)
```

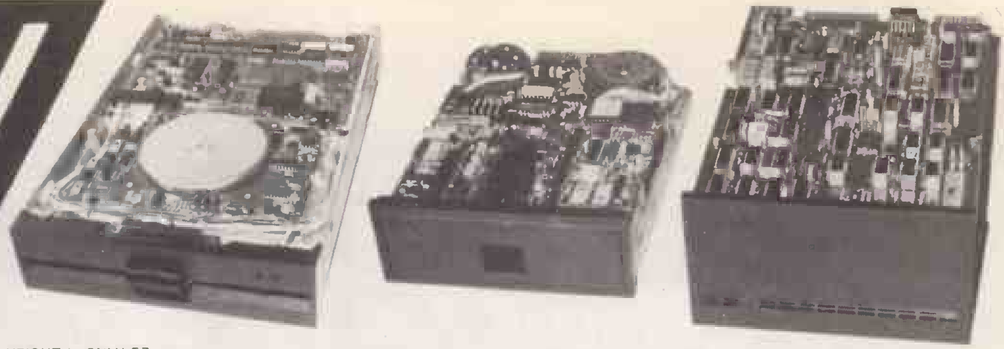
Since this program was written a new version has been produced. It provides two new routines, one to list programs on an Epson printer and one to delete the last routine written. It is also more user-friendly. I would be pleased to let anyone have a copy if they could send me a self-addressed, stamped envelope.

I regret if there is any delay in the return of the listing but I have to fight for computer time with people finishing their O-level computer projects. I also regret that I must ask for 10p for the listing, as I need to pay the school for the paper.

A Cox,
"The Gables",
Mill Place,
Scawby Brook,
Brigg,
South Humberside.

NEW FROM BASF

range of Floppy & Winchester disk drives, from official BASF distributors



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- Status indicator light on front panel.
- Industry compatible interface (Shugart).
- Well proven reliability with MTBF of 10,000 P.O.H.
- High precision positioning system: Head carriage is guided with ballbearings in precision spiral-wheel-yielding low friction and high track accuracy.

Tech: Features — BASF 6180 5¼" DRIVE
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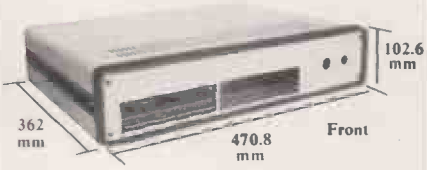

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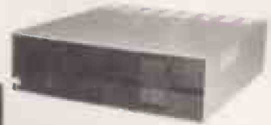

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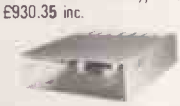

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The packages range from traditional accounts programs to sophisticated computer-aided design systems and there is a whole host of software for specific industries and professions.

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PROGRESS REPORT

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How has Comart's controlled, down to earth development strategy kept Communicator a firm favourite in the UK, and the leading candidate to reverse the tide of microcomputer imports?

New Range Additions The Communicator range has broadened to add a new 20 Megabyte 5" Winchester Hard Disk Drive System to the already well established 5 Megabyte and floppy diskette models. Another new system offers 8" floppy disk drives for compatibility of data transfer. With the associated tape and additional Winchester back up systems that adds up to eight basic models – all in the same neat, stackable, casing – all based on S100 bus construction to keep future options in memory, users, peripherals and interface requirements wide open.

New System Additions Communicator operating systems continue to broaden both in options and facilities. An improved CP/M offers enhanced diagnostics, for example, and auto boot from Hard Disk. These basic improvements are reflected in the now tried and tested Communicator multi-user MP/MII™, which also provides for full CP/M™ compatibility.

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Some things don't change Communicator still has Comart's established dealer network and nationwide after sales service back up, supporting thousands of Communicators already at work throughout the UK.

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● Circle No. 114

Commodore 64 and 8000-series spreadsheet

CALC RESULT is a three-dimensional spreadsheet program for the Commodore 64 micro which also runs on the 8000-series machines. It is capable of handling up to 32 pages divided into rows and columns like any other spreadsheet. There is a window facility to allow the parts of one page to be copied elsewhere and portions of up to four pages can be displayed on the screen at any one time.

Formulas are recorded in such a way that alteration of a value causes immediate recalculation of the whole. There is a graphics output facility as well as print formatting.

The 64 version costs £99 excluding VAT while the 8000 version is £149. For further information contact Kobra Micro Marketing, Farm Road, Henley-on-Thames, Oxfordshire.

Program copier to Apple discs

VERSION 4.0 of Copy II plus is a copying program for the Apple II micro. According to Tony Riley, managing director of the supplier Orchard Software, "if it starts with 'Visi' then our product will copy it". Apparently the package does not make any difference to software piracy as most purchasers are from large organisations and simply require a back-up copy of purchased software for their own use.

In addition to cracking various types of software protection, the package will also format new Apple discs at five times the speed of the Apple DOS master disc. The software is more than merely a bit copier, it is in fact an entire system utility offering 20 other useful routines. At the time of going to press, Orchard Software is working on a similar package for the IBM and preparing for the flak that is bound to come from the American giant.

Copy II Plus retails at £35 plus VAT and is available from Orchard Software, 17 Wigmore Street, London, W1. Telephone: 01-580 5816.

Image processor for Pet and BBC

MICROSCALE, an image-processing software package, is now available to go with Digithurst's TV camera add-on for the BBC and Commodore Pet computers. The software allows you to measure the areas and perimeters of objects or parts of objects placed before the camera.

Microscale costs £295. The camera and interface hardware unit is called Microsight and costs £495. Contact Digithurst Ltd, Leaden Hill, Orwell, Royston, Hertfordhsire SG8 5QH. Telephone: (0223) 208926.

Texas TI-99/4a Scrabble pack

SCRABBLE PLAYERS will soon be able to play against the Texas Instruments TI-99/4a. The game will cost about £30 on cartridge and TI says it will be available by the autumn.

Computer Scrabble is produced by Little Genius under licence from J W Spear and Son, maker of the manual version. The Apple version of the game was reviewed on page 134 of *Practical Computing*'s January 1983 issue. Details from TI stockists or from Texas Instruments Ltd, Manton Lane, Bedford MK41 7PA.

Better database

PSF, the long-established Apple database package, is available in a new incarnation for the IBM PC and the Apple IIe and III. PSF costs £105.

A more sophisticated report-writing add-on, PSF Report, costs an additional £92. Both packages will run on the standard, 64K IBM machine with 160K or 320K discs. More details from Personal Computers Ltd.

PSF will also run on the new Texas Instruments Professional Computer, scheduled for release this year.

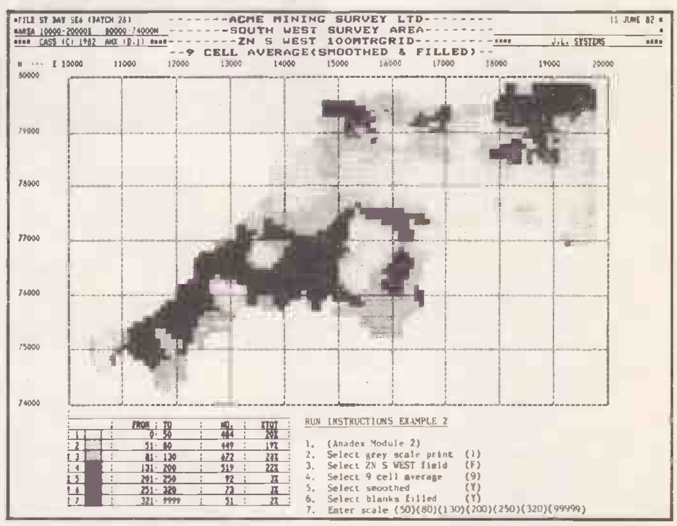
TI is known to have signed an agreement with Digital Research to supply CP/M-86 and Concurrent CP/M-86 for the machine. It looks as though Texas Instruments is at last preparing a strong contender for the business sector of the market.

Word processing and games in Audiogenic 64 range

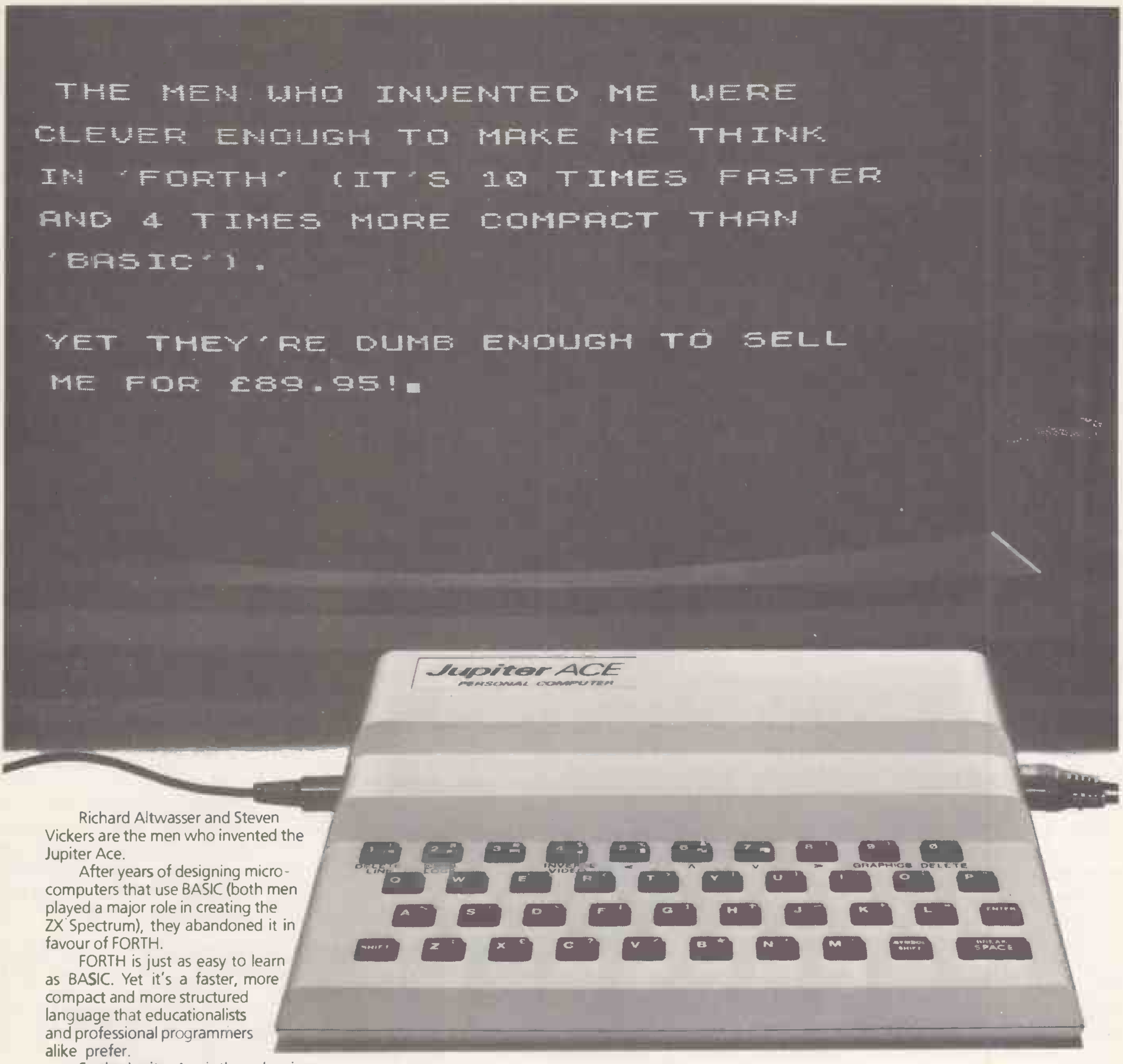
SOFTWARE 64 is a new brand label for a range of programs supplied by Audiogenic for the Commodore 64. All the products in the range will be available directly from Audiogenic or through the nationwide network of Commodore dealers. There are applications software, games and utilities in a range that covers most areas of micro-computer use.

Among the range is Wordcraft 64, a version of the Vic-20 word-processing package. A monitor program that includes a Centronics interface and an implementation of the Forth programming language are also available. The games include a chess-playing program, Grandmaster, and a version of the Othello game which Audiogenic calls Renaissance.

Further details of the Audiogenic range can be obtained directly from Audiogenic, PO Box 88, Reading, Berkshire. Telephone: (0734) 595647.



This is an example of the output from the Cass Survey System, which runs on 8000-series Commodore Pets. The system is suitable for any data that can be represented as a value for a cell of a regularly spaced grid, which means most land-survey data. It has data-averaging and smoothing routines built in, and produces output in the form of tables, histograms, grey scale maps or 1cm. squared Ordnance Survey overlays. The simplest version of the package with single fields per cell costs £275, while a more powerful version costs £875. Details from JL Systems, 17 Pydar Street, Truro, Cornwall. Telephone: (0872) 76029.



Richard Altwasser and Steven Vickers are the men who invented the Jupiter Ace.

After years of designing micro-computers that use BASIC (both men played a major role in creating the ZX Spectrum), they abandoned it in favour of FORTH.

FORTH is just as easy to learn as BASIC. Yet it's a faster, more compact and more structured language that educationalists and professional programmers alike prefer.

So the Jupiter Ace is the only micro-computer you can buy that is designed around FORTH.

Using it, there's little fear of accidentally 'crashing' programs halfway through and having to start all over again (a common fault with BASIC). The Jupiter Ace's comprehensive error checking sees to that.

The Jupiter Ace has a full-size keyboard, high resolution graphics, sound, floating point arithmetic, a fast, reliable cassette interface, 3K of RAM and a full 12 month warranty.

You get all that for £89.95. Plus a mains adaptor, all the leads needed to connect most cassette recorders and T.V.'s, a software catalogue (35 cassettes available, soon to be 50), the Jupiter Ace manual and a free demonstration cassette of 5 programs

The Jupiter Ace manual is a complete introduction to personal computing and a simple-to-follow course in FORTH, from first principles to confident programming.

Plug-on 16K and 48K memory expansions are also available, at very competitive prices. (There'll be a plug-on printer interface available soon, too.)

It'll take you no time at all to realise how clever Richard and Steven were to design the Jupiter Ace around FORTH. And even less time to realise what a silly price £89.95 is to charge for it.

Technical Information

Hardware
Z80A; 8K ROM; 3K RAM.

Keyboard
40 moving keys; auto-repeat; Caps Lock.

Screen
Memory mapped 32 col x 24 line flicker-free display upper and lower case ascii characters.

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High resolution 256 x 192 pixel user defined characters.

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Internal loudspeaker may be programmed for entire audio spectrum.

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Programs and data in compact dictionary format may be saved, verified, loaded and merged. All tape files are named. Running at 1500 baud.

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● **Circle No. 115**

Take-away from Texas Instruments

THE COMPACT COMPUTER 40 is the latest battery-powered portable micro designed for the business user. The computer has an integral LCD display and is programmable in enhanced Basic. Applications software will be provided in either plug-in solid-state cartridges or from small tape cartridges.

Peripherals for the CC-40 are also battery powered. They include RAM expansions which take the standard memory of 6K right up to 16K. Application ROM packs can consist of up to 128K. A hexbus intelligent peripheral interface connector allows attachment of other peripherals, which at present include an RS-232 interface, a printer/plotter and a digital tape drive.

The computer itself costs £169.95 and the RS-232 unit is a further £99.95. The four-colour printer/plotter is £149.95 and the Wafertape digital tape drive is £119.95. There are already 22 applications packages available, ranging in price from £34.95 to £125.95, and more are to follow.

Spectrum Centronics interface

THE ZX PRINTER may be a wonder of engineering, but is not the most polished of computer products. Now it is possible to print readable output with the ZX LPrint.

The device takes LPrint and LList output from the Spectrum and converts it to the parallel Centronics format. It can then be printed on any existing Centronics-type printer.

At around £30 plus the cost of a printer, the ZX LPrint does seem expensive. Yet it will prove invaluable to microcomputer magazines, software houses and schools, and will be a must if you already have a Centronics printer. For details contact Euroelectronics, Zlin House, Oakfield Street, Cheltenham, Gloucestershire. Telephone: (0242) 582009.

Acorn recalls defective school tape recorders

ACORN has had to withdraw 3,600 defective tape recorders sent to schools with BBC computers as part of the package subsidised by the Department of Industry.

The bug was only discovered when the first schools received their equipment at the beginning of March. If a teacher or a child pressed the Play or Rewind buttons while a program was loading, a voltage passed over the erase head and left a patch on the tape.

This was enough to render unusable the introductory software contained in the Micro-Primer. Acorn Computers, manufacturer of the BBC Micro, said it was aiming to replace all the faulty tape recorders within two weeks.

Unhappily the incident is typical of the BBC machine's teething troubles. A headmaster in Leicestershire, where the computers were distributed in the first week of March, said it was likely to further discourage teachers who had little or no previous experience of computers.

He said it would also revive criticism from primary-school teachers who had been experimenting with microcomputers in the classroom for some years. They are almost unanimous in their belief that tape drives are not appropriate for primary-school use, and that despite the extra expense disc drives should have been the order of the day.

Acorn Computers told *Practical Computing,* somewhat lamely, that the bug in the tape recorders would not have been noticed if they had been used for playing music. The recorders were manufactured in Hong Kong to Acorn's specifications.

When the teachers do finally get tape recorders that work, Micro-Primer contains some neat programs which are already receiving rave reviews from the microhackers of Leicestershire.

A 16-bit computer for £75 sound a little unlikely but here it is, the Texas Instruments TI-99/2. It is a training machine, designed to teach people how to use a computer. The no-frills TI-99/2 will interface to the same peripherals as the Compact Computer thus making it the basis of a reasonably powerful system. It has only a monochrome display and the keyboard is of the rubber moving-key type. There will be a large number of plug-in software cartridges available, featuring both games and tutorial-type programs.

BBC/Winchester link

THE NEW GSL Winchester Interface allows the BBC Model B to be interfaced to up to four 85Mbyte hard discs, providing up to 340Mbyte of on-line storage.

GSL can also supply a whole system including Model B, interface module, disc/tape controller, Quantum hard disc and Archive tape streamer for back-up.

A provisional filing system is provided to allow the disc to be filled with more than 31 files. It is being expanded and will eventually be provided as an EPROM for direct access via the BBC Micro's paged ROM facility.

Contact Geophysical Systems Ltd, 2 North Way, Andover, Hants. SP10 5AZ. Telephone: (0264) 58744.

ACT to build British

ACT, the Birmingham-based microcomputer company currently known as the importer of the Sirius computer, is to build its own microcomputer in Scotland. The new machine is to be a portable 16-bit micro weighing under 20 pounds. Project Apricot, as the machine is being called, will include the 3.5in. Sony floppy and will maintain a software compatibility with the fast-selling Sirius.

Also expected to be included in the machine is an optional 8087 processor to complement the 8086. Like the Osborne, the ACT machine will come with packaged software, probably including a word processor, and a spreadsheet program.

(More news on next page)

Apple II pared to its core

THE U-COM2 is an Apple computer minus the power supply, case, video generation, cassette interface, keyboard and Apple manufacturer's label. It is made by U-Microcomputers, and includes 2K of ROM, eight expansion slots and a game I/O socket.

Needless to say the micro costs a lot less than the Apple II. It can only be bought in large quantities, but 1,000 of them will cost £127 each. It seems that the need for the product came about because people have been buying Apple II's and pulling them to bits so that they can be used to run factories or control Meccano models of the Falkland Islands.

Naturally the U-Com2 is compatible with the Franklin Ace, the ITT 2020, Basis 108 and Pearcom computers, as well as all the others that make Apple sales managers' blood boil. For further details contact U-Microcomputers Ltd, Winstanley Industrial Estate, Long Lane, Warrington, Cheshire WA2 8PR.

New Atari boasts 64K of memory

ATARI'S new micro is the 1200XL. The best thing about it is that it is software compatible with the current 400/800 models. There are so many Atari programs that, as with the Apple II, the software base is far more important than the hardware.

The main improvement over the 800 is that the 1200 comes with 64K of RAM as standard. As the operating system, etc. still takes up the same amount of room, this does not actually increase the RAM free to Basic. However, from a marketing point of view it rubs out the Commodore 64's advantage.

The 1200 also has the GTIA graphics chip, which gives 256 colours, but this is already standard on Atari's U.K. machines.

Additional features are 12 user-definable function keys, self-diagnostic routines, Help features and additional European character sets.

The 1200 has radically different styling from the 400/800, being flat, sleek and black and white. The flat top now takes a monitor. A single cartridge slot is now fitted in the left side of the machine.

Peripherals are being produced for the 1200 in matching styling. These are the 1010 Cassette recorder, 1025 80-column printer — which is the Okidata Microline 80 — and a 40-column four-colour printer/plotter called the 1020.

The new system is not expected in the U.K. before late summer. New software for the 400, 800 and 1200 includes Family Finances, Paint, Microsoft Basic II, Donkey Kong, Superman III and a ROM-based word processor Atari Writer.

Nissei 16-bit Samurai

SAMURAI is the latest 16-bit micro to reach our shores from the Land of the Rising Sun. Manufactured by Nissei Sangyo, a subsidiary of Hitachi, the Samurai is distributed by Micro Networks Ltd.

Quality control and reliability are two of the key features of the machine. The confidence of the supplier is reflected in the year-long warranty period and the after-sales service. Should the machine fail, engineers will call on the same working day. There is a no-quibble replacement if repairs cannot be completed within 24 hours.

Applications software is already available and will run under either MS-DOS or CP/M-86. It has the now old-fashioned looking 8in. floppy drives that are still popular with Japanese manufacturers, so standard IBM-format discs can be read. It also has a high-resolution screen which can be either colour or monochrome. Memory is a standard 128K, expandable in steps up to a total of 768K. Optional extras include light-pens, Winchesters, a calendar/clock and a speech synthesiser.

A standard system costs £2,795 from Micro Networks Ltd, 382-386 Kensington High Street, London, W14 8NL. Telephone: 01-602 7405.

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Microprocessors: Concurrent 16-bit 8088 plus 8-bit 8085
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Storage Options: Up to 4 add-on Winchester drives plus streaming tape backup
Communications: 4 workstation ports (RS-422-compatible), plus 2 synchronous/asynchronous programmable RS-232 ports

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Printer: Bidirectional, 80 characters-per-second, friction and tractor feed

SOFTWARE

Operating System: User-friendly, multi-tasking, CP/M, MP/M, PC-DOS compatible
Languages: BASIC, COBOL, Pascal
Applications: Spreadsheet, Database, Text Processing Communications

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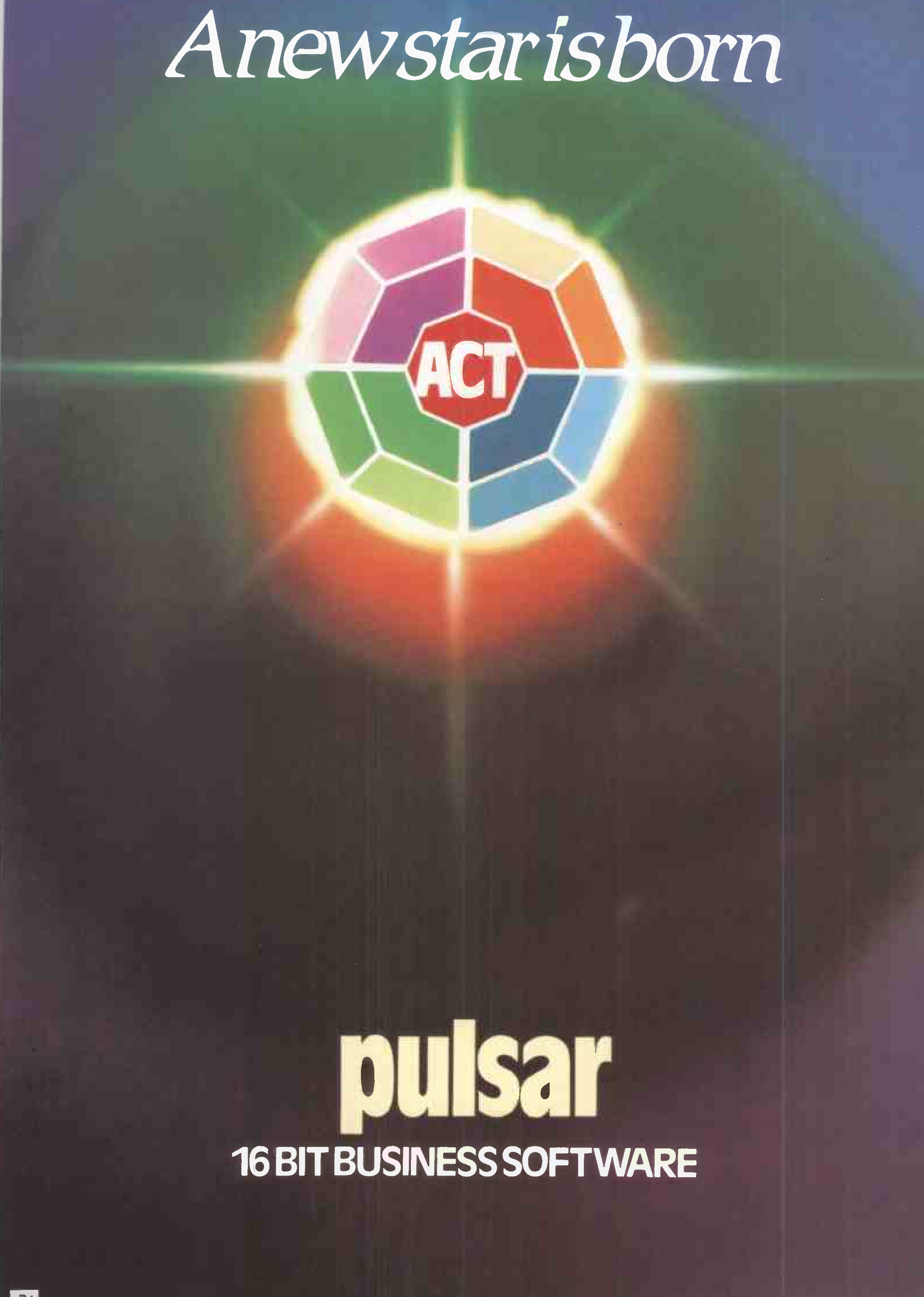
the RAIR Business Computer.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You are in command of the Federation's most powerful starship the USS Enterprise. Armed with your phasers and photon torpedoes, your task is to patrol the furthest reaches of the Galaxy, protecting Federation space against the forces of invading Klingons. Your ultimate mission is to rid the Galaxy entirely of the Klingon menace... before they destroy you. Your crew awaits you aboard the Enterprise. Starfleet Command wishes you Bon Voyage and Good Hunting!

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VisiCalc and Co now on PC

THE VISICORP programs that, reputedly, sold so many Apple IIs are now available for the IBM PC. They are VisiCalc, Desktop/Plan, VisiFile, VisiTrend/Plot, VisiSchedule and the most recent addition to the family, VisiWord.

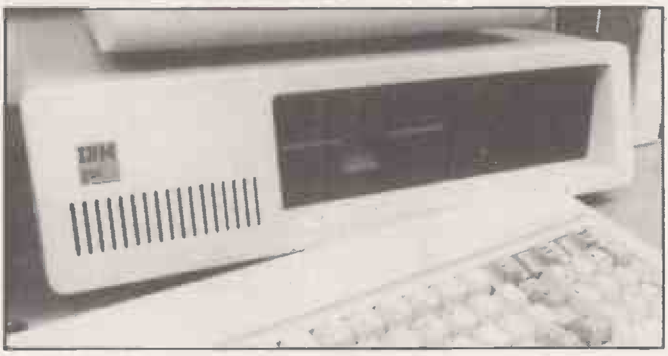
Contact Rapid Terminals, Rapid House, Denmark Street, High Wycombe, Buckinghamshire. Telephone: (0494) 26271.

CP/M-86 version

DIGITAL RESEARCH has produced an enhanced version of CP/M-86 for the IBM PC. Enhancements are a print spooler to provide background printing, GSX graphics extensions, and device drivers for popular printers, plotters and cards. The U.S. price is $60.

Contact Digital Research, Oxford House, Oxford Street, Newbury, Berkshire. Telephone: (0635) 35304.

Go-faster PC announced



THE NEW IBM Personal Computer XT is an expanded version of the PC with one of the floppy drives replaced by a 10Mbyte hard disc. The XT also features 128K of RAM as standard, a communications adaptor and eight expansion slots.

Naturally, the 40K of ROM includes an enhanced BIOS to support the hard disc. The DOS is the long-awaited version 2.0 with piping and other facilities that will permit an eventual upgrade to Unix.

The one thing the XT lacks is "go faster" stripes to indicate how much quicker it will run applications packages in practice. IBM's price for the XT is £4,858 plus VAT. The new MS-DOS 2.0 costs £51 plus VAT.

An existing PC can be ugraded to XT level by the addition of an expansion box. Contact IBM United Kingdom Ltd, Baltic House, North Harbour, Portsmouth PO6 3AU.

Chatterbox Aeon and Omninet networks

TWO COMPANIES have announced networking for the IBM PC. Chatterbox Computers has launched Aeon, which stands for advanced electronic office network. A Chatterbox card is slotted into the expansion bus of each PC on the network, and the network is controlled from a 40Mbyte, 80Mbyte or 160Mbyte hard disc.

Each PC can run a different operating system, and the network provides password-file protection. Contact Chatterbox Computers Ltd, Whitechapel Technology Centre, 75 Whitechapel Road, London E1. Telephone 01-377 9341.

Newly appointed IBM dealer Keen Computers can now offer the Corvus Omninet network for the IBM PC. The system is already familiar on Apple and other networks. The system uses a Corvus hard disc. Contact Keen Computers by telephoning 01-236 5325.

All-in-one Lotus

LOTUS 123 is one of the new generation of integrated software packages being launched to compete with Apple's Lisa and VisiOn, when that eventually appears. 123 integrates graphics, spreadsheet analysis, simple text editing and filing in a single package. The same data and a similar command set can be used for each task.

Lotus 123 requires a PC with at least 128K and the 320K disc drives, plus MS-DOS. As a party trick, it can drive a colour monitor through the IBM colour card at the same time as a monochrome screen. Colour graphics can be shown on the monitor while the spreadsheet used to generate them is shown on the mono screen.

123 will read dBase II and VisiCalc Dif files, and costs £349. It was written by Mitchell Kapor, president and founder of Lotus, who created VisiPlot and VisiTrend for VisiCorp.

Contact the Personal Computers Ltd office at 220-226 Bishopsgate, London EC2M 4JS. Telephone: 01-377 1200.

Doxiver add-ons

THE PC can be networked using PCNet distributed bustechnology. The hardware is a single-slot adaptor board, and software is provided as an interface to MS-DOS. This provides for disc sharing, file locking and multi-tasking.

Other add-ons being distributed by Doxiver include the Orchid monochrome Graphics adaptor, the Persyst Spectrum range of multi-function boards, the Omni board, and the Santa Clara series of removable Winchester hard disc. Software includes a print spooler called Wait-less printing, and the PC-Edit full-screen editor.

For further details contact Doxiver Ltd, Six Acre House, Town Square, Sale, Manchester M33 1XZ. Telephone: 061-962 9418.

(More IBM news on page 31)

Daisy gives you the answer

DAISY is a dairy information system which runs on the IBM PC, and various other micros, under MPSL's BOS operating system. It will give you an answer if you ask it about milk yield, quality deficiencies, feeding plans, health and fertility, etc. Daisy is written in Microcobol and handles up to 700 cows.

Contact the Department of Agriculture and Horticulture, University of Reading. Telephone: (0734) 85123. Or contact MPSL, 87-89 Saffron Hill, London EC1N 8QU. Telephone: 01-831 8811.

Maintenance country-wide

CDS OFFERS an independent field-maintenance service for the IBM PC—and the Apple II and Sirius micros—over most of the U.K. CDS guarantees a response within 24 hours, but boasts an average of only four hours. Annual cost is about 10 percent of equipment price.

CDS has been in business over 10 years and services over 2,500 accounts. Contact Commercial Data Systems Ltd, Downham Road, Ramsden Heath, Billericay, Essex CM11 1PU. Telephone: (0268) 710292.

More games from Pete & Pam

PETE & PAM is now importing more games for the IBM PC. Three are Space Strike from Datamost, Pig Pen from Datamost, and Ulysses and The Golden Fleece from Sierra Online. Pig Pen is a maze game. Ulysses is an adventure game, but whatever happened to Jason?

Two come from Insoft of Portand, Oregon. Called Quotrix and Wordtrix, both are word-games which should appeal to crossword-puzzle types. Each costs £19.95.

Contact Pete & Pam Computers, New Hall Hey Road, Rossendale, Lancashire BB4 6JG. Telephone: (0706) 227011.

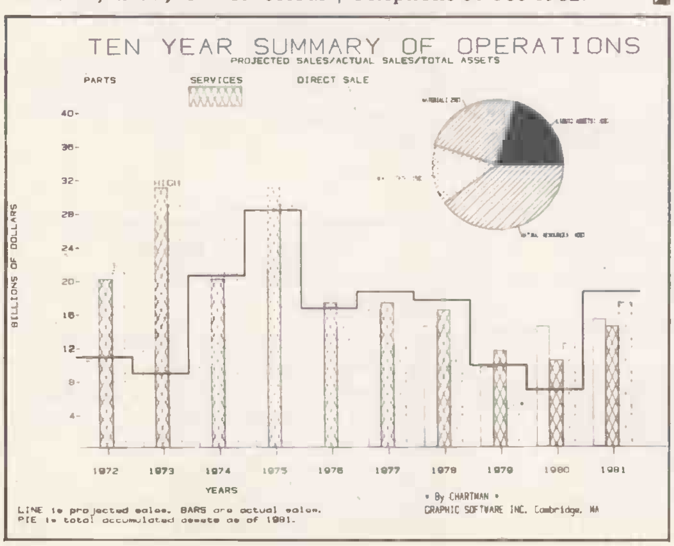
APL * Plus and Codewriter

APL*PLUS is now available for the IBM PC as well as IBM mainframes. It requires at least 128K of RAM and one disc drive. The price is £600. Contact APL*Plus Ltd, 1-2 Henrietta Street, London WC2. Telephone: 01-240 5765.

The Codewriter program generator costs £249 for the IBM PC. Contact Dynatech Microsoftware, Summerfield House, Summerfield Road, Vale, Guernsey. Telephone: (0481) 45934.

Chartman business graphics

CHARTMAN is a business-graphics package available from IBM PC dealer Bonsai in two versions: for monochrome plotting on Epson printers plus Graftrax, £295; or for colour printing on IDS Prism colour printers and IBM XY-7500 plotters at £395. Contact Bonsai, 112-116 New Oxford Street, London WC1 1HJ. Telephone 01-580 0902.



Diary dates 1983

APRIL 14—16

Fourth London Computer Fair
Sponsored by the GLC and run by the Association of London Computer Clubs. Central Hall, Westminster. Contact Barry Goddard, 55 The Chine, Grange Park, London N21 2EE. Telephone: 01-360 0021.

APRIL 28—30

The Midland Computer Fair
Organised by *Practical Computing* and *Your Computer*. Personal computers, home computers and small business systems. Bingley Hall, Birmingham. Contact IPC Exhibitions Ltd, Surrey House, Throwley Way, Sutton, Surrey SM1 4QQ. Telephone: 01-643 8040.

MAY 10—12

Micro City '83
Computing, word processing, business systems and communications. Bristol Exhibition Complex. Contact Stephen Hybs, Tomorrow's World Exhibition, 9 Park Place, Clifton, Bristol BS8 1JP. Telephone: (0272) 292156.

MAY 10—12

RIBA Computer Conference and Exhibition
Royal Institute of British Architects' own computer show. Bloomsbury Crest Hotel, Coram Street, Russell Square, London WC1. For conference contact Sheena Parsons on 01-580 5533 ext.237; for exhibition contact Jo Hunting on 01-580 5533 ext. 250

MAY 24—27

IWIPEC '83
International Word and Information Processing Exhibition and Conference. Wembley Conference Centre, London. Contact Carl Byoir Associates Ltd, 11a West Halkin Street, London SW1X 8JL. Telephone: 01-235 7040.

MAY 24—26

Computers in the City
Conference sponsored by the Stock Exchange. Barbican Centre, London. Contact Online Conferences Ltd, Argyle House, Joel Street, Northwood Hills, Middlesex HA6 1TS. Telephone (09274) 28211.

JUNE 3—5

Apple '83
National Apple Exhibition and Convention. Fulcrum Centre, Slough, Berkshire. Contact Val Seddon on 061-456 8383 (day) or 061-442 0189 (night).

JUNE 7—8

Fluid engineering
International conference on the use of micros in fluid engineering. Tara Hotel, London. Contact Micros in Fluids Engineering, BHRA Fluid Engineering, Cranfield, Bedford MK43 0AJ. Telephone: (0234) 750422.

JUNE 16—19

The Computer Fair
Organised by *Practical Computing* and *Your Computer*. Personal computers, home computing and small business systems. Earls Court, London. Contact IPC Exhibitions Ltd, Surrey House, Throwley Way, Sutton Surrey, SM1 4QQ. Telephone: 01-643 8040.

JUNE 21—23

Compec North
Mainly for business buyers. Belle Vue, Manchester. Contact Tracey Cannon, IPC Exhibitions Ltd, Surrey House, Throwley Way, Sutton, Surrey SM1 4QQ. Telephone: 01-643 8040.

JUNE 27—29

Videotex '83
Europe-wide conference. RAI Centre, Amsterdam, The Netherlands. Contact Online Conferences Ltd, Argyle House, Joel Street, Northwoods Hills, Middlesex HA6 1TS. Telephone: (09274) 28211

JULY 6—8

Microtrade
Hardware and software for the micro trade only. Barbican Centre, London. Contact Tim Collins, Montebuild, 11 Manchester Square, London W1. Telephone: 01-486 1951.

AUGUST 14—17

Digicon '83
International Conference on the Digital Arts. Vancouver, Canada. Contact Computer Science, Centre for Continuing Education, University of British Columbia, 5997 Iona Drive, Vancouver, BC, Canada V6T 2A4.

AUGUST 25—28

Acorn Computer Shows
Fun show with emphasis on family and educational computing. Coincides with the launch of the Electron. Cunard International Hotel, Hammersmith, London W6. Contact Susan Phipps, Computer Marketplace Ltd, 20 Orange Street, London, WC2H 7ED. Telephone: 01-930 1612.

OCTOBER 4—7

European Computer Trade Forum 1983
For volume buyers and sellers. National Exhibition Centre, Birmingham. Contact Aubrey Irwin, Clapp and Poliak, 232 Acton Lane, London W4 5DL. Telephone: 01-747 3131.

OCTOBER 10—13

INFO 1983
The 10th international information management exposition and conference. New York, USA. Contact Tony May, Marketing Manager, Clapp and Poliak, Unit 20, Erdington Industrial Park, Chester Road, Erdington, Birmingham B24 ORD. Telephone: 021-384 3384.

Critical review?

"The sound commands on the Oric 1 are, for a computer of this price, very sophisticated. Three music channels, and one noise channel, mean that you can program some fairly complex sounds."
POPULAR COMPUTING WEEKLY

"Oric is everything you hoped it would be. Alive with colour, and zapping with built-in sound effects, the Oric looks like a match for any machine now selling for less than £200"
YOUR COMPUTER

"The 16k Oric – fighting the 16k Spectrum – is £25 cheaper. It feels a good deal more 'professional' than the home-appeal Sinclair. Oric's sound is extremely versatile, and well up to the standard of the £300 or £400 BBC microcomputer made by Acorn."
WHICH MICRO?

"Oric was over twice as fast as the Spectrum. Surprisingly perhaps the Oric, which initially seemed only faster when performing the simplest of calculations, has come back to beat the Spectrum by a small amount. As the problems get more complex the Oric comes into its own. One final point – in entering the benchmark tests – the Oric was certainly the easiest to handle."
WHICH MICRO?

"This slope coupled with the design of the keys makes the Oric an easy machine to touch-type on. All keys have auto-repeat and there are four keys dedicated specifically to cursor control. It is certainly easier to type on than any of Sinclair's offerings."
YOUR COMPUTER

"Oric will soon be selling a Modem so that Prestel will become available. Owners will be able to accept telesoftware – programs loaded straight down the phone line – eventually electronic mail could come into the home by the same route, and with the addition of a tape recorder the Oric with its Modem could become a telephone answerer and message taker."
YOUR COMPUTER

"One good feature of the Oric is an on-screen reminder in the top right hand corner to show that you've engaged all-capitals mode. So much better than the BB's variety of lights in the corner of the keyboard. The Oric is sound, simple to get along with and offers great expansion potential."
WHICH MICRO?

"When compared to the stogginess of the Spectrum's keyboard this is certainly an improvement. I can't see any Orics failing through bad assembly. If only the £2400 IBM were so easy to use."
WHICH MICRO?

"Instead of the Spectrum's 28 look-up single-character error reports, the Oric has 18 self-explanatory messages. If you actually want to do computing, rather than just exploring the world of off-the-shelf games programme entertainment the Oric will be a better buy."
WHICH MICRO?

"A good speaker and built-in noises get the Oric's sound off to a good start. Typing Zap, Ping, Shoot or Explode produces convincing arcade game noises which can easily be incorporated into any program."
YOUR COMPUTER

"The modem is certainly unusual in a machine of this price. Together with the other peripherals, when finally available, it should make for an attractive package for a small business... surely a match for machines costing much more"
POPULAR COMPUTING WEEKLY

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COMPUTECH GRAPHICS DISK	
for printing Apple pictures and graphs on Epson and Microline (free with printers purchased from Computech)	£30
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● Circle No. 124

You'll be seeing less of Rodime

Chris Bidmead witnesses a product that lives up to its marketing promises.

A TENTH OF A THOU below the manganese zinc ferrite head, the dead flat oxide face of the rotating rigid metal plate spins by at 20 miles an hour. The case is sealed — nothing must be breathed from the atmosphere outside. The head aeroplanes on a tenuous buffer of air sucked round by the disc, reading the bits as they flash by, 11,000 of them to the inch. The tiniest particle of dust could tumble it out of orbit to plough up the disc surface irremediably.

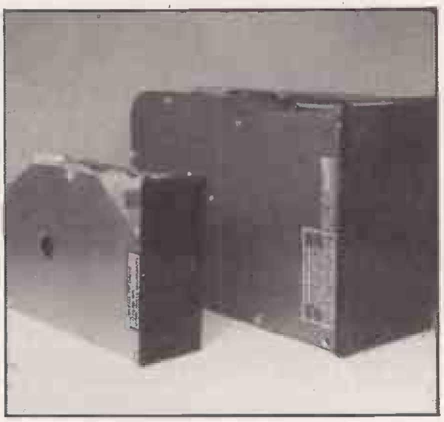
Life inside a Winchester disc is a rigorous business, I thought, turning the gasketed and riveted metal container over in my hand. I put it back on the table, to which the dinner-jacketed waiters were already returning with silver plates piled high with rare roast beef, vol-au-vents, salad and paté. The Crystal Palace Room of the Hilton Hotel, Park Lane was beginning to take on a distinct atmosphere of lunch.

Technological journalism has its moments and this, as I ineffectually refused my second glass of wine, was one of them. Another had come half an hour earlier in the lecture room next door. The marketing director was in mid-flow, saying the sort of things you expect from marketing directors, "advanced design features, first manufacturer in the field to build a double-capacity drive, reputation for reliability". The usual modest overstatements of marketese. But something had made my hair stand on end, a sudden gut feeling that this Crystal Palace Suite was the dead centre of the known universe.

The trigger for this unhingeing sensation was the growing realisation that in this instance everything Malcolm Dudstone was telling the gathered pressmen was no less than the exact truth. I know of Rodime's remarkable performance on the New York Stock Exchange — last September it went to the over-the-counter market to ask for $8 million to put its production into overdrive. Rodime got it, and the lenders have seen their share value double in six months.

I know the way the product has been selling. The hard disc market is dominated by United States manufacturers with Seagate and Tandon in the lead. Rodime is British based in Scotland. It launched its first drive towards the end of 1980, and a year later had sold £57,000 worth. The year after that turnover was £4 million. Independent projections confidently expect sales of around £2.5 billion by 1988.

I have some first-hand knowledge in the matter too. I have been using a 6 Mbyte Rodime drive for a year now, day in day out, to write articles, television scripts and a couple of books. The technology has literally changed my approach to work. The fast response time of the hard disc lets me use sophisticated word-processing software built around virtual-memory techniques that would be too slow for comfort on floppies.



Rodime's RO-350 3.5in. Winchester weighs just 2.2lb.

I still find it a cause for wonderment that six fast megabytes can be crammed into an opening designed to take a 500K mini-floppy drive. But Rodime is not pausing while I catch my breath. In the past year it has kept the wagon rolling, and is currently fitting 40Mbyte into the same slot. None of this is frontiers-of-science stuff, you understand. It is all solid, conservative engineering that can be churned out on a production line. It has to be — it has sold 20,000 of the things so far, more than half of them to the US.

All very impressive, but Rodime was not buying us this expensive lunch just to look back on past achievements. The new product we were gathered around is not something you are going to see for a month or two. When it reaches production volume towards the end of this year, I give you my word, it is going to have more impact on the market than any highly hyped 16-bit chip.

If you thought the 5.25in. Winchester was a miracle of miniaturisation, take a look at this. It is half as high and half as wide — that is a quarter of the size. Picture a Sony Walkman, think of it as being able to contain the equivalent of 21 full-length novels, and imagine accessing any word in any of these novels within 85 milliseconds. Rodime calls it the 350, because it is designed to fit on to the same slot as the new generation of 3.5in. mini-floppies.

According to Dr. Norman White, the Director of Engineering there was so much untapped capability in the standard Rodime technology that the problem was not squeezing down the dimensions so much as deciding what precisely those dimensions should be. While it is nice to be the first in the market with a new standard, it is not so nice to be first and last. Rodime was very concerned to lay down a track that others will be happy to follow.

The electronic and power interface is taken care of. A standard has already been established for 5.25in. drives, and there is no engineering reason why the same standard should not apply to the new size.

Two of the dimensions were easy to settle. For the purpose of discussion imagine the drive as being mounted horizontally, with the plane of its platters parallel with the ground. Make the height half the height of the standard 5.25in. device and you can package the same drive for sale as a half-height mini-winnie. Make the depth exactly the same as the existing mini-winnie width and you can put two of them side by side, or sell a single drive as standard size with its own built-in disc controller card.

What makes the third dimension tricky is the lack of standard among so-called 3.5in. floppies. The Sony drives are one size, everybody else's will be another. Rodime plumped for a width of 4in., which is the width of the fascia mounting for all the non-Sony drives.

Portable computers are the obvious initial market for the new device, and it is not just a matter of size. The 350s are 50 percent lighter and need less than half the power of the bigger drives. The first generation of 5.25in. mini-winnies had to have their actuators and platters physically bolted down before they could be moved. Nowadays most Winchesters handle this automatically when you switch off. The 350s are endowed with a special shock mounting designed for portable use.

Rodime was cagey about how much the devices will cost, but promised they would be competitive. If you take that to mean comparable byte for byte with current prices you can reckon on a hundred-up OEM price of around £500 for the 10Mbyte version, £400 for the 5Mbyte — or you could just buy Rodime shares.

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You might have two files whose records are directly related to each other, so that the first file (say containing names and addresses) refers to the second file (say financial and other information relating to the same record numbers in the first file) directly. Then you can simply select that in file 1 you are interested in just the name and telephone numbers, whereas in file two, you are interested in the income, trading period and number of branches, information. Your enquiry can then pass through both files highlighting that information only, rather like the display below.

File 1 record 1	G.W. Computers	01-636 8210		
File 2 record 1	800,000		5 years	1
File 1 record 2	Lloyds Bank	01-123 4567		
File 2 record 2	1000,000,000,00		100 years	500
File 1 record 3	Selfridges	01-631 4818		
File 2 record 3	100,000,000		98 years	1
File 1 record 4	Debenhams	01-636 1234		
File 2 record 4	120,000,000,00		50 years	50

Actually there doesn't need to be a strict correlation between the same record numbers in different files, and you can also on just one JUMP command go to any record in any of the 32000 records in any of the twelve files and carry on cross-referencing from there onwards. Do you see that? Only from G.W. Computers Ltd. The database leaders.

ONE OF THOUSANDS OF DIFFERENT TASKS ON WHICH THIS PROGRAM MIGHT BE EMPLOYED

DBMS'S MACROS WORK FROM THE MOMENT YOU INSERT THE 'TASK DISK' IN THE COMPUTER

Simply design your file, give its fields your words, setup your report mask, and then enter your records. Switch to 'automatic drive' and formulated any task you wish to program to fulfill, the task is stored as a macro. Take a copy of the program on another 'task disk' and from then on, the task disk will function without a single key-stroke. Think of a number of such 'task disks' such as "stock-re-order reports"; "stock-valuation reports"; "analysis"; "patient history analysis"; "research-analysis"; "budgetting-analysis"; "vehicle-location control"; "librarian analysis"; "plus more?"

Previous issues showed examples of 'employees-short-list', 'garage stock re-order', 'sales analysis', 'librarian's report', 'hospital's patient list'

Here is an example of a 'rental file' and a report it might generate.

The record may look like this:
1-record number (413)
2-client (Radio cars ltd)
3-date of contract (01.04.81)
4-date last pmt (12 02.82)
5-period/frequency (36 / monthly)
7-amount of pmt (22.50)
8-Item type (Taxi-phones)
9-repairs made (faulty microphone — Item replaced)
10 cross reference (3.422!C details of full system spec and supplier)

One report might be: select ?? all records where the amount of payments are less than 50 pounds, that were taxi-phones and faults were detected. When found, pick up the cross reference code and look up that record to identify the supplier.

Another report might be. select ?? all records in the file where the commencing date of rental was 04.81 and the term was greater than 12 months. Print a list of all those records where the date last payment was prior to (ie smaller than) 03.82 and prepare a short address file for 'reminders'.

DBMS II (WITHOUT MACROS) AND DBMS III ARE FULLY IMPLEMENTED UNDER CPM-86 (tm) and MS-DOS (tm) ie: (SIRIUS/VICTOR/IBM)
DBMS II IS 395.00 (or 250.00 by mail order ex. training). DBMS III is 575.00 (or 295.00 by mail order ex. training)

NOTE: Corvus drives with multiplexor may network sirius.. Superbrain.. Concept.. PET.. Victor.. IBM..

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	·Compustar 64K RAM/320K disks	1995.00
	·Compustar 64K RAM/700K disks	2495.00
NORTHSTAR	·Advantage 64K RAM/700K disks	£2195.00
(exc DOS)	·Advantage 64K RAM/5.3M disks	£3095.00
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	·Sirius 3 128K/10MEG disks	£3995.00
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CORVUS	Concept 16 bit pc	call.00
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mbasic 80	diagnostics	msort/dsort
recover	autoload	instant basic
cbasic	disk/games	library case

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Based on 8 bit hardware, 16 bit software varies.

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	·Microline 82A	395.00
	·Microline 83	695.00
	·Microline 84	895.00
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	·DP 9501	1045.00
	·DP 9501 (A)	1145.00
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RICOH	·RP1600	1495.00
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NOTE: Corvus drives with multiplexor may network sirius.. Superbrain.. Concept.. PET.. Victor.. IBM

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G.W.L.	·BUS V8.00 (Accounts)	275.00
	·DBMS II (Database)	£395.00
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Software formats on all micros in our hardware list.
All prices marked £ are available 8/16 bit formats.

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G80/86 SOFTWARE

Fully implemented on MS-DOS, CPM 2.2 and CPM 86 (tm)

Works on IBM, Sirius and Victor 9000 and all micro-computers in our price list
Requires the prior acquisition of DBMS 111.7

Sales ledger (95 pounds)
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Nominal ledger (95 pounds)
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The address mailer (95.pounds)
Qasort/Qnsort (500 records/15 seconds) (95 pounds)

Each module is a set of 'task disks' designed for minimal learning curve. This software derives from modules of 'DBMS III' and runs reports without your secretary having to touch a single key

Consider the advantages in these features
The user manual is contained in FIVE pages.
All reports are generated by robot functions
Reliability tested (benchtest PCW June)
Works in a network multi-user environment
Fast easy data entry
Files are re-organised and sorted automatically
Produced by the same people that originated 'BUSiness' 'DBMS II', 'DB-CALC', 'AUTOLOAD AND RECOVER' 'ETC' and sold successfully over the past five years
Also see our advertisement next page.

The G80/86 networks

Based upon one hard disk and multiplexor module the G80/86 networks feature full network sharing of data resources by adding different stations that may be as various as Sirius/Victor 9000f/IBM/Superbrain/Pet/N'star/Sanyo
We also have a special 'spooler module' as well as software controllable port expanders and modems for output to telephones, printers, and screens so that a number of terminals may share the resources of one printer, as well as be able to send files over the telephone at any time (day/night) to both store on the hard disk and print out as well.

only from G.W. Computers (the leaders in database)
call us on 01-636-8210 or 01-631-4818 and leave your address for our standard 'infopacks'

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Contains the highest state of the art software available today

ALL IN ONE PROGRAM
THE DBMS IV @ 575.00

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The list is endless and the outlay several thousands of pounds.

Features.	Design a form as wide as a window of 250 characters, long as needed. Cursor movements are 'left, right, up, down, delete left delete right, tab right-left-up-down' Paint your form as you like directly on the screen.
Text......	Write a letter as you see it on the screen, edit it then simply enter ^P to print.
Calc......	Set into the form, your data fields, "££££££" and specific file-related activities, formulae and validation checks. Enter values and see the spreadsheet calculate itself.
Database.	Search files for data to be inserted to fields specified. All the features of DBMS III, explained elsewhere in our ad.

Here's an example of an invoice you might design for your stationery ......
You could design your own spreadsheet, order form, statement, or any other kind of form that is required to fit your existing stationery.

< 0 >££££££££££££ INVOICE

To £< 1 >£££££££££££
£< 2 >££££££££££££££££
£< 3 >££££££££££££££££
£< 4 >£££££££££££
£< 5 >££££££

From: G.W. Ltd
55 Bedford Court Mans.
Bedford Avenue
London W.C.1.
Tel: 01-636 8210

Date < 6 >££.££ Tax point < 7 >££.££ Agent < 8 >£££

Quantity	Description	Cost	Tax	Total
< 9 >£££	< 10>£££££££££££££	< 11>££	££	< 13>£££
< 14>££	< 15>£££££££££££££	< 16>££	< 17>££	
				< 18>£££

and so on ......

Total......< 19 >££££££ Tax......< 20>££££

<??> items < 1 >to < 5 >internal command to request name input, and then search an address file for details.
<??> items < 6 >to < 7 >request date input and validate.
<??> item < 8 >request agent number and validate range.
<??> < 9 >request quantity, validate range.
<??> < 10>request description, search file, accept, and calculate fields < 11 >, < 12 >, < 13 >, if finished invoice then calculate fields < 19 > and < 20 >

Now comes the more valuable facility, you can provide the 'FORM' with file-related instructions, not only to request a 'console' input for a file search against names, and stock, but after the invoice is finished the fields you have selected may be passed to related files.
EG: Send fields < 0 >, < 1 >, < 6 >, < 7 >, < 11 >, < 12 >, < 13 >, < 19 >, < 20 > to a sales ledger.
Then send fields < 9 >, < 10 >, < 11 >, to product analysis file.
Then send fields < 0 >, < 1 >, < 7 >, < 19 >, < 20 > to V.A.T. file
Then send fields < 10 >, < 11 >, < 12 >, < 13 > to Nominal ledger.

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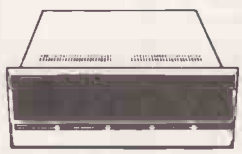
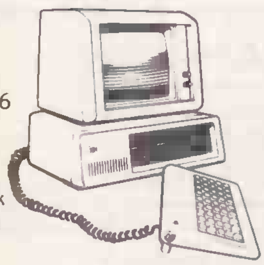
16 Bit Stand Alone Micro with superb features. 128K, 1.2MB Floppies CPM86 as standard – £2395



Altos
Up to 4 terminals and 40MB of Winchester Disk. One of the biggest selling small business systems starting at £2200
16 Bit system with 8 terminals available.



IBM Personal Computer
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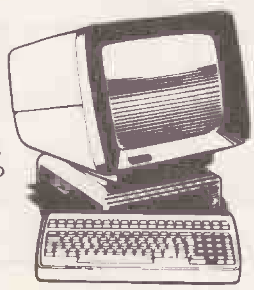
From £2515



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Incomplete records and time recording systems.

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Enables a micro-computer to act like a mainframe terminal and transfer data from Floppy disc to another computer.

Languages – From £150.
Most major computer languages are available: Basic. Cobol, Fortran, Pascal and Assembler.

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● Circle No. 130

The 44 million chip question

ALTHOUGH Texas Instruments was first on the scene with a 16-bit microprocessor, its 9900 introduced in 1976 did not take off in the big way that had been hoped. It certainly found its way into many up-market control systems, but its relatively low performance and its high cost persuaded personal-computer designers to stay with eight-bit devices like the 6502 and the Z-80 until the competition had time to catch up and introduce 16-bit devices of their own.

The Intel 8086 and the Motorola 68000 families, both very popular choices for the new generation of 16-bit microcomputers, make the 9900 look like a seven-stone weakling. Even the introduction of newer 9900 versions such as the 9980 and the 9995 have done little to stem the tide.

Still confident that it has the right basic chip architecture however, Texas is not giving up, and has now introduced a powerful new group of 16-bit processors called — you guessed it — the 99000 family. The 9900 had some nice features, such as its unique memory-to-memory architecture which put all the registers in external RAM memory. The 99000 family remains faithful to that basic design, which it also shares with the 990 series of minicomputers. To enable the new devices to compete with the muscle-bound competition from Intel and Motorola, however, Texas has added a lot of new bells and whistles.

One particularly useful feature of the new 99000 family is the provision of an on-chip macrostore memory area which can be programmed during manufacture with the code for additional instructions emulated in software. The processor normally executes any program in the conventional fetch-execute fashion common to all microprocessors, but when it encounters a macro instruction detect, MID, op code it saves the processor status and branches to an appropriate routine stored in the 1K macrostore ROM.

Since the macrostore memory has a very fast access time, the macro instructions stored there execute at high speed with no wait states. To the programmer, these macro instructions appear to be just an extension to the normal instruction set, but because they are performed by complete software routines, the new instructions can implement high-level functions not otherwise available on a microprocessor.

If you speak nicely to the people at Texas and promise to buy 99000s a few thousand at a time, no doubt they will put your very own macro instructions in the 99000 macrostore. If you cannot see yourself adopting that strategy, you will have to make do with one of the standard options, like the 99110.

The 99110 is a 99000 processor with the attractive advantage of a set of 12 floating-point arithmetic instructions added to the standard set of 84 conventional op codes. They confer the ability to perform directly 32-bit floating-point addition, subtraction, multiplication and division, along with all the associated loading, storing, conversion and comparison functions.

Everyone will agree that a 16-bit processor with built-in floating-point number crunching is a nice idea. Yet it is only software after all, and didn't you read somewhere that Intel has a co-processor chip for the 8086 which does all that really fast, the 8087?

True enough, you have a choice. Use either the low-cost but somewhat slower Texas approach, or the rather expensive but more capable two-chip approach from Intel and others.

Texas may have been disappointed by sales of the 9900 16-bit processor, but that was offset to a large extent by the amazing success of the rudimentary TMS-1000 four-bit single-chip device which, because of its low cost and simplicity, has become by far the most common microprocessor in the world. The TMS-1000 is used in toys, games, doorbells, washing machines and many similar appliances where its primitive calculator-style architecture is less important than its very low cost and availability: 44,000,000 TMS-1000 devices were sold in 1980 alone.

by Roy Coles

Texas knew that the TMS-1000 was a tough act to follow, but it also knew that the world would not put up with four bits for ever, even in doorbells. The result is an eight-bit successor called the TMS-7000. Like its common-as-muck predecessor, the 7000 series has on-chip RAM, ROM and I/O, and is designed for low-cost mass-market applications. Early indications are that the new family is doing quite nicely thank you, and now other manufacturers are climbing on the bandwagon with TMS-7000 variants of their own.

One which caught my eye, is the 62710 from SEEQ Technology, a firm famous for its low-voltage EEPROM — electrically erasable programmable read only memory — technology. What SEEQ has done is to take the basic TMS-7020 processor design and graft on a 2K array of non-volatile EEPROM memory to replace the masked ROM of the Texas chip, together with the necessary voltage-generator control logic and instruction codes to program the on-chip EEPROM. The result is an NMOS eight-bit processor with 3K of reprogrammable program/data memory, 256 bytes of RAM, an eight-bit counter timer, three hardware interrupts, 32 I/O lines, and an instruction set with 61 commands, all running from a 5V supply and living in a 40-pin package.

In the beginning, there was the PDP-8. This Dec processor, first of the so called minicomputers, caused quite a storm when it first appeared in about 1965 because for the first time computers were cheap enough to go to the job, rather than the job having to go to the computer. The PDP-8 is still widely used, and its zany 12-bit architecture is often considered ideal for industrial applications where input data from sensors usually has to be represented by 12-bit numbers.

One of the first CMOS microprocessors, the IM-6100 from Intersil and Harris, actually used the PDP-8 architecture and instruction set. Despite the great antiquity of the basic design, this microprocessor has built up a reasonable following among PDP-8 addicts and others. I have to confess I thought that in the age of the 99000 and the 8086, the PDP-8 and the IM-6100 had finally been laid to rest — but no!

Dec itself has resurrected the PDP-8 architecture in the new range of Decmate II microcomputers aimed at low-cost office applications. Even more surprisingly Harris has introduced a new version of the 6100 microprocessor with added features for higher performance.

If the PDP-8 brings tears of nostalgia to those tired old eyes of yours — or if you still actually *use* it — take a look at the Harris HM-6120. It now runs at 5.1MHz and has two 12-bit stack pointers — sacrilege to true PDP-8 afficionados. Nobody ever needed more than 4K words of memory on a PDP-8, nobody could afford it anyway, but the new Harris chip can reach 64K — Kbytes, that is. There is even a nifty I/O controller, coded the HD-6121, which can control up to five 12-bit parallel I/O ports and has priority interrupt-control logic.

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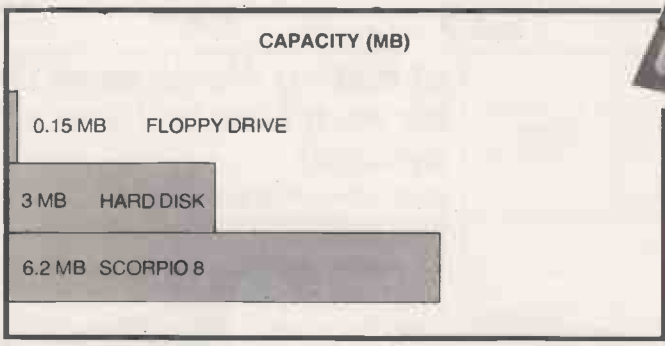

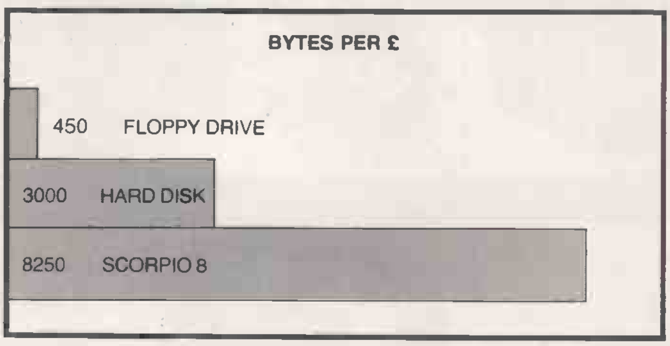

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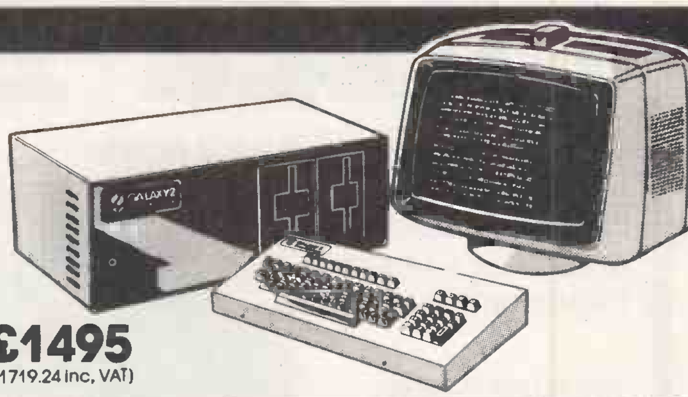

£1495
(£1719.24 inc. VAT)

Total support for Gemini & nascom Products

nascom 3 available from MicroValue

Based around the successful Nascom 2 computer, this new system can be built up into a complete disk based system. Supplied built and tested complete with PSU, Nas-Sys 3 and Nas-Gra.

48K System
£549 (£631.35 inc. VAT)

CP/M 2.2
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NASCOM 2 KIT
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Disk System for Gemini & nascom

GM825 Disk Drive Unit – The GM825 floppy disk housing is supplied with either one or two 5.25" single sided, double density, 96TPI high capacity Micropolis 1015F5 disk drives. These provide 400K bytes of formatted storage per drive. (Gemini QDSS format). The CP/M2.2 package available supports on-screen editing with either the normal Nascom or Gemini IVC screens, parallel or serial printers.
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Single Drive System
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for Nascom
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GM829
for 8", 5.25" and Winchester Drives
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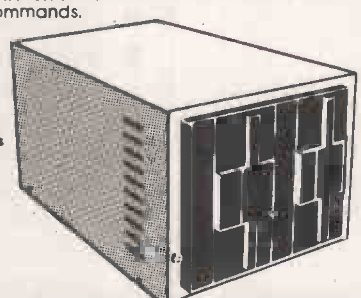

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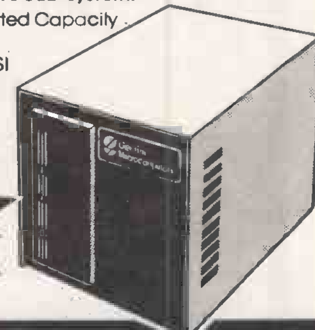

PRINTERS

Epson MX80 Type III
£348 (£399.95 inc. VAT)
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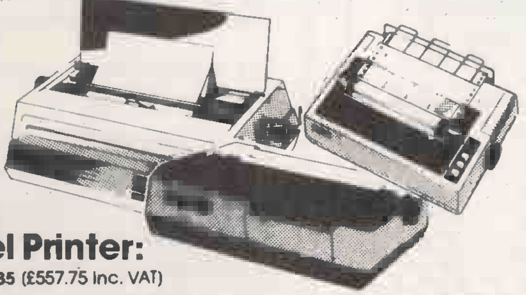
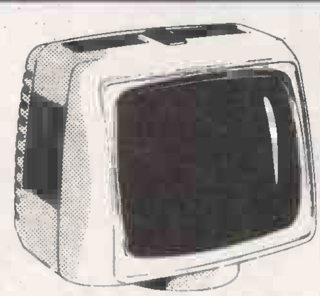


Daisy Wheel Printer:

Smith-Corona TP-1 **£485** (£557.75 inc. VAT)



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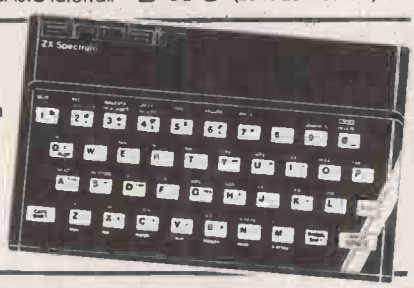

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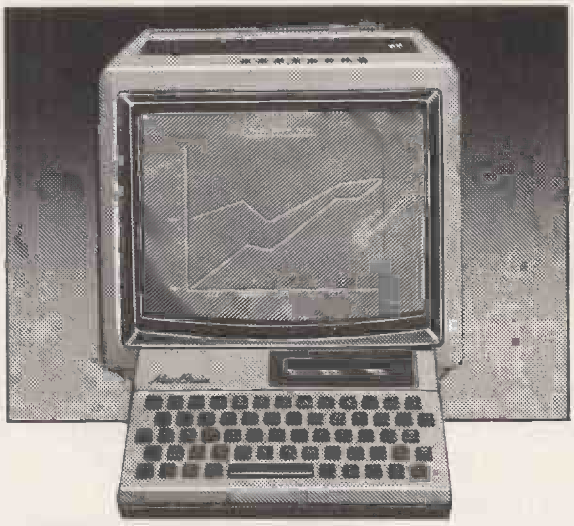

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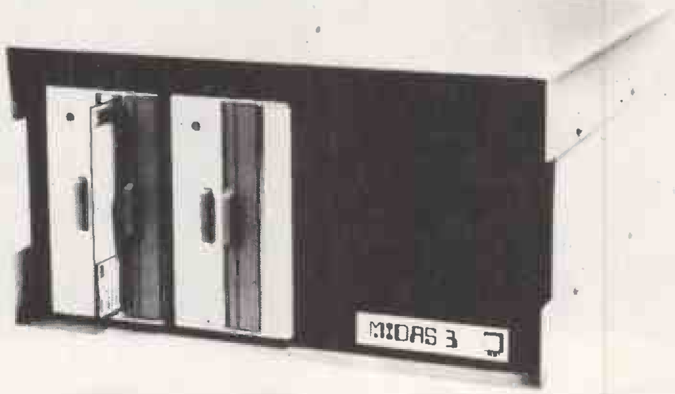

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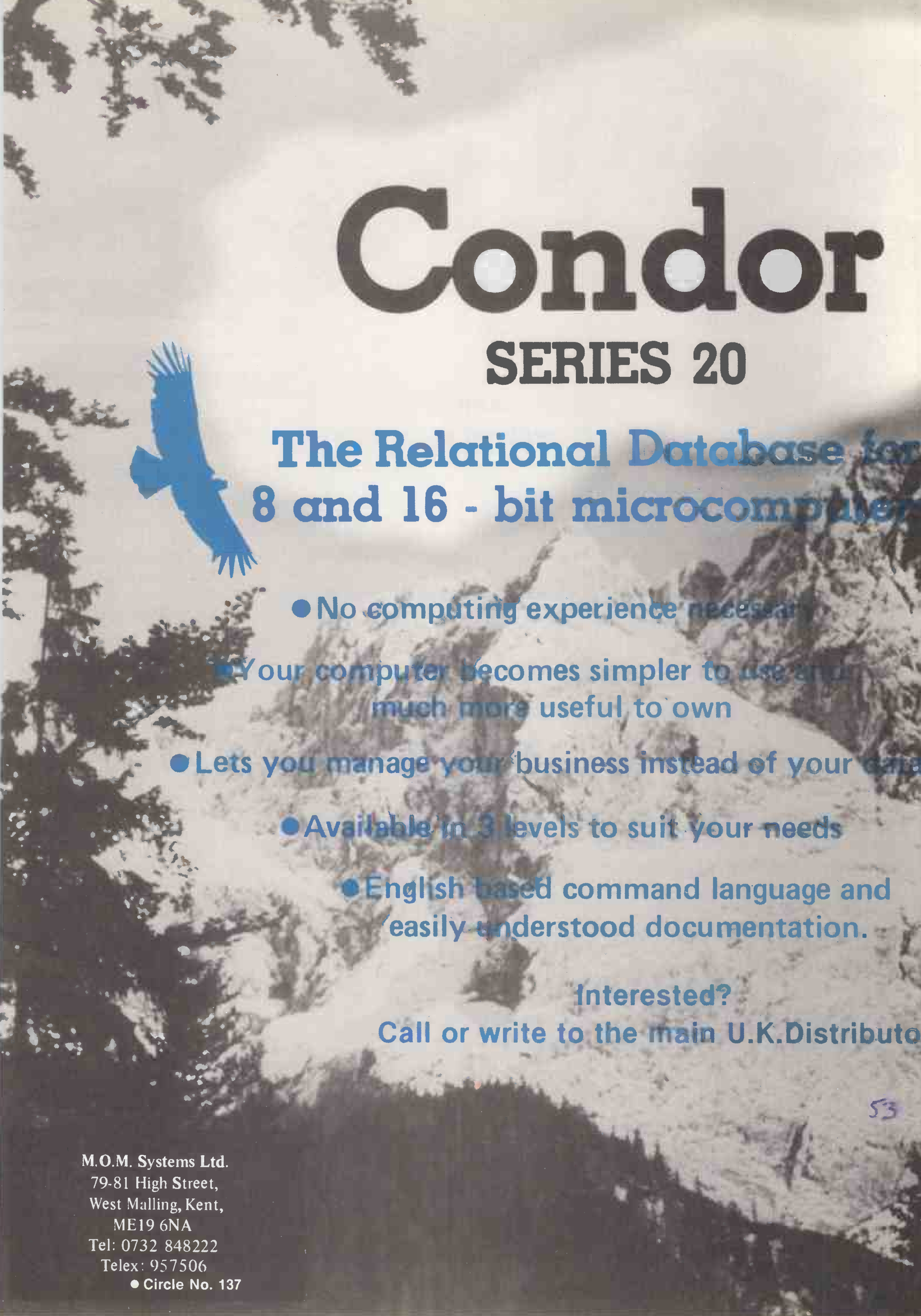
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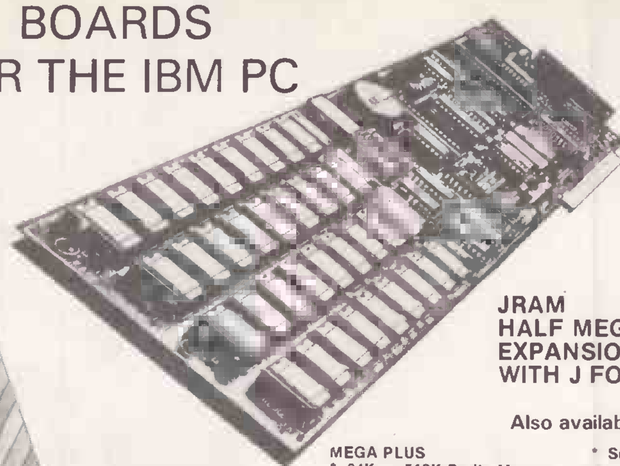

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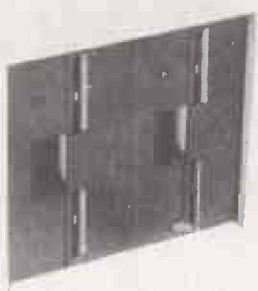

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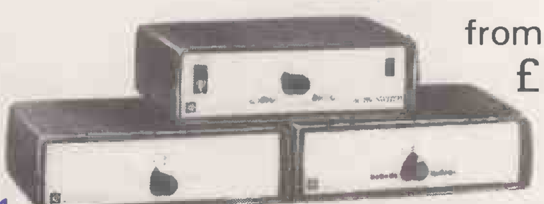

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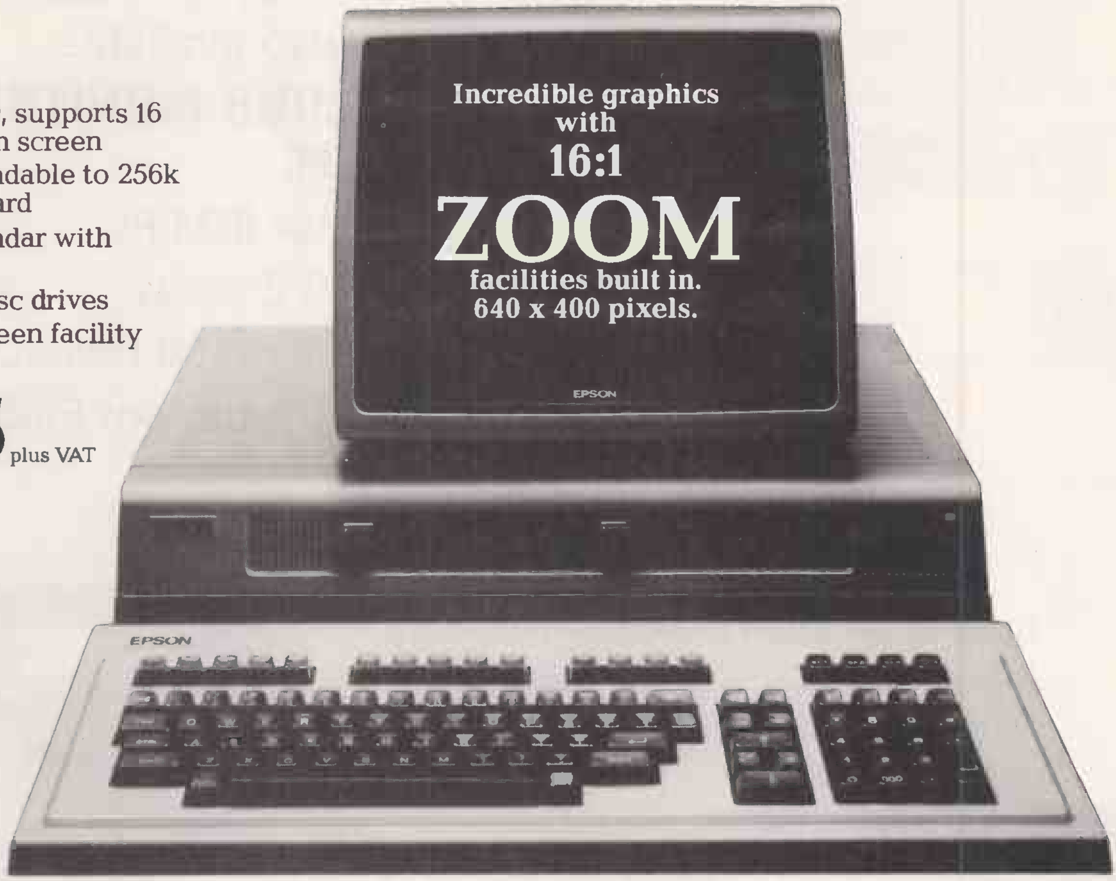

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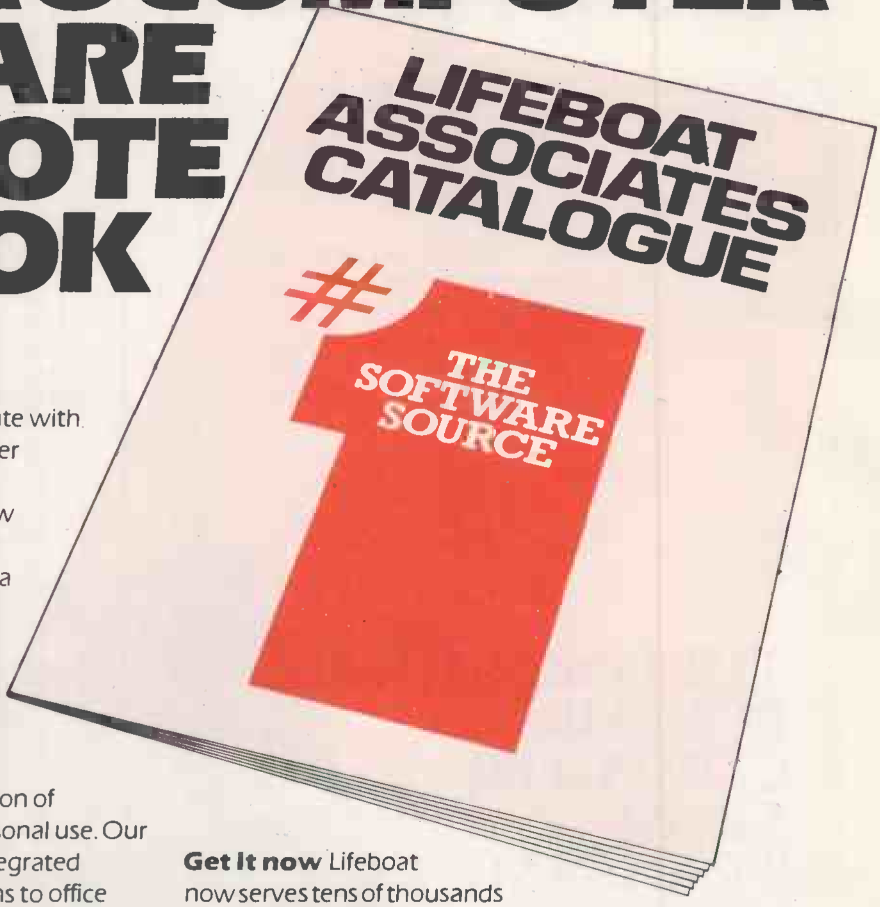

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LS22	12
LS27	12
LS32	13
LS30	12
LS38	15
LS42	28
LS47	35
LS48	55
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LS73	18
LS74	18
LS75	20
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LS139	28
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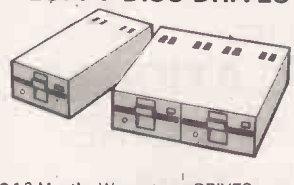

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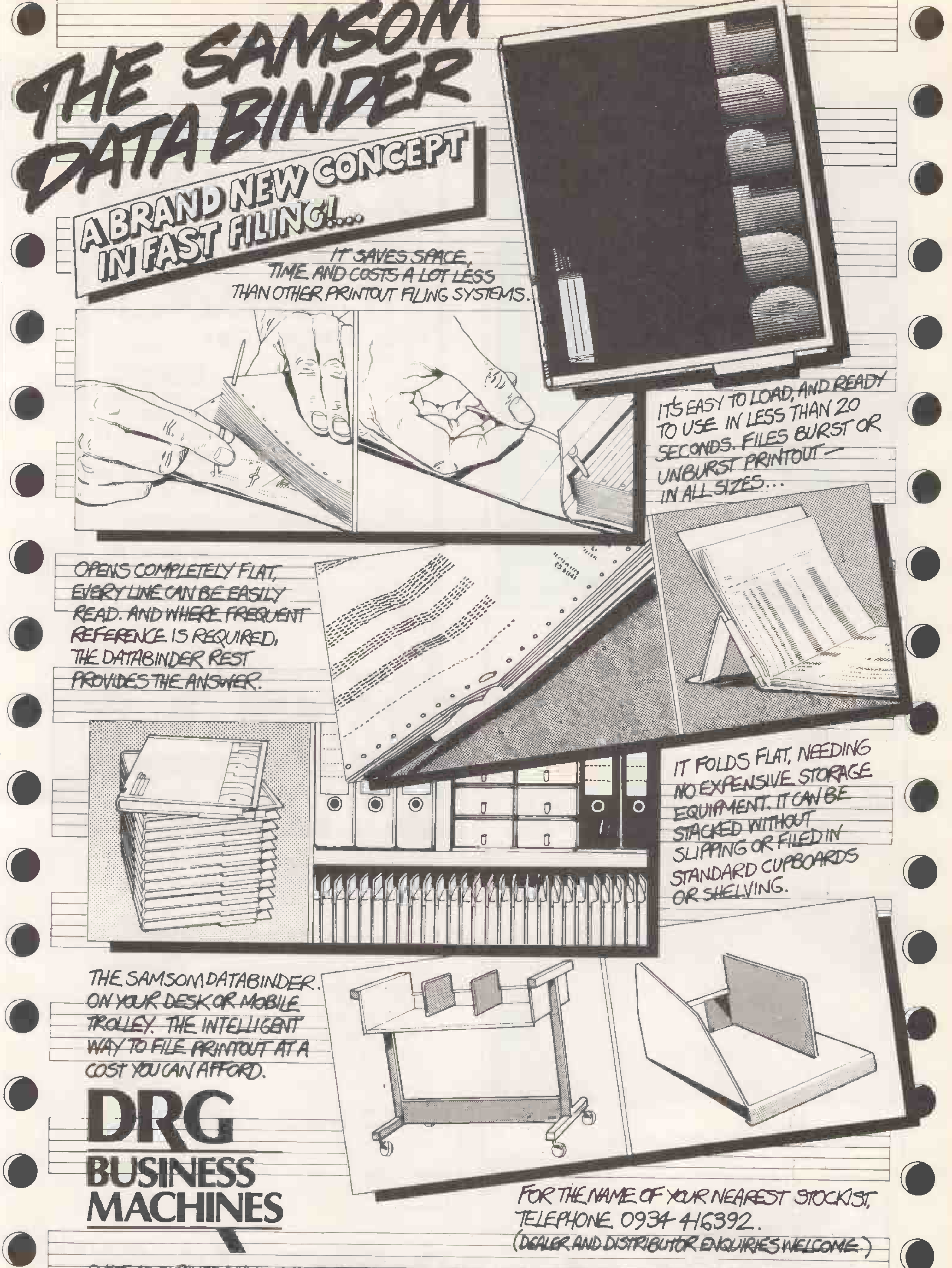
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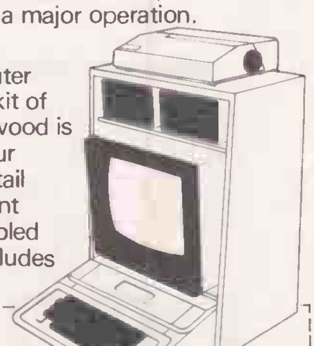

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In November 1982, PCW published a bumper round up of all the Benchmark Timings since PCW began. The Olivetti M20 came out top of the 'league' with an average Benchmark timing of 11.5. Running the same Benchmark test programs, the Apple II Plus with Accelerator II averages a timing of 8.58 — that's an incredible 25% faster than the Olivetti M20.

We have reproduced some of PCW's findings, incorporating Benchmark Timings for the Apple II Plus with Accelerator II.

Machine	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Average
Apple II Plus with Accelerator II	0.3	2.4	4.5	5.0	5.5	8.2	12.9	2.98	8.6
Olivetti M20	1.3	4.0	8.1	8.5	9.6	17.4	26.7	1.6	11.5
IBM Personal Computer	1.5	5.2	12.1	12.6	13.6	23.5	37.4	3.5	17.6
Osborne 01	1.4	4.4	11.7	11.6	12.3	21.9	34.9	6.1	19.9
Intertec Superbrain	1.6	5.2	14.0	13.9	14.8	26.3	43.2	5.6	21.9
Apple III	1.7	7.2	13.5	14.5	16.0	27.0	42.5	7.5	24.7
ACT Sirius 1	2.0	7.4	17.0	17.5	19.8	35.4	55.9	4.3	24.8
Xerox 820	1.7	5.5	15.5	15.1	16.2	28.9	46.1	8.0	26.1
Apple II	1.3	8.5	16.0	17.8	19.1	28.6	44.8	10.7	30.4
Commodore CBM 8032	1.7	10.0	18.4	20.3	21.9	32.4	51.0	11.9	34.3

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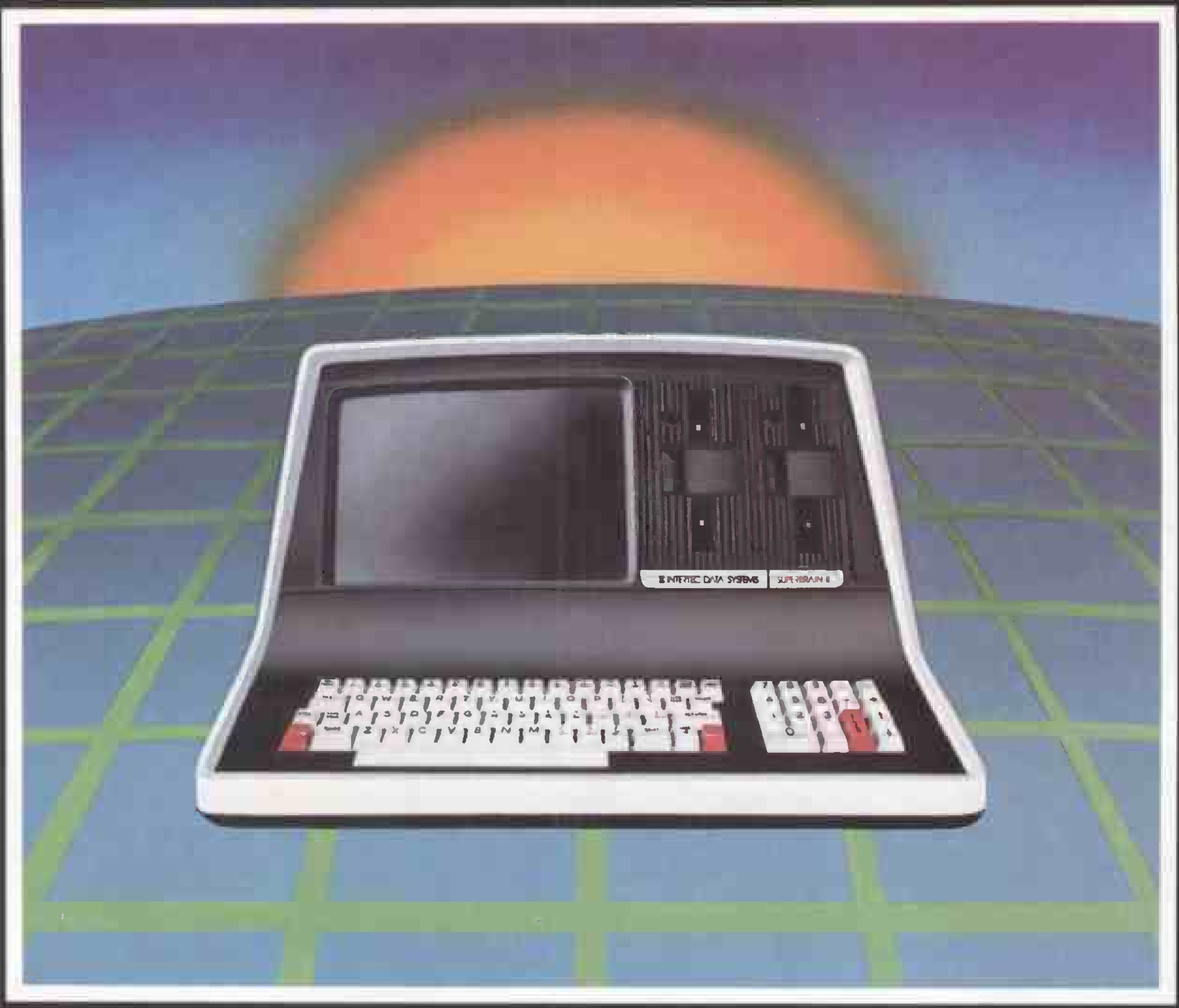

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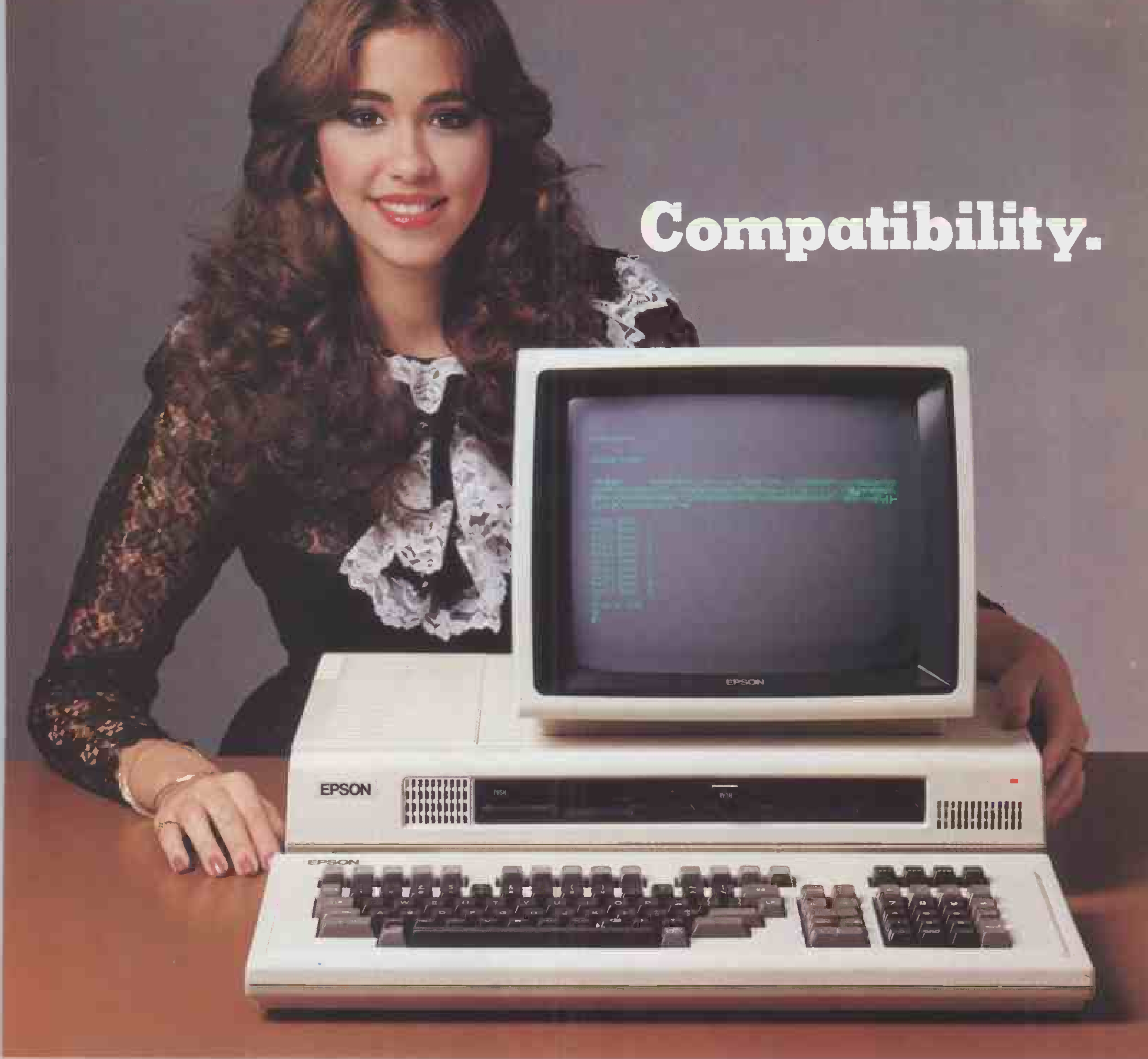

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Although the NewBrain is conceived as a total system, the unexpanded Processor itself has a great deal to offer. It is available in two forms: Model AD, shown below, with a built-in line display; and Model A, without the line display. Both models can operate with a monitor or a television set.

MEMORY

- 24K bytes of ROM;
- 32 bytes of RAM, at least 28K of which is available to the user.

THE SCREEN DISPLAY

- 40 or 80 characters to the line – without affecting the 28K bytes of RAM at your disposal;
- 24 or 30 lines to the screen;
- well-formed characters, with true descenders;
- a full European character set;
- normal or reverse video, high resolution graphics on screen of controllable size, 256, 320, 512 or 640 horizontal resolution by 250 vertical lines;
- a facility to set up a "page" of up to 255 lines, with the screen acting as a "window" to display it;
- ability to maintain several such pages simultaneously, and to switch rapidly between them;
- text may be used on graphics screen as well as on parts of the video screen not used by graphics.

CHARACTER SET

- 512 characters, including the full ASCII set, all European accented characters, Greek and graphics symbols.

GRAPHICS

- 20 powerful graphics commands;
- all text characters usable on the graphics screen;
- variable-sized graphics screen, with the rest of the screen available for text – for versatility and to save memory.

SOFTWARE

Enhanced ANSI BASIC; screen editor (32 commands); mathematics package (10 significant figures); graphics commands.

- a very friendly screen editor – a delight to use and readily adapted to text processing;
- arithmetic to 10 significant figures;
- very controllable output formatting of numbers – invaluable for accounting, statistics, and scientific applications;
- a powerful, much enhanced BASIC;
- a very flexible operating system, which allows any data stream to be opened to any device.

INTERFACES

- two tape cassette ports built into the processor unit;
- a built-in printer interface;
- a built-in communications interface (V24/RS232);
- a video monitor interface;
- a TV interface;
- an expansion interface for NewBrain system expansion modules.

KEYBOARD

- standard typewriter pitch, action, layout and size, with editing control and graphics keys.

*CP/M IS A REGISTERED TRADE MARK OF DIGITAL RESEARCH INC.

You can get everything in the box on the

If you understand the facts and figures on the left you'll soon realise that NewBrain has to be one of the most powerful micros around.

However, if you find the box on the left a little hard to follow, don't worry.

We've got over 120 dealers nationwide who've got all the answers at their fingertips.

Either way you'll discover that NewBrain is the kind of micro that will stop the competition getting a look in.

At £269 it starts off with twice as much memory as most of its competitors and can expand to over thirty times that amount. So there's no chance of being left behind in the micro race.

It comes with a very powerful language (enhanced ANSI BASIC) and it'll take CP/M,* so it'll work on the same system as similar big business micros, giving you the capacity to use an almost limitless variety of tried and tested software.

But most of all NewBrain is a machine that can expand.

It's designed to take disks, printers and memory expansion modules (up to 2M bytes) plus anything else you'd expect a professional business micro to handle.

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CANON AS-100C

It's about as far from portable as a micro can be. Jack Schofield carried out the test.

CANON is a well-established Japanese company, founded over 50 years ago. It made its first impact on the West in the early 1950s with a high-quality rangefinder camera which was a copy of the German Leica.

In the 1970s Canon was the first camera company to put a microchip in an SLR, the Canon AE-1. It sold around 5,000,000 in the first five years, taking Canon to world leadership in the quality camera business. During the 1970s the company also diversified rapidly. Calculators, office photocopiers — including colour copiers — and, most recently, video equipment have been the major non-camera products. They now account for more than half of Canon's turnover.

When it comes to computers, Canon's first serious effort was the CX-1 business micro, an all-in-one micro with twin-floppy drives and 12in. green screen. When launched it was overpriced and lacked software. Price reductions, software launches and a recent advertising campaign based on "Canon Man" have secured it a small niche in the U.K. market place.

The CX-1 is a high-technology product based on the 6809 microprocessor and Canon's own MCX operating system. But as Canon found, high technology is no substitute in the business market for industry-standard operating systems and well-known packaged software.

For its new micro, therefore, Canon has thrown its hat into the largest available high-technology ring: the one surrounding the IBM Personal Computer. The AS-100M and AS-100C micros use the Intel 8088 CPU, like the IBM PC, and offer both MS-DOS and CP/M-86 operating systems. Canon intends to capitalise on the large software base being generated for the IBM machine. In addition, the so called Advanced Station offers attractions of its own.

The Canon AS-100 comes in two versions, suffixed either M for monochrome or C for colour. We tested the colour version. It may be an IBM work-alike, but it is certainly not a look-alike. It is very boxy, and looks more like a photocopier than a conventional computer. The main processor boards and memory are integral with the VDU. Matching 8in. or 5.25in. disc drives are plugged in on the right of the screen, and a detached keyboard plugs into the front.

The design prevents the screen from being tilted or turned to suit the user, which limits the number of ways it can be used on the desk top. It is also massively heavy, as was the CX-1, and not easy to move about, so it defiantly occupies about a quarter of an average desk top. This is more than a micro with a small footprint such as the Sirius 1, but no worse than the IBM PC itself. The Canon surpasses the IBM in that the AS-100's flat top is ideal for standing a printer on, and when the keyboard is not in use, it can sit on top of the disc unit.

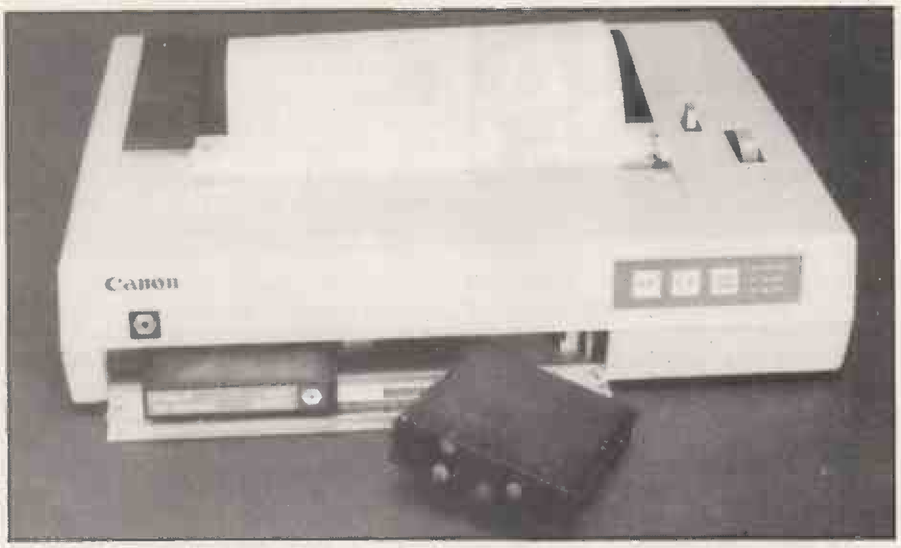
The main unit and disc drives both have power switches on the front, which light in green when on. The rear connectors are all accessible and neatly arranged. A connector is provided for another pair of twin floppies to be daisy-chained to the first.

The main unit has two recessed holes on the front panel. Poking a pencil down the left hole provides a reset, as on the Olivetti M-20, and reboots without interrupting the power supply. This is something the IBM PC itself lacks, and needs.

The 12in. screen is recessed, but still picks up a lot of reflections as well as an unusual amount of static. Fortunately the clarity and definition of the screen is exceptional so glare was never a problem. Even so, some sort of anti-reflection treatment would be worthwhile.

The keyboard is one of the best aspects of the AS-100, and far superior to the IBM PC's. The alphanumeric keys are laid out typewriter style with nothing to get in the way of the large Shift keys. The left-arrowed Return key is oversized, and a ridge clearly separates it from the numeric keypad on the right. Twelve function keys are arranged in three groups of four along the top of the keyboard, and there are a number of extra keys, making 94 keys in all.

The keys have a light touch and very little mechanical "feel", but when pressed each key gives an audible blip. An Alpha Lock key, with a green LED, instantly changes the standard layout so that unshifted keys produce capitals and shifted keys give lower-case letters.



One of the attractions of the colour version of the AS-100 is that it links to the A-1210 seven-colour ink-jet printer. It prints bidirectionally at 40 characters per second and can dump a colour screen in about four minutes. Characters are made up on a five-by-seven dot matrix and lack true descenders. The printers takes only friction feed, not tractor-feed, paper. But then, it costs less than £600.

The numeric keypad includes a large 0 key and a huge 23mm.-by-33mm. Enter key. Pressing the Cursor Lock key, also with a green LED built in, converts the numeric pad into a cross-shaped cursor-control pad. The 7 key becomes Home and 9 and 3 take you Page Up and Page Down respectively.

The keyboard has two more features. First, it has two screws on the back which enable you to choose the angle at which it sits on a desk. Second, a DIN socket is provided on the right-hand edge for a controller—not actually a mouse, but a device which provides a similar input. A mouse could, no doubt, be fitted as an alternative.

Naturally all the keys are soft, with the character set being loaded from disc on booting up. A utility called FNTEDT or Fount-Edit allows you to customise the characters. It throws up a nice blue box with rules to map an eight-by-16 pixel block. Letters can be drawn on it in bright yellow, using the Cursor Control and function keys. Then the new letters or whole set can be saved to disc, and autobooted later under the FNTSET.CMD utility under CP/M-86.

The 12 function keys were ready-customised on the AS-100 supplied for review. Under MS-DOS the functions were, in order, List, Run, Save", Load", Cont, "LPT1:", TrOn, TrOff, List, Edit, Files and CHR$ (. The Files function provides an instant disc directory from inside Basic.

Using the function keys and keyboard, it takes only four keystrokes to clear the screen, and List and Run a Basic program, as Return is included in the F2 key along with Run. This compares with 13 keystrokes when doing everything normally. You can very quickly get to like this kind of economy, especially when running and rerunning tedious benchmarks.

When running Canon Basic under CP/M-86, the function keys provided different functions: Edit, Load, Save, List, XRef, Run, Cancel, DList, RName, New and Bye. Bye, naturally, exits back to CP/M.

The function keys are programmed under MS-DOS in exactly the same way as on the IBM PC. To make the F6 key mean Auto, for automatic line numbering, you just construct a little program including the line

```
10 KEY 6, "AUTO": NEW
```

run it, and there you are. Of course, having chosen your functions—leaving a couple blank for instant macros—you would put them into an Autoexec.BAT file and boot it up with Basic.

The keyboard has a beeper which can be sounded by using the command Beep or else Print CHR$(7). Again, this is exactly as on the IBM PC. The Sound command also follows IBM logic. It is of the form Sound X, Y where X is the frequeny in hertz, and Y is the duration in clock cycles. It is a simple matter to use Read and Data statements to play simple tunes.

On the IBM PC, Sound X,0.01 produces a continuous tone — presumably the short duration confuses the cycle counting. On the Canon, sounds shorter than 0.4 produce only silence.

The alternative way to play sounds is to use the Play command. The form is Play "CEG", which will play the notes C, E and G. Adding P inserts a pause. There are

(continued on next page)

Benchmarks

The Canon AS-100C ran the standard *Kilobaud* benchmarks rather more quickly than the Canon CX-1, and about as quickly as the IBM PC. all times in seconds:

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8
Canon AS-100C	1.2	4.9	10.9	11.2	12.3	22.4	34.5	3.7
IBM PC	1.4	5.2	12.1	12.6	13.6	23.5	37.4	3.5

CANON AS-100C

(continued from previous page)

seven octaves so adding, say O4 specifies the fourth octave. You can change the length of the notes; for example L4 gives quarter notes. You can change the Tempo; T80 gives 80 beats per second, and so on.

You can have the music in staccato form, MS, or normal, MN, or legato form, ML, and in the foreground or in the background — if you want to do something else at the same time. You end up with a string of characters that looks like something off the Rosetta Stone, but it is really easy to use. No musician would take seriously the Canon's one-voice rendering of *Twinkle, Twinkle Little Star*, but then, no one is going to buy a £3,000 micro to play tunes. Think of the sound facilities as a free bonus.

Unfortunately the AS-100 parts company with the IBM PC when it comes to colour commands. The Screen X, Y, Z type of command that changes the IBM colours has no effect. Some of the IBM screen calls work, but most do not. For example, Color 0,7 changes the characters to inverse video—and Color 7,0 changes them back to normal.But 0,17 does not produce the expected Underline blinking mode; it produces the error message Illegal Function Call instead.

Colours can be set on the AS-100 by two methods. Under MS-DOS you use the Pallet command with the letters R, G and B appearing to control the guns directly. Under CP/M-86 the Pallet commands take numerical values, which can prove confusing without prolonged study.

Unfortunately this limits the AS-100's ability to run IBM PC software. For example, I managed to load the Calendar program which runs under Basic on the IBM PC. Even though it is mainly a text program, running it produced so many illegal-function calls that I soon abandoned the effort.

This again points up the value of having syntax checked on line entry, as it is on cheap micros like the Sinclair and Atari machines. It also points up the fact that while the AS-100 will undoubtedly benefit from the IBM PC software base, it will not be a simple matter of buying an IBM disc and booting it up.

The other outstanding feature of the AS-100, apart from the keyboard, is the screen. The display is very sharp, rock steady, does not scintillate, and provides brilliant colours. It provides scrolling by line or by pixel, and with 400 pixels in the depth of the screen, pixel scrolling is really smooth. The maximum definition of the AS-100 is 640 by 400, whereas the maximum on the IBM PC is 640 by 200.

The screen has a bright but low-persistence phosphor, which means there is no visible after-image when scrolling. This is an annoying feature of many monitors, especially the Apple III model.

The AS-100 also provides a full screen monitor for Basic running under MS-DOS, which is a huge improvement on the Microsoft line editor. The numeric keypad controls can be used to zip up and down the screen letter by letter or line by line. Pressing the Control key provides word-by-word movement.

Error messages are an enormous improvement on most comparable micros. My favourite test of leaving the drive door open and trying to load a program produces not the infamous

BDOS ERROR ON B: BAD SECTOR

but the sensible, English remark "Disc not Ready". Saving to an absent disc produces the same message and leaves you in Basic with your program intact. As you will have gathered, all round the Canon is a very user-friendly machine.

The Canon was supplied with two pieces of software for review: the Canobrain spreadsheet, and a colour version of WordStar. At this point it must be noted that the machine was supplied with no documentation at all—no manuals, nothing. The only information in the U.K. at present is in Japanese, and even this was not available for loan. It says a great deal for the logical approach of the system that I managed to get both packages up and running very quickly.

Canonbrain is hard to break into, but typing the date sends you into the first of several menus, which are all based on the 12 function keys. Pressing F1 for Book produces a list of the books or volumes on the data disc. Ours is number 5 and called Practical, so we enter 5.

You are then presented with a list of the pages so you can select one of them or start a new one. Loading a page produces a typical spreadsheet screen, only with green rules separating the cells. At this point the function keys stand for Input, Pattern, Generate, Duplicate, Formatting, Retr/Sort, Print, CD File, Defintion and Monitor.

Starting a new page by entering 0, F1 and a name allows you to choose Table or Graph. Table is the spreadsheet part; Graph offers eight types of graph, diagram or

Specification

CPU: Intel 8088 running at 4MHz. Optional 8087 arithmetic processor
Operating systems: MS-DOS and CP/M-86
Memory: 128K expandable to 512K
ROM fitted: 8K
Interfaces: Centronics fitted as standard; options include RS-232C, IEEE-448

KEYBOARD
Type: 94-key detached with 12 function keys and numeric/cursor-control pad
Features: auto-repeat on all keys, controller output port for pointing device
Dimensions: 480 × 32 × 185mm.

DISPLAY
Type: built-in 12in. colour with brightness control; monochrome optional
Displays: 80 characters × 25 lines, with graphics to 640 × 400 pixels using eight from 27 colours available
Dimension: 400 × 340 × 429mm.
Weight: 23kg.

DISCS
Type: two 5.25in. 612K (formatted) floppies, or two 8in. 1.2Mbyte floppies or hard discs
Dimensions: (5.35in.) 80 × 340 × 370mm.
Weight: 6.3kg.

chart. Canobrain is not just a spreadsheet. It is a business-graphics tool, like having Visiplot built in. It is so easy to use it is almost frightening. I produced a pie chart from scratch, never having used the package before, in under a minute. The information, of course, comes straight from the table you have already entered.

Starting a new chart, you enter the row number and a separate column width for every column, in the range 1 to 75. Canobrain promptly draws in the lines. Naturally all this line drawing slows down the rate at which you can zip through the cells, but the program is so easy to use in other respects that it is acceptable.

The F12 key is very useful in this program, as hitting it almost always takes you back to the screen before—that is, the screen before you did what you now wish you hadn't. With a few F12s you can go right back to the title screen.

WordStar is bog-standard WordStar. Anyone familiar with the standard Micropro package will feel at home with it straight away, and be able to run it with eyes closed. This is not recommended, however, as you would miss the pretty Canon colours.

The menu is displayed against a blue background, with status lines and the ruler in turquoise. Text is entered in white. Comment lines such as for setting the help level appear in purple. In a block move, the marked block words appear in turquoise.

WordStar remains as slow and tedious as ever, and the Canon MS-DOS implementation is certainly not speedy. However, the colour helps a lot. WordStar is also customised to use the AS-100 function keys. It is neat to be able to press F8 and get CTL KK, or F1 and get Help.

Without documentation it was not possible to investigate the memory organisation or the Basics supplied in any depth. Yet it is curious that in a micro with 256K for RAM, only 61,026 bytes should be free to Microsoft Basic running under MS-DOS. This is Advanced Basic-86 Version 1.0 created 8 January 1983. Really it is about time Microsoft wrote its Basics with the ability to address more than 64K. The Canon Basic which runs under CP/M-86 provides the user with 170K of RAM.

The Microsoft Basic seems to lack the Cint statement. IBM PC watchers will be familiar with the famous so-called bug in Microsoft's Basic which if given the line

```
10 Print 9.9, 990/100
```

calmly returns the answers 9.89999 and 9.89999. Listing the program then shows

```
10 Print 9.8999, 990/100
```

The Canon does the same only more so, returning 9.899999.

Of course this is not really a bug, but the result of doing floating-point calculations in binary arithmetic. You have to use the conversion functions CSNG(X), CDBL(X) and CINT(X) to declare single, double or integer precision, and that can be very messy indeed. This seems to be a standard feature of Microsoft Basic-86, and is also found onthe Orion reviewed elsewhere in this issue.

Conclusions

• The Canon AS-100C is an excellent microcomputer which is semi-compatible with the IBM Personal Computer.

• The Canon's colour display and keyboard are better than the IBM PC, but the lack of complete software compatability is a limiting factor. Canon's customisation of independent software packages like WordStar may reduce the relevance of this limitation.

• In appearance the AS-100 is distinctive and different from anything else. Whether this is preferred is a matter of taste, but on test the design proved to be more practical than it looks at first.

• No documentation was supplied for review. Potential buyers must check its usefulness themselves.

• The AS-100 is much more user-friendly than the usual CP/M-86 and MS-DOS business micro, and seems good value. The system tested with 256K of RAM and two 8in. floppy discs, colour screen and colour ink-jet printer costs £4,840 plus VAT. A minimum configuration with 128K, two 5.25in. floppy discs and monochrome screen costs £2,290 plus VAT.

• For further information contact Canon (U.K.) Ltd, Waddon House, Stafford Road, Croydon CR9 4DD.

TEXET TX-8000

Another colour micro competing for the first-time buyer's money, assessed by Bill Bennett.

PRICE is of major importance in the home micro market. On this criteria the Texet scores points by being cheaper than the Oric.

If the difference in price between the Texet and the Oric is significant, so is the difference in performance and overall capability. On amount of user RAM the Texet loses dramatically. It has only 4K, of which 2K is for the so-called high-resolution graphics, leaving only 2K available to Basic.

Peripherals include a printer for £129, monitors, cassette players, remote-control joysticks, light-pens, etc. There is also some software, which is essential for a machine of this nature. The Texet isn't going to sell in the kind of numbers that the Oric or the Spectrum will, so support from the independent software suppliers is not likely to be strong.

The hardware inside the review machine was a mess. Huge blobs of solder everywhere and wires soldered to chip legs or directly to the PCB indicated that it was simply a prototype.

The chips all had their indentification codes painted out, and were held down with adhesive. Clearly, Texet did not want us to go looking around. The large heat sink was insulated from the rest of the components by a short piece of sticky tape. The video circuitry is crude, and as tatty as the rest of the hardware.

The processor appears to be a Z-80. I use the phrase "appears to be" because the people at Texet insist it is a 6502. Yet there is no sign of the 6522 interface chip which is required to support the 6502, nor is there any sign of a ULA which could be used in place of the 6522.

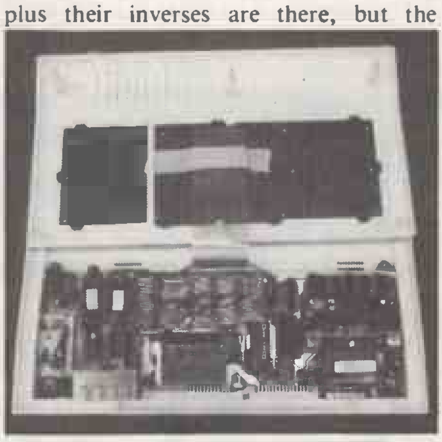
A similar mystery surrounds the amount of memory included with the machine. The company claims that there is 8K but a look at the memory map shows only 4K.

Memory map of Texet TX-8000.

0000-3FFF	Operating-system ROM
4000-67FF	Not used
6800-6FFF	Input/output
7000-77FF	Video display RAM 2K
7800-7FFF	User RAM, 2K
8000-FFFF	Expansion area

The 2K video memory allows two graphics modes — text and a so-called High Resolution mode. In the text mode, characters can be located in any one of the 32 by 16 locations on the text screen. They can be printed in the normal manner or Poked into the appropriate area of memory, the first 512 bytes of the video RAM; 255 characters are available in the Text mode.

Where the Texet differs from other micros is in what 255 characters are available. The normal alphanumeric set plus their inverses are there, but the graphic character set is repeated four times.



Colours are bright, but they do not include white. Black is only included by virtue of being the other colour in any given graphics character. Letters and numbers cannot be printed in colour in the text mode, but instead are either dark green on light green or light green on dark.

A third shade of green is used as the background in the graphics mode. "High-resolution" is hardly an honest description as there are a mere 64 by 128 pixels. Perhaps you have already worked out that 64 by 128 gives 8K. So how is it managed with a mere 2K of video RAM?

The reason for the anomaly can be seen when Poking into the video RAM when in Graphics mode. Each byte of the 2K can have any one of 255 values. In the Texet each of the 255 values represents a string of four pixels, each one of which can be any one of eight colours.

The horrible, rubbery keypad brings back memories of the Spectrum, but at least it is possible to enter keywords in full. A good feature is the On/Off switch which allows you to reset the computer without pulling the power plug out of the back.

Sound on the Texet is very limited. It can hardly be heard above the ordinary background noise of a house, let alone the *Practical Computing* office. The Sound command has two parameters. Pitch can vary between 0 and 31, duration between 1 and 9.

Basic is fairly standard, with For-Next-Step and If-Then-Else. Sometimes using CLS to clear the screen gave an error for no apparent reason. Some programs written in Basic for other machines seemed to work, but one thing that didn't work on the review machine was the cassette operating system. Perhaps this was due to the recording levels of the cassettes, but more likely it had something to do with the sloppy circuitry inside the Texet. My neighbours would not appreciate the medium-wave radio signals it radiates.

Conclusions

- **Against the Oric, the Texet TX-8000 is not an impressive machine; at around £70 it is worth the few pounds more than the 1K X-81, if only for the colour.**

● Circle No. 194

Drawing what's best from the BBC Micro

John Harris tests three packages which provide easy access to the BBC machine's outstanding graphics.

THE BBC MICRO is designed as a front-end processor of a highly expandable hardware configuration. Accordingly, if it is run without any of the hardware extensions, the highest-resolution graphics facility will use up the vast majority of on-board memory.

That is just another way of saying that the designers have done a grand job of memory management in terms of the full machine specification. And if you ran your programs on a second processor communicating via the Tube the graphics make no difference whatever to the amount of memory your program has at its disposal.

For those of us living in the present, however, compromise and clever coding are the only answer. As table 1 indicates, outside the low-resolution mode 7 Teletext format the memory available for Basic program and variable storage is somewhat abridged.

Of the three packages under review only Salamander's manages to make use of the very-high resolution mode 0, and it is limited to Model B machines in consequence. The two offerings from the BBC will run on both A and B machines. They pay the penalty that Drawing uses high-resolution two-colour mode 4 instead of mode 0 or 1, while Painting uses medium-resolution four-colour mode 5 instead of mode 2 or 1.

Salamander Software's EDG Graphics package was developed by EDG Engineering International. It arrives as a boxed cassette with a spiral-bound A5-sized manual. Typing

CHAIN " "

makes the package climb on board, and a cursory glance indicates that there is no possible way of patching the programs to operate as a disc-based system. It has a lot of functions to cram into the available space, and all that disc work area must have looked far too tempting. Score −1 to EDG.

Screen mode is then selected by pressing 0, 1 or 2. The screen mode can be changed during the graphics session. The operating screen includes a four-line text area which normally displays the current function and prompt, a colour menu, percentage of picture memory used, x,y co-ordinate of the cursor, angle and length of cursor position from last significant position, and Draw mode. The cursor is visible in the graphics window as an unobtrusive cross-hair — score +1 for visible, it makes quite a difference. The picture window starts blank.

Cursor movement is by the four arrow keys, starting slowly and speeding up as you hold down a key. When the cursor hits the edge of the screen it disappears from view, and the x,y co-ordinate display gives the only indication of where you are. The cursor can go up to about 10 screen-widths from the screen itself, and a good imagination is needed to "see" it hanging four feet left at 320 degrees, especially if the last significant point was off the screen as well.

The reason for these mental gymnastics is to make perspective lines meet off-screen, or to define the centre or edge of a polygon off-screen as in figure 3. Should you wish to return to any point on- or off-screen there is a Home instruction. It allows you to move to screen centre, to one of three saved locations or to the last significant point — the cursor address where the last completed function instruction was performed.

There is no direct cursor addressing, only the arrow keys. A background grid of dots can be switched on or off at any time by pressing G, and helps interpret the co-ordinate addresses.

Figure 1.

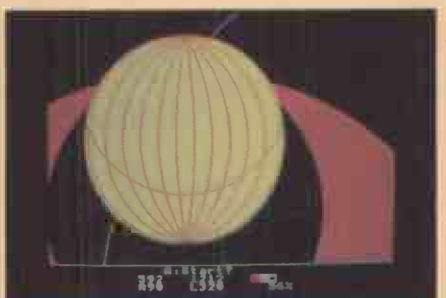


Figure 2.

Figure 3.

Figure 6.

Figure 7.

Figure 8.

Table 1. Screen display modes on the BBC Micro.

Mode	Colours at one time	Resolution Text	Resolution Graphics	Memory used	Left for Basic Model A	Left for Basic Model B
0	2	80 × 32	640 × 256	20K	n/a	6K
1	4	40 × 32	320 × 256	20K	n/a	6K
2	16	20 × 32	160 × 256	20K	n/a	6K
3	2	80 × 25		16K	n/a	10K
4	2	40 × 32	320 × 256	10K	3K	16K
5	4	20 × 32	160 × 256	10K	3K	16K
6	16	40 × 25		8K	5K	18K
7	16	40 × 25	80 × 75	1K	12K	25K

*where 16 colours are indicated, these are eight steady and eight flashing pairs.
n/a not available


Figure 4.


Figure 5.

Figure 9.

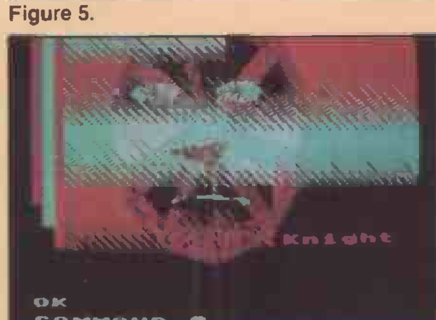


Figure 10.

Table 2. EDG Graphics package, drawing functions.

Key	Function
A	Arc, draws any circular arc
B	Box, draws any parallelogram
C	Circle, draws any circle
F	Fill, fills any closed area with colour
L	Line, draws one or more connected lines
T	Text, puts text anywhere on the picture

Table 3. EDG graphics package, editing functions.

Key	Function
R	redraw one item, reverses X
X	delete one item, screen and instruction list
Ctrl-F	forget one item from instruction list
Ctrl-L	Load instruction list
Ctrl-P	set Copy From pointer on instruction list
Ctrl-R	redraw screen complete from instruction list
Ctrl-S	Save instruction list
Ctrl-X	delete complete screen
Ctrl-Z	forget instruction list

Colour selection is made from the palette by moving a selector with the < and > keys. By holding Shift at the same time the logical colour for a given palette position can be changed, giving access to all the colours possible on the BBC even in the two- or four-colour mode.

Within appropriate functions a drawing mode selection may be made. It is done by pressing Control-D between Lined, Dotted or Filled; Lined is the default. Lines and dots can be seen on figure 1; the yellow area of figure 2 is a filled circle, though after the event it is impossible to say whether it was filled at the time or later through the Fill function.

The drawing functions themselves are given in table 2. Examples of arcs are seen in figure 2. The system prompts for the two end points of the arc and then guides the cursor along the bisector of the implied circle until you select an edge location. The latitude lines in figure 2 converge on two common end points and provide natural candidates for the Save/Home cursor commands.

Boxes prompt for two opposite corners, circles for the centre and edge. The line

(continued on page 85)


The Sword Range
Quality Colour Monitors for all Micros
APPLE • ACORN • BBC • COMART • DRAGON HP • ORIC • IBM • NEC • NORTH STAR • RAIR RESEARCH MACHINES • SAGE • SIRIUS • ETC
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0.20 MATRIX TUBE
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GLOVER TOWER
LEAD CHAMBER
LEAD CHAMBER
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Dealer enquiries welcome

Drawing what's best from the BBC Micro

(continued from page 83)

function, once entered, allows any number of joined lines to be created without reselection. It is helped by the existence of the elastic band, a temporary line on the picture joining the cursor to the last significant point and moving when the cursor moves. Text may be added anywhere on the picture at any time as in figure 1.

Figure 3 was created with Save/Home cursor, the line function, subsequent line verticals and horizontals, and a liberal use of Fill. Any area being filled which is not perfectly closed allows the colour to run into adjacent areas. The sky changed several times from blue when filling the blocks and required a patch to the line boundary followed by a corrective fill where the colour had spread. There is alternative provision — see table 3 — to "forget" the last instruction from the instruction list and redraw the picture to its previous point.

It is in the editing functions that the package makes its real impact. The instruction list for the drawing on the screen can reach 100 percent full, but the "picture so far" can be saved to cassette. The instruction list can be zeroed without disturbing the screen contents and drawing them recommenced, so that an unlimited instruction list can be effectively built up and subsequently recalled to the screen.

Given a library of instruction lists previously created, sections of different drawings can be amalgamated to create new results. While there is no capability to shrink, enlarge or move sections of the picture about you can bet your boots there was in the original commercial system it was developed from.

The BBC has adopted an opposite approach for its own packages. Both Drawing and Painting are the creations of Brian Smith of the Royal College of Art. The accompanying booklets say you can learn how to use the graphics capabilities of the BBC Microcomputer — draw shapes in a magnificent array of colours, change the colour of the shape you draw, delight your children, your friends and yourself with a plentitude of effects, then move on to the next program. But they are most emphatically not capable of producing technical drawings.

Yet when you get past the packaging and load the programs, you find that they have nothing to do with teaching you the use of the micro's graphics. While they can change the logical colours displayed they can only have two and four colours on the screen at once.

Compared to the EDG package, the commands for Drawing are simplicity itself. The 10 red function keys are active, and the cursor is aimed eight ways by pressing one or two of the arrow keys. Each time a numeric key is pressed it is moved by a distance proportional to the value.

The space bar is used for repetition of the drawing functions, which allow lines, polygons, spheres, cones and grids to be placed on the drawing. Figure 4 shows a four-sided cone repeated over several cursor movements, while figure 5 contains a sphere of specified height representing Middle-Earth, about which the Midgard serpent is gliding. Note the significant use of blue.

Do you detect a glimmer of graphics raising its head? That, after all, is what the packages are all about: the ability to put images on the screen. Nothing I could do could raise the level of the EDG package results above clean-edged cartoon standard. Drawing is starting to be just a touch arty.

The Painting program, instead of having a lot of preset shape generators on its function keys, has a set of textures. Only the polygon is common. A brush of square or triangular cross-section spreads solid blocks of colour. It can be set at any width from dot-size to half screen. An airbrush with similar size characteristics will spatter dots on to the screen, and a cross-hatch generator will place a grid of specified size and mesh at the cursor position. Text can be placed anywhere on the screen.

The colour is selectable, as is the logical colour. Up to four may appear on screen at any time. Each change to the screen can be specified as Normal, Ored or XOred. Normal overwrites anything, Or overwrites darker colours only and XOr never obliterates anything on screen but changes its colour. Any XOr change except airbrush is cancelled by re-pressing the space bar without moving the cursor.

Being a stablemate of Drawing, Painting has a very similar operating technique. The cursor is handled the same way, the space bar performs repetitions, the function keys react as before — see table 6 for the instruction set.

The speckling on figures 6, 7 and 8 are from the airbrush; everything else on 7 and 8 is polygon, while the rest of 6 is cross-hatching. Figure 9 is all polygon, while 10 was done using a little of everything, including brush.

One of the most useful attributes of the program is the speed with which it can convert ideas to results. Figure 9 was completed in about 70 keystrokes, which is less than two lines of this review.

One niggle about the BBC programs concerns the cursor. It is the most awkward, obstinate pig of a cursor in the history of computing. It does admittedly go where you tell it to go, but it adamantly refuses to let you know that it has arrived. When it hits the invisible boundary of the canvas it goes to the centre. So you creep it up on the invisible boundary again and back to the centre it flips, simply because you cannot see it for half of the approach.

Table 4. EDG Graphics package, miscellaneous functions.

Key	Function
G	grid switch on/off
H	home cursor
M	mode change
N	normalise colours
O	options selection within drawing function
S	save cursor
Z	zeroise length display
/	elastic band switch on/off
Ctrl-C	calibrate length display
Ctrl-D	draw mode within drawing function
Ctrl-Q	quit program
< >	colour selection
shift < >	logical colour change

Table 5. BBC Drawing functions.

Function key	Function
0	clear screen
1	select colour, foreground and background
2	line drawing
3	polygon
4	sphere
5	cone
6	grid
7	horizon
8	text
9	stop run

Table 6. BBC Painting functions.

Function Key	Function
0	clear screen
1	select colour for subsequent functions
2	set logical colour
3	optical effects: normal, Or, XOr
4	airbrush
5	brush
6	cross-hatch
7	polygon
8	text
9	stop run

Conclusions

- **The EDG Graphics Package is marketed by Salamander Software. The boxed cassette is accompnaied by an A5 spiral-bound manual and costs £24.95.**
- **The Painting and Drawing packages each cost £9.95 for a cassette and 24-page A5 booklet. They are published by the BBC.**
- **The EDG package has a solid, competent feel to it. Its strong point is technical drawing: there is no guesswork in measurement and each step is repeatable and editable.**
- **The Painting and Drawing packages are suitable for more imaginative graphics, and results are more difficult to repeat. Painting is a triumph; Drawing appears more like a talented afterthought.**

Pet alternatives

David Oborne compares Wordpro and Superscript, two remarkably similar packages to run on Commodore's well-established family.

THE EXPLOSION in sales of personal and desk-top micros has led to a correspondingly bewildering array of programs to purchase. This is particularly so for business users, and many word-processing systems, databases, spreadsheets, index files and other applictions compete with each other for use on the same make of micro.

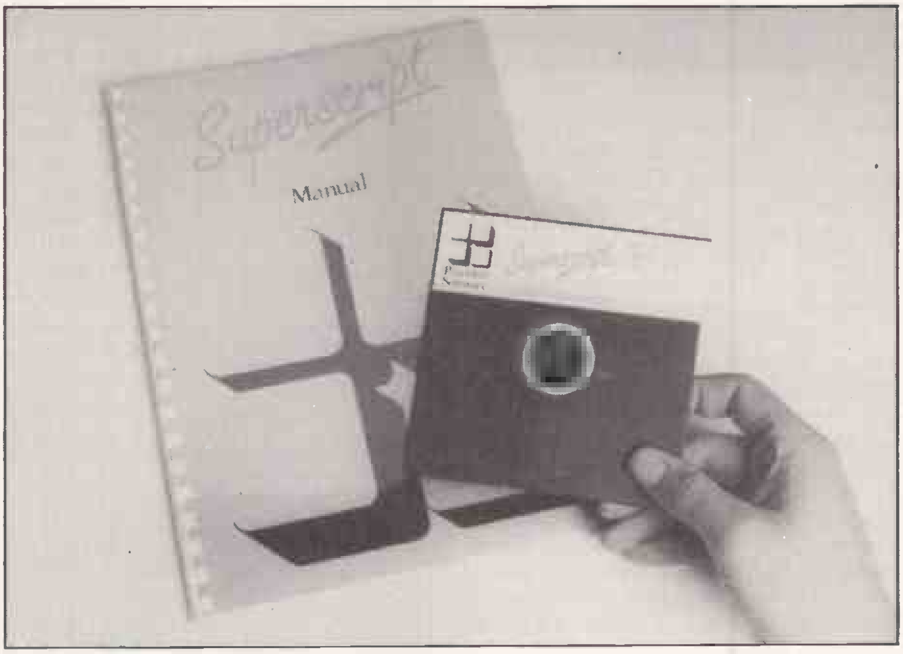
Of course, they all seem to do the same sorts of things—process words or numbers—but the problem which often faces the computer owner is how to make up his or her mind which to buy. Independent reviews in magazines such as *Practical Computing* can help, but they often comment only on one particular program at a time, making it difficult to compare the pros and cons of different packages.

Wordpro and Superscript are both word-processing packages and both run on the Pet. Wordpro is marketed in the U.K. by Wego Computers Ltd, and seems to have been available for Pet users for many years—like a week in politics, a year in computers is a very long time. Since its introduction it has developed with the evolution of the Pets to what is now its fifth generation for the large 8096 machines.

Superscript is a much more recent entrant into the market, not to be confused with Tandy's Scripsit or Superscripsit. It is produced by Precision Software Ltd and was written, so the advertising says, by Simon Tranmer of IPUG who "couldn't find a word processor which would handle 20K of text, with window scrolling up to 240 columns and able to use the screen while printing. So he wrote one." He seems to have written a very similar program to Wordpro.

The first and most obvious difference between the two programs is the way that the authors have chosen to protect their products from pirating. Wordpro will run only on designated machines. You can make as many back-up copies of the program as you like, but they will only run on one machine. A security ROM has to be inserted into one of the spare Pet sockets and the program continually searches it for data. If the ROM is not present the program refuses to work.

Superscript is protected by being made impossible to copy—at least not without a lot of difficulty. The author has included some fancy software within the program which makes it effectively uncopyable even when taken block by block. Security copies cannot be made and the program



cannot be altered to suit your own requirements as can be done with Wordpro—see *Practical Computing*, October, 1982—but the program can be run as many machines as are needed.

The two programs also differ in the machines on which they run. Wordpro can be used on all versions of the Pet including the new series now emerging though a new program must be purchased when changing between certain of the models. The same program bought as Superscript can be run on any level of machine. The program is simply instructed which type of machine that it is running on.

Long documents

Once loaded and running, the two programs at first sight appear similar both in design concept and appearance. Both use the idea of linking shorter files together to compose large documents. A long document such as a chapter will be composed of a number of smaller files—say two or three pages—and at the end of each file an instruction is inserted for the computer to call the next file and to continue printing. The length of the final document is determined only by the amount of file space left on the disc, and even this can be extended by periodically inserting new discs into the drives.

Both the programs depart from the normal practice of automatic word-wrap which shows on the screen what the final document will look like. Both Wordpro and Superscript split words at the end of the line, so the final document that appears on the screen looks nothing like that which will be printed out. But both packages provide the facility for the user to print the document to the screen, although this is not available for Wordpro 1 to 3 for the 3000 or 4000 Series Pets. Lack of word-wrap facilities also makes editing more difficult since the printout of a document which is to be edited does not look the same as the information on the screen; words do not appear at the same place on the lines, for example.

The two packages also have similar formatting instruction for use when, say, printing out the document. Both use commands which are embedded in the text such as

1mxx

for the position, column xx, of the left margin, and

ju

followed by 1 or 0 for right justified or not right justified. Since the two programs are so similar in design it is possible to use one of the programs to process words created using the other. This is particularly useful if you also have the Superspell spelling-checker program.

The appearance of the programs when loaded is also very similar. For example, having initialised the programs the first thing the user sees is the status line, which provides information on the current mode, the column and row numbers that the cursor is on, etc. Both programs insist that a format command is prefaced by a "tick", produced by pressing the Control key and then the / key.

In any word processor text is typed into the memory store just as it would be on an ordinary typewriter. As with a typewriter, certain formatting parameters have to be set to make the printed page look acceptable. On a word processor they are included at the beginning of the text—left margin, right margin, single/double spacing, number of lines per page, number of lines to be printed on the paper, etc. With both programs the "tick" character signals a formatting command.

Both programs allow for the provision of header and footer lines to be printed at the top and/or bottom of each page. They may include details of the document being printed and the page numbers, automatically incremented at each page. Both programs allow headers or footers to be placed anywhere within the text so that different pages could have different types of information printed at the top or bottom. The commands used by both programs are

hdx: text

and

ftx: text

for header and footer respectively. The x represents the number of blank lines to be left between the header and the start of the text or between the footer and the end of the page.

The text is what is to be written at the top or bottom of the page, and the text line is divided into three equal areas—left, centre and right, separated by commas. So,

<tick>hd3:, chapter 1,

would put the text "chapter 1" at the top centre of each page, leaving three lines before the beginning of the text. If the characters < > appear in a Wordpro header or footer, or a reverse # in Superscript, then the page number will be printed at that point.

Once the main text has been typed in, or the available memory filled, then it has to be stored on to a disc. Once again, the pocedures are very similar for both programs. Superscript asks you to press the Off/Rvs key and then F. Why it does not make it easy to remember and ask you to press Rvs and S for Save is another question. After all, the efficient saving of text on to the disc is the most important aspect of a word processor, as anyone who has spent hours typing at the keyboard only to loose the text through stupidity caused by tiredness will know!

Sensible saves

Wordpro is better in this respect. It asks you to press Shift and Clr/Home keys together and then to press the M to memorise. While on the topic of easy-to-understand computer dialogues, it is worth pointing out that Superscript is just as annoyingly ambiguous with its instruction for recalling material from disc—it uses the letter L for load. Efficient computer operators may all know that loading means taking data from the disc to the machine, but a naive user might, not unreasonably, interpret it to mean loading information on to the disc. Any room for ambiguity risks loss of valuable material. Wordpro's use of the terms Memorise and Recall offers less chance for misunderstanding.

Putting text into the machine, storing it and recalling it, however, is only part of the value of a word processor. Its main task is to manipulate words. Most word processors can move blocks of words around the text, search for a particular word and, if necessary, replace it with another, remove whole sections, paragraphs, words or letters, and set up standard documents so that specific pieces of text such as names and addresses can be merged into them. All of these facilities are offered by both Wordpro and Superscript, although it is at this point that slight differences between the two programs appear to creep in.

The first difference that appears between the programs is the method of accessing text from the discs. With Wordpro, you simply ask for a directory by keying Shift/Rvs, drive number, Return, take the cursor to the required file name and then recall the file by pressing the Backslash key. The file is loaded on to the screen from the column 1, row 1 Home position.

Access from disc

Recalling a file from disc using Superscript is a slightly more complex procedure. There are two ways of recalling a directory from disc. Simply to look at the directory, you need to go into the Disc mode by pressing Control - >. Then, to access the directory you type $dr, where dr represents the drive. But if you want to use the information to recall a file from the directory, you need to type +$dr, which adds the directory to the file. You then use Shift-Rvs to toggle the file name on to the status line. The program puts each name on the directory on to the status line each time you press Shift-Rvs. With the appropriate file name on the status line, Return loads that file. Unfortunately it loads the text below the cursor position, so if you have moved the cursor parts of the directory will also have to be erased.

If you simply want to look at the directory Superscript has one major advantage over Wordpro in this respect. Loading it does not erase the text currently on the screen, although adding the directory to some text using +$dr does erase a portion of the text. Calling a directory in Wordpro erases all text from the memory.

Wordpro recognises that replacing the text in the computer's memory with the directory can be a little annoying, so it makes you key an extra Return before the directory is loaded. Unfortunately this soon becomes habitual and so its value as an error trap is soon removed. You can, of course, dump the directory to the extra text, but this requires forethought — something which doesn't always come readily after a long session at the computer.

Both programs offer the user the advantage of saving files as ASCII files rather than in the usual compacted form. To many users this will not be of much interest, but it does mean that computer programs themselves can be composed, saved and edited using Superscript rather than the Pet's own editor. Being able to get rid of the computer's Teletype mentality, for example, of only listing a program from top to bottom represents a great leap forward for many amateur programmers. The same facility is also useful for accessing text as sequential files from other versions of Pets or even, with appropriate software, from other computers or types of program.

Extra text

Once the text has been entered the differences between the two programs' operation can also be seen. The most obvious is Superscript's larger memory for files since, unlike Wordpro, it does not reserve a variable amount of space for extra text. This approach has its limitations but it does mean that more usable memory is available for straight text. Although file memory limitations are not that important, thanks to both programs' very strong file-linking facilities, the longer the file the easier it is to edit, particularly when moving blocks. As the maximum file size is reduced, it means that you are more likely to have to go through the cumbersome process of creating additional subfiles in order to move a block of text from one file to another.

Processing blocks of text is an area in which Superscript scores. It can only move whole lines to another part of the file, or to another file, though it appears that future versions of Wordpro may not be keeping to this restriction. But in existing versions a very complex procedure is needed to transpose a sentence which extends from the middle of one line to the middle of another. All of the lines in which the required sentence occurs must be moved, and the text is then cleaned up by deleting the parts of the lines that were not meant to be moved. The same pieces of text then have to be replaced in their original position.

Superscript allows you to move blocks of text of any length—from one character to paragraphs and pages—from and to anywhere in a line. Transposing sentences and words becomes a much simpler procedure.

Wordpro does allow you to delete words or sentences, but this can be rather time consuming since blocks have to be made up by repeated instructions to delete a word or sentence. Superscript's blocking process allows deleting to be done much more simply. It also has a useful Paragraph Delete function.

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Pet alternatives

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Users may initially have some problems with Superscript's syntax, which distinguishes between Deleting and Erasing. Wordpro makes the same distinctions, but not in such a confusing way. Using Superscript you can Delete or Erase any sections of text, but the two commands do different things. Deleting removes the text and closes up the gap; Erasing removes the text and leaves a space. It is difficult to see the value of the Erase function, since even after closing the gap with Delete, typing new text in the Insert mode will always allow new text to be added.

One of the excellent features provided by Wordpro is the ability to append frequently used information into the text that is being typed. Standard words, phrases, sentences or even paragraphs are added by dividing the available memory into a Main Text and an Extra Text area. By relatively simple key presses, information in the Extra Text area can be inserted while typing in the Main Text area. The amount of memory available in each area is variable and under the control of the operator in all versions except Wordpro 5.

You could type a small letter in Wordpro's Main Text area and leave a large amount of room in the Extra Text area for mailing details. Alternatively a very small extra text area could be set aside, perhaps with only a couple of standard phrases, leaving the majority of memory free for the main text. Superscript does not have any of these facilities. All of the Pet memory is used for the text, which is how more memory comes to be available per file.

Mailing shots

Superscript's method of doing mail shots is not as easy as using Wordpro. Both programs require the operator to insert specified characters in the general document which indicate where the variable information is to be put for example, names, dates, addresses, etc. Using Wordpro, the variable information is put into the Extra Text area, either direct from the keyboard or loaded from a file. Printing out the document which includes variable information is then a simple matter of typing Control, O, and 1. Only if the list of variable information is longer than the memory available in the Extra Text area do things become slightly more complicated, as the variable data has to be loaded from a separate file. This file can have been created either by using Wordpro or by using the Basic program described in the November 1982 issue of *Practical Computing*.

With Superscript all the variable data has to be loaded from a separate, previously created file. It is no more difficult than the Wordpro system, but it does mean that a file has to be created and saved before repeated mail shots can be produced, rather than text simply being typed into the machine. An operator using Superscript only needs to learn one way of creating the variable information for a mail shot, whereas the Wordpro operator might need to learn two: using the Extra Text area for small lists and separate files for large ones.

Superscript also allows the user to type in variable information from the keyboard, but this has to be done each time a new letter is produced, so the operator has to remain at the keyboard all the time. With Wordpro all the variable information can be typed into the Extra Text area at once and, having set the machine going, the operator can leave it to run.

Good for tables

Superscript scores over Wordpro in the ability to pan over more than 80 columns, which is particularly useful for tables. Both vertical and horizontal tabs can be set within a line length of up to 240 characters, defined at the beginning of a session when Superscript is loaded. The tabs can be saved as part of the file by appending a + to the end of the file name when saving. Tables wider than 80 columns are a very messy business on Wordpro since more than one screen line has to be used for each row of the table. In Superscript the text around the table does not have to be printed out with the same margins as the table. The lm and rm formatting commands can be used to see to that.

Both programs allow you to print to either the screen or the printer. Screen printing is imperative when word-wrap is not available since the text will not be printed in the same format as it appears when being composed. Whereas the same Superscript program enables you to print to the screen on any version of the Pet, the 40-column Wordpro versions do not. Both programs also allow you to print a file from disc while editing another file but this is not available on Wordpros 1 to 3.

Superscript has the very useful Of command to offset the printer from column 1. It is of particular value to users who have sheet feeders attached to their printers. Setting the left margin position to, say, column 15 has the same effect as offsetting the printer head, but means that all other left margin settings have to be reset. Simply including an offset command on the first file makes life much easier. To do the same thing with Wordpro you must use the special character facility to send the appropriate control characters to the printer.

Both programs allow specified pages of text to be printed rather than the whole document. It is done by printing out the file to the screen until the required page is reached. The precise procedures used differ: Superscript's is probably easier to understand, whereas Wordpro's is faster.

Using Superscript, you can change from video to printer printing simply by pressing V or P after the output command. Unfortunately the change can only be made at the end of each page, so the printout has to be restarted at the end of each page by pressing V or P. To begin printing from a particular page you simply press V at the end of each page until the appropriate page appears, and then press P each time.

With Wordpro the change can be made using continuous printing. The procedure required here is for the output first to be to the video. Then as soon as the required page occurs the output is aborted and restarted at the same place, but is sent to the printer. To restart, type Control, O, P, G for global files, C for continuous output and Return. Then, when the file name is requested, press the Back Arrow key.

On Wordpro the process is faster with a large number of linked files; Superscript is faster with smaller number of files. But Wordpro only allows the facility with linked files, whereas it is possible for any file with Superscript.

Documentation

Both Wordpro and Superscript come with good documentation, though it would be useful to have a full index in the manuals. Though Pet owners should find either program immensely valuable for word processing, both have annoying features.

Wordpro's cursor is a solid block and Superscript's is a flashing block. When composing at the keyboard the flashing cursor becomes rather annoying, but it is useful when using the program's editing features. Wordpro's non-flashing cursor just sits there, and you have to scan the screen to find it, which is just as annoying as Superscript's flashing cursor.

Conclusions

- **Both programs are excellent.**
- **On cost alone, Superscript scores: at £249 it is around £100 to £150 less than Wordpro, depending on which version of Wordpro you buy.**
- **If you already are using one type of program then it is not worth buying the other simply for word-processing purposes.**
- **For processing straight text Superscript has the edge over Wordpro with more text space available and a proper block-move capability.**
- **Superscript will compose tables on the keyboard up to 240 columns wide, which is very useful for report writing.**
- **Wordpro's strengths lie more in the business user's orientations, with easier mailings, insertion of standard passages, and easier disc operation for inexperienced users.**

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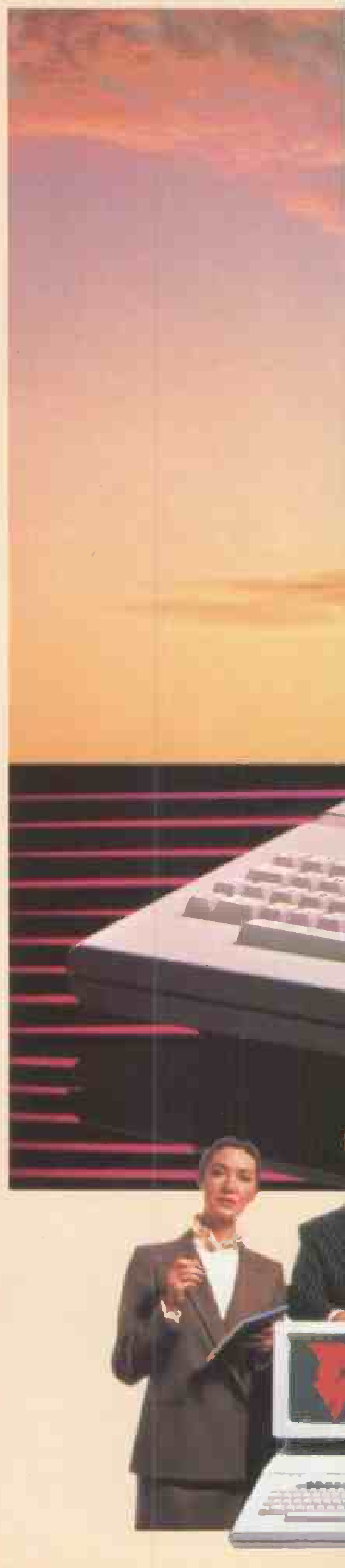

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ORION

Fast, British and expandable, the Orion seems well placed to compete for sales. Ian Stobie investigates.

THE 16-BIT computer market is becoming crowded. It is no longer enough for a new machine merely to make use of a 16-bit processor. It needs something extra to distinguish it from the competition. What the Orion has is speed.

The Orion is one of the few machines you can go out and buy now which uses the Intel 8086 processor rather than its less powerful brother, the 8088. Consequently the Orion is much faster than both the Sirius and the IBM PC at performing standard benchmark tests, and even beats the outstandingly fast Olivetti M-20.

The machine is being distributed by Office and Electronic Machines plc, a major British office-equipment group, with its own dealer network and direct-sales force. The OEM group is sole U.K. agent for Adler, Triumph and Imperial typewriters, and also sells the Bitsy range of word processors. The Orion represents an extension of OEM's range into general office systems. The standard single-user system costs just under £3,000, which is competitive, considering that the Orion has better-than-average communications and netwoŕ ing expansion possibilites.

The Orion was designed for OEM by Future Technology Systems. It is being built at FTS's plant at Beith in Ayrshire, where many of the parts are also made. The floppy-disc drives are American but most other parts are British, including the Scottish Rodime hard discs.

Externally the Orion has a conventional modern design, following the now standard three-box pattern. A detached keyboard and separate screen unit plug simply into the back of a system box, which contains the main circuit board and the disc drives.

The detached keyboard has a conventional layout, with a separate numeric keypad and plenty of programmable function keys. A groove running above the keys accommodates replaceable metal legend strips to describe function-key use with different software packages.

The keyboard has a light, fast feel. It pleased the touch typists in the office, although I found it a little trigger happy. I have yet to see a keyboard attached to a computer which has the the adjustable sensitivity that is common on electric typewriters.

The display is a 12in. green-on-grey CRT. This unit is also on the end of a single cable, so it is easy to move around, and the screen can be swivelled and tilted. Text is displayed clearly. Each character is formed from an eight-by-14 matrix of dots within a 10-by-16 cell.

A utility is provided for users to create their own character sets for specialised applications. It potentially allows the full 400-by-800 resolution of the screen to be used in graphics applications, but it is probably not the easiest way to go about things. Better software support for graphics applications is promised. An optional colour board is available.

One irritation is the absence of a brightness control on the screen unit. Screen brightness can, in fact, be adjusted through eight levels, but through a software switch. This involves going into the operating system and typing Ctrl-B a number of times, something which will not come easily to the average office user.

The system box contains the Intel 8086 processor, memory and disc drives. The review machine contained the minimum 128K RAM but it still had 62,395 bytes free after loading Basic, which is considerably more than some of the Orion's 16-bit competitors. The display uses its own additional 72K RAM area, so it does not eat into the space available for application programs. RAM can be expanded up to 896K in 128K increments.

64Kbit chips are used on the Orion main board at present. A new release of the main board going into production at the moment will also be able to take the latest high-capacity 256Kbit RAM chips. Once they become sufficiently cheap it will be possible to add large amounts of memory without using the expansion slots. Other options available or announced for fitting into the expansion slots are Modem, Telex, viewdata and colour cards.

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ORION

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Several disc options are available for the Orion, including 6Mbyte and 12Mbyte Winchester hard discs. They are 5.25in. units and fit neatly into the standard system box alongside a 1Mbyte double-sided floppy disc.

The entry-level machine we had to review came with the smallest-size discs, twin 520K 5.25in. American-made Micropolis floppy drives. When you turn the machine on a series of diagnostic checks are performed, the four lights over the Orion logo flicker impressively, then the message

Please insert a system disc

appears on the screen. Putting a floppy into the drive and shutting the door causes the operating system to load automatically, and the next screen to come up asks for a User ID and password.

What we are in conversation with here is Eos, the Orion's Easy Operating System, which is an extended version of CP/M-86. Eos is meant to be, and probably is, more suitable for the average office user. It provides improved security and a simple menu approach to using the system. Behind Eos lurks a quite conventional CP/M-86 from Digital Research, which you can reach easily if you want to.

After entering a valid user ID and password, the next screen to come up depends on the disc you have inserted. For example, one of our discs yielded

1 Peachtext
2 Peach Calc
3 Extended floppy disc formatter
4 Edit menu items
5 Edit user ID items
6 Enter the operating system
7 Log off from the system

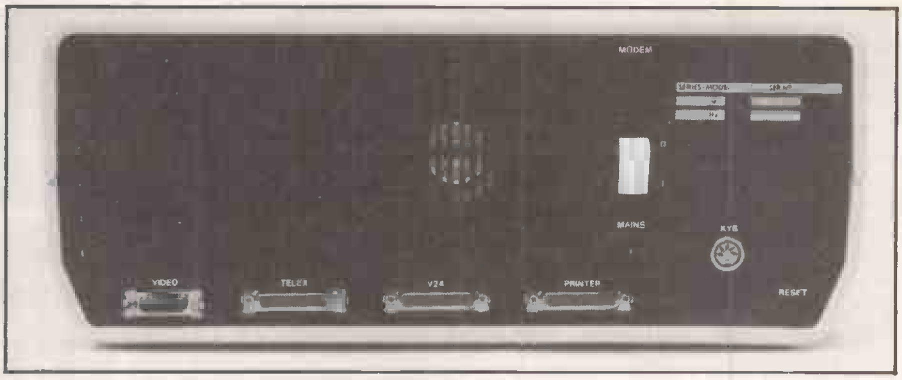
You type in the selected item number and go off into that chosen application.

The documentation with the system is excellent. The Eos manual is clear and simple, covering the facilities which would be of day-to-day concern to the office user. It includes a quick run through the most useful CP/M-86 commands. Another manual *Introduction to the Orion* is even simpler, and deals with things like connecting the machine up.

OEM seems to have a good appreciation of what office users want — which is to be kept away from technicalities. I suspect that it is this kind of thing which will make the machine a success rather than its speed and technical sophistication.

So far I have been describing Eos-C, the standard Orion operating system. Eos-M is also available as an option, corresponding to MP/M-86. It can be used with a single Orion, most effectively with a hard-disc system. It divides memory up into a number of partitions, allowing several programs to be run concurrently.

This is a more powerful feature than at first appears. Time-consuming tasks such as sorting a file or printing lengthy documents can be detached from the screen with a simple Ctrl-D command. The ordinary Eos prompt then comes up on the display and you can start doing something else while the Orion continues to sort or print without your intervention.



A concurrent operating system like EOS-M really comes into its own when communicating facilities are added to the standard machine. For instance, with the Telex option fitted, a program can be running continuously to monitor the Telex port. It can signal the user — hard at work with, say, a spreadsheet package — when a message requiring attention comes in.

FTS is planning to bring out a networking option to connect up to 15 Orions to a resource controller, which will itself be another Orion. Other plans are for a full Ethernet-compatible network interface. The Orion will also function as an intelligent terminal connected up to other computer systems, and software is available to support the IBM 2780, 3780 and 3270 protocols.

Conclusions

- **The Orion is a generally well-designed office computer with good expansion possibilities. It is likely to be of particular interest to users who want to link it to Telex, viewdata or a local area network in the future.**
- **It is one of the few machines available off the shelf to use the Intel 8086, making it a true 16-bit machines.**
- **The Orion really comes into its own when running the concurrent version of its operating system, which allows the user to run suitable tasks simultaneously.**
- **Whether the Orion will sell depends more on the way it is marketed than any technical consideration. OEM is well placed to sell it into offices.**

Specification

SYSTEM BOX
CPU: Intel 8086, 8 MHz
Memory: 128K expandable to 896K; additional 72K dedicated to the display
Discs: twin 5.25in. floppies, single-sided 512K each standard; double-sided 1Mbyte optional; 6Mbyte or 12Mbyte hard disc plus one 1Mbyte floppy available
Bus: six free expansion slots
Interfaces: three RS-232C configured for printer, communications and Telex
Dimensions: 420 × 410 × 165mm.

DISPLAY
Type: 12in. green-on-grey CRT
Display: 25 lines by 40 or 80 columns; 800 by 400 high-resolution graphics
Dimensions: 390 × 334 X 290mm.

KEYBOARD
Type: Detachable with standard QWERTY layout and spacing
Features: 96 keys in all, with 14-key numeric keypad, six cursor keys and 13 function keys
Dimensions: 420 × 210 × 55mm.

Manufacturer: Future Technology Systems
Price: £2,950
Distributor: Office and Equipment Machines PLC, 140-154 Borough High Street, London SE1 1LH. Telephone: 01-407 3191

Benchmarks

The time in seconds to run eight standard Basic routines. The routines test out various typical tasks, each repeating an appropriate set of carefully chosen Basic statements 1,000 times. The Basic interpreter is Microsoft's Basic-86 revision 5.21 supplied with the Orion.

	1	2	3	4	5	6	7	8	Av.
Orion 8086	0.6	2.1	4.8	4.9	5.8	10.5	16.7	13.0	7.3
Olivetti M-20 Z-8000	1.1	4.0	8.0	8.4	9.2	17.1	26.5	12.0	10.8
IBM PC 8088	1.4	5.2	12.1	12.6	13.6	23.5	37.4	35.0	17.6
Sirius 1 8088	2.0	7.4	17.0	17.5	19.8	35.4	55.9	42.5	24.7

The double life of Martin Healey

The designer of the Orion told Ian Stobie how he views current developments in the micro industry.

MARTIN HEALEY is reasearch director of Future Technology Systems, and the man responsible for the design of the Orion, reviewed in this issue. He is also Professor of Microprocessor Engineering at University College, Cardiff.

Combining academic and commercial roles in this way is still unusual in Britain. Martin Healey explained how it worked: "It is a way of turning my academic ideas into production, of putting my money where my mouth is. Universities have no skills of commercialism, no production skills. And there is a world of difference between what can be made and what can be just prototyped. A university can be no more than a prototyping vehicle; it cannot be a production vehicle."

Martin Healey set up the company in 1979 together with Peter McHugh the managing director, and David Shear the marketing director. They have since been joined by Sir Monty Finniston as chairman. For a U.K. start-up company in a high-technology area it was very well financed, with Norwich Union Insurance, Scottish and Northern Investment Trust and the Scottish Development Agency each holding a 20 percent stake in the equity capital.

FTS's initial product was the Series 88 work station, a fairly up-market multi-function office computer built around a 16-bit processor. There are now several machines in the Series 88 range, and they are mainly used, several at a time, in multi-user, multi-machine networks.

The Orion is a lower-cost machine aimed at the general office market. It was designed on behalf of Office and Electronic Machines plc, who will actually sell it. Healey finds it a satisfactory arrangement. "OEM's strength is in marketing, our strength is in design and manufacture. The OEM/FTS combination gives us strength which neither of us could achieve individually."

OEM could have simply imported a machine from America or Japan instead of having FTS build for them. The advantage to OEM, according to Healey, is simply that they are much more in charge of their own destiny: "The history of American companies coming into this country is to set up with a big dealer to get things rolling. As soon as he gets it going nicely they then

come in themselves, clobber off the dealer, and then muck it up."

Though no protectionist, Healey is saddened at the way that so many foreign manufacturers make inroads into the British market thanks to local skills: "Look at the Sirius situation. A terribly mundane, mediocre machine — nothing better than that — beautifully, superbly marketed. The element that is terrific and superb about the Sirius is the British element, the marketing. It is ACT that is good, not the product."

"You have got have that dedication, that personal interest, that burning desire to do it. It is absolutely crucial."

The Orion invites comparison with other 16-bit machines of similar price, the Sirius and IBM PC in particular. Yet it is a comparison which Healey does not find valid. In his view the Orion's speed sets it apart — not for its own sake but because it allows the Orion to run Concurrent CP/M.

Healey believes the choice of operating system to be crucial: "I honestly do not think people appreciate the impact that Concurrent CP/M is going to make. Concurrent CP/M is a step-function leap forward in user computing. Once you get two machines installed, one running CP/M and one running Concurrent CP/M then the user of the CP/M machine is going to resign unless you upgrade her machine to Concurrent CP/M."

Conurrent CP/M allows the user to run more than one task at the same time. It is more than a simple foreground/background operating system, as found on some minis and advanced word processors. The user can switch the display from one program to another without interrupting program execution.

Healey explains further: "It is virtual screens which are so phenomenal. If in the middle of doing your word processing somebody comes along and says 'Please can we look at what is in the diary?' all you do is hit a function key, look what is in the diary, hit another function key and go back to doing your word processing."

Application programs that run under Concurrent CP/M have to be MP/M-86 based applications, not CP/M-based. The original eight-bit MP/M, Healey describes as a "load of rubbish" adding that it is rather unfortunate that you have to use almost the same terminology for MP/M-86, "a very superior product" as he puts it.

In addition to Digital Research's Concurrent CP/M, several companies are reacting to the possibilities opened up by powerful 16-bit hardware with new software products. Apple's Lisa machine integrates several standard applications into a single multi-tasking user environment, as do the Visicorp VisiOn, Lotus 123, and MBA Context packages.

These are multi-tasking in one sense — you can jump between different applications very easily — but Martin Healey believes it is important to preserve the distinction in people's mind between this type of product and an operating system like Concurrent CP/M. "What they mean is taking one task — what I would call a task like word processing, and then

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making it much much more friendly, by making it more integratable. That is lovely, I like that, and roll on VisiOn and things like that, 123. But I believe that they need to run as a task under Concurrent CP/M. Then you need other tasks, which are much more isolated, like a batch-file data-transfer program.

"The point I am trying to make is that nobody has yet seen Concurrent CP/M. When they see it, users won't want the other stuff. Users will want the better product. It is the first time that the user is going to get to see something that he prefers better or she prefers better than the norm."

There are several other 16-bit operating systems he could have chosen, so why did Healey go for the Digital Research family? "There is no real choice of operating system in the market place. MS-DOS is the only hiccup. Once you have a decision to go 16-bit machinery you only have two choices of processor. They are the 8086 and the 68000. If you want to go in for office processing and so forth you have got to go for the 8086 because it has CP/M-86 available for it. There is nothing for the 68000 in terms of software. We would have gone bankrupt if we had gone for the 68000 instead of an 8086, no question of doubt. Lack of software would have killed us."

This does not mean Healey writes off 68000-machines — it is more a question of making the correct choice for a particular market. The 68000 is more for technical and university-type people, who will probably be developing their own software in a Unix environment.

He declines to contribute to the Unix verses CP/M argument. "That is rubbish, they are quite different products and different things altogether. Absolutely different. Concurrent CP/M is the real icing on the cake that has arrived by staying with the CP/M family. The thing we did not need was MS-DOS.

"In a sense it came about because the initial releases of MS-DOS are much faster at disc I/O than CP/M-86. Very low-performance machines like the Sirius and the IBM really have to use it to cover up for their lack of performance.

"But of course what has happened is that Concurrent CP/M has got all the cacheing algorithms and the hashed disc directories and so forth, and so Concurrent CP/M is quicker at disc access than MS-DOS. It has leapfrogged straight over the competition. And the next release of CP/M-86 will have all the improved disc facilities so it will be as fast as MS-DOS. Then you have got a family, CP/M-86, Concurrent CP/M-86 and MP/M-86."

Healey went on to point out an advantage that micro share had over minis and mainframes. "The beauty of the microcomputer industry was that we have had common software vendors, we had the one operating system. That is why we progressed so fast, because of this commonality of base software.

Concurrent CP/M is one of the Orion's strong points.

"Now instantly you produce two similar operating systems, like MS-DOS and CP/M-86, then you have got to write two Basic compilers, two Cobol compilers, two Pascal compilers, and it is just a damned nuisance. There is nothing wrong with MS-DOS. How they compare technically is irrelevant: we did not need two. The only thing that is holding MS-DOS into that market so strongly is lack of performance of CP/M-86 on its disc I/O, and lack of performance on the processors of the Sirius in particular."

The Orion is capable of supporting two terminals, so as well as multi-tasking it can be a multi-user machine. Again, solving the technical problems is only half the battle, according to Martin Healey. "I believe the next generation of marketing support has got to be far, far more aware of the end-user problems of running two-user systems as opposed to one-user systems. Good-quality two-user software is not two copies of single-user software.

"Basic is bad news as far as multi-user systems is concerned. Therefore you are finding companies like Peachtree, for example, writing ordinary single-user stuff in Basic, but all the multi-user stuff is written in Cobol.

"All the standard syntax required for sharing files is a fundamental feature of Cobol. Nobody is saying it can't be added to Basic, and there are some smashing Basics like the MAI Basic, which is fine, but in general Basic is not ideal."

Healey is not wildly partisan on behalf of one language or another — in fact just realistic. "In general the quality of documentation is far more important than what the language is that something is written in," is how he sums it up.

Returning to the subject of his company, Healey is optimistic about its prospects: "There isn't another start-up company in the U.K. in computers that has been funded to the level of FTS. We are currently running at a level of £2,000,000 funding, and we are running on target for about an £8,000,000 turnover. One thing we are not out to be is another little back-street company.

"They will catch us up. What we have proved to be extremely good at is producing new products and new designs fairly quickly. So what we are after is markets that are all about producing, designing, manufacturing and shipping products quicker than the large corporations can do it. I think we can beat them to the punch very easily.

"What we would like to do is attract them to us. We are sure that we can design a machine very significantly cheaper, and we can prototype it and get it into what we would call high-volume production — which they may call low-volume production — very much more quickly, very much more cheaply than they can. So we would rather join them than beat them."

Healey believes FTS has better prospects than most in the struggle for this market: "I think one thing FTS has got more than most is some spunk and some guts, and we are going fight for it. One thing you notice with American companies is you identify people with the corporations. You identify Gordon Bell with DEC, and Peddle with Sirius.

"You have got to have that dedication, that personal interest, that burning desire to do it. It is absolutely critical. I mean, these are my designs you are talking about. I have this burning personal desire to see my designs thrust forward, not stopped. There is a tremendous feeling of authorship.

"In the same way as I am in a unique situation in my industry/university relationship, I would like to see far more personality being pushed into the industry. You can't deny that the Americans are more successful than the British. It is no use turning around and saying 'Well, we don't like the way they do things.' You have got to take some note."

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Robot ping-pong

John Billingsley announces a challenging contest to be held in 1986.

THE ASTONISHING PERFORMANCE of the micromice competing in a diabolical maze at the Finnish Euromouse Finals indicates that the contest has come of age. Participation by the multinational companies — never outstandingly successful — has faded away, and there are increasing numbers of participants representing schools in the novice contests. The contest, as with a Rubic cube, is no longer a question of "can you devise a way to do it" but one of "can you clip another second off your time".

Now is the time to announce a new contest to stretch the mental muscles — Robot Ping-Pong. The first contest will be held in 1986, by which time many more one-armed robots will be in the hands of enthusiasts, many of whom will have built their own from scratch.

To avoid danger to health and safety at play the table is a mere 50cm. wide, and a frame at each end further limits the playing space to 50cm. in height. The net in the middle of the two-metre long table is 25cm. high.

Above the net is yet another 50cm. square frame to outlaw the unsportsrobotlike practice of lobbing the ball out of view of the opponent's sensors. The bat size must not exceed a circle of diameter 12.5cm. and the bat must not encroach inside the playing frame at the end of the table.

A simple mechanism near the top of the centre frame serves the ball towards the robot which is serving. It must return the ball so that it bounces once on the opponent's end of the table before emerging from the opponent's playing frame. The robot opponent must in turn return the ball to bounce just once on the opposite end of the table and the game proceeds. If the ball strikes the playing frame, the point is lost. It is possible that there may be some very long rallies, so if the opponent successfully returns the ball 20 times it wins the point.

The surface of the table will be three-quarters of a metre above floor level and each robot will have a 1m. square of floor on which to stand. The means of illumination will be agreed with contestants as the contest draws nearer, but will probably be by tungsten filament lamps well out of the field of view of each robot.

Robot vision is at present a costly commodity. Many of the techniques at present under development require massive computer power to analyse the optical image. Hopefully the contest will encourage the development of low-cost sensor techniques capable of tracking the ball, perhaps with no more than half-a-dozen simple photocells behind a cheap camera lens.

It has been suggested that restrictions should be placed on the resources used and that links to mainframes should be banned. Anyone who can get a real time response from a main-frame at the speeds required here has my admiration. I would instead point out that an early mouse builder admitted to being hampered by an excess of resources.

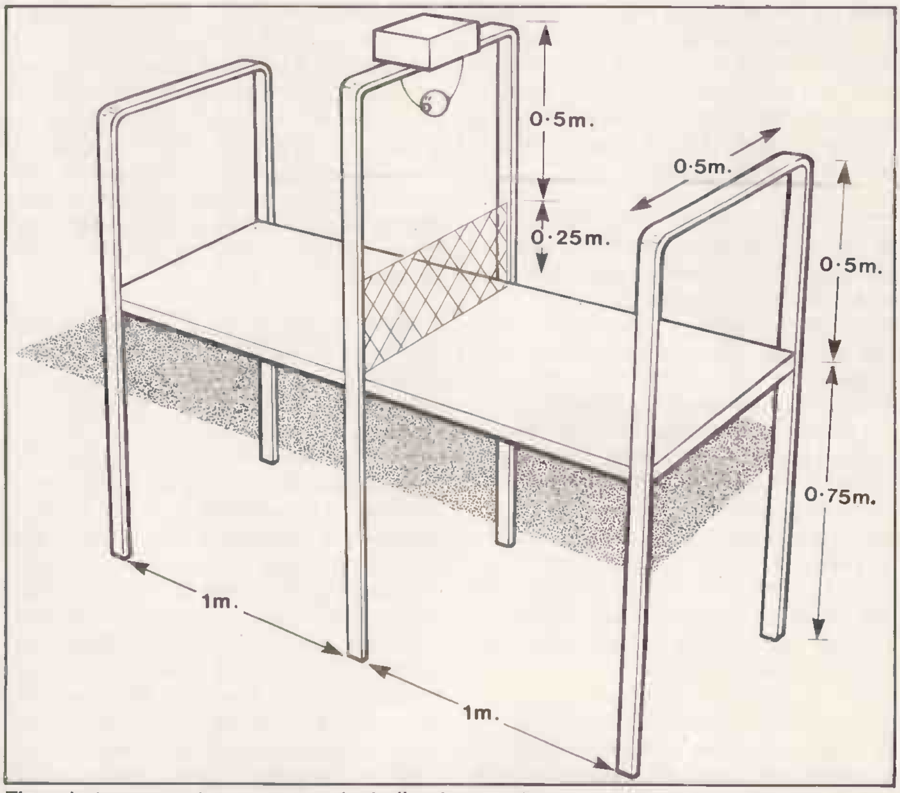
Restrictions must be applied to the moving mass and power of the robot for safety reasons. At this early stage it is hard to set a limit: a Puma 600 is clearly over the top, while an Armdroid lacks the reach and speed. I suspect that we will see some ingenious home-grown robots perhaps with a structure of glass-fibre reinforced foam. Car window-winder motors could be in great demand.

The fastest net-skimming return from a low ball takes just under 0.5 seconds from bat to bounce, and has a vertical velocity on bouncing of just over two metres per second. It should be almost within the performance of the servos of any self-respecting high-speed plotter. On the other hand, a lob will give more time to respond but may have double the vertical velocity.

Contestants should avoid some of the more obvious preconceptions. The bat need not look very much like a bat provided that it does not exceed the size limitation. A curved surface could enable accuracy of control to be traded for the need for bat angle actuators — a corner reflector must be ruled out because of treble hitting. The robot need only rely on arm movement to strike the ball, a spring-loaded bat could be triggered to give an impact, which suggests accurate range finding and precise timing.

The problem of vision is reduced by allowing both robots to lock on to the ball before it is served. The net is transparent and so the problem is one of tracking not of acquisition. A robot which cannot keep its eye on the ball will deserve to lose the point. Those parts of the robot seen by its opponent must be dark in colour to provide a good contrast — it may be necessary to specify a black paint which is also black to infrared light. The back of each robot should, in contrast, be flamboyant and entertaining.

If you are prepared to meet the challenge of Robot Ping-Pong please write to Dr John Billingsley, Department of Electrical and Electronic Engineering, Portsmouth Polytechnic, Anglesea Road, Portsmouth, PO1 3DJ.



The robot opponent must return the ball to bounce just once off the opposite end of the table.

The computer that cared

by Randall McMullan

I first wrote to the computer as a slightly desperate whimsey. Computers are not supposed to have humanitarian feelings, at least not yet, but this one could read and I must have felt that the basic skill of literacy gave us something in common. If the computer was a little limited in its choice of literature then, after all, I was similarly limited in my mathematical powers.

Our relationship began one evening as I sat in a pub, carefully matching my drinking to my dole money. I was redundant, I was bored, and I was worried. On the damp table alongside my beer I had spread the unpaid bills. Each payment card instructed me to write upon it the amount of my payment. The computer would then automatically transfer funds from my account — that was the theory.

For the mortgage I wrote, in dutiful pencil, a payment for the sum of nought pounds and nought pence. Then writing on the card I continued with the words, "This payment is a worry". It was a memo for myself rather than for others, but I felt better for having shared this alcoholic little insight into my finances. On the way home I passed the bank and offered the payment cards into the metallic slot of the 24-hour automatic till. The bankomat hummed contentedly as it pulled the cards from my hand with a greedy grip.

Two days later the postman delivered an envelope from the bank. It contained no letter, just another computer card, but its demands were now philosophical rather than fiscal. The printout read, "Have no record of term labelled worry. Do clarify. Make input on this card. Use restricted vocabulary."

I assumed that this message was a standard pre-programmed response. Yet I enjoyed receiving it, the morning post and the evening drink were the peaks of my monotonous existence. So in the pub again that evening I replied to the computer. I used a terse form of cablegram prose laced with some words of computer jargon which I had taken on board during my orbit as a high-flying executive.

The zero payment, I explained, was like a bad printout caused by incomplete input data, not enough money in my case. I equated worry to a computer having to run a faulty program which could never give a correct output. Then I asked this computer just how it was able to read and write. I did not really expect any answers, except perhaps from the computer staff or from the public relations department.

However, the envelope that arrived by return of post came directly from the computer. The message was printed out on to lots of cards, some of which I could understand, but I needed the help of reference books to decipher all the terms. I spent hours in the local library completely absorbed in my project, undistracted by the crackles and snores of the newspaper readers nearby. The computer printout combined the challenge of a crossword puzzle with the grip of a good story.

My computer, it seemed, had been among the most powerful of its generation when it had first pulsed at the heart of Central Banking. International monetary matters were transacted in its circuits, its memory banks had stored every trading trend, even a few financial fiddles had been played on its terminals. But these capabilities were no longer needed. As part of a scheme to minimise tax liability the bank had acquired another computer, a later-generation machine. I felt a pang of almost electronic fellowship as I recognised the parallel with my own replacement by a younger-model executive.

Unlike myself, the computer had not been completely written off. It now acted as a controller for the automated banking tills by checking the identity of magnetic cards, by opening slots, and by reading numbers on payments. But the computer now did nothing further with this information except to pass it on to the new machine for processing. It had become a mere intermediary in the system, a digital messenger boy. However, no one had bothered to remove the original data files and their operating systems from the redundant parts of the computer. All that information, the best and the worst of international banking knowledge, was stored unused, probably forgotten.

By deciphering further printouts I discovered just how the computer had been able to communicate with me. While it had been scanning the endless number of payment cards it had begun to record the writing as well as the numerals written on the cards. The computer had stored this information in its under-used memory and had then analysed it for all possible trends, employing the various techniques that it had once used for financial analysis. By these means it has apparently taught itself to read. It had always been able to write and had access to an automatic mailing machine. Like myself, when redundant the computer had become bored.

On the final card of its long message the computer stated that our future communications should be direct — I should obtain an appropriate terminal and connect it to the computer via my telephone. With a certain sharpness of tone in my programming language I replied that I had no input of money. In a few weeks time I would be lucky if my telephone was still connected, as a quick scan of its own data would verify. Furthermore, to keep my own circuits alive I needed rather more than the electricity supply that sufficed for itself.

Having posted the reply I felt a little ashamed of its unfriendly tone, especially as these transactions had taught me a lot about computers. The knowledge could be useful. According to the Minister for Unemployment computers were the key to the future.

My own computer contacted me promptly with an envelope which bulged with bank statements for all my accounts. Each statement recorded that all arrears had been paid — nothing more was owing. On a card from the computer itself I read the following message: "Use credit card for all purchases. Make no payments. All accounts in balance. Do not worry."

So I did not worry. The payments had never been very tangible when they were deducted straight from my salary, paid with money that I had never seen. Now with my salary stopped it seemed appropriate that my payments should also stop. Besides, the tersity of our communications did not allow much room for moral debate and I was happy to obey the command not to worry. Instead, I travelled into the city centre and bought, on credit, a suitable terminal from one of the computer shops — by now I was fluent in computer talk. At home I connected the unit to my telephone and by sending certain codes I could communicate directly with the computer.

We fell into a routine of linking up each morning before the banks opened and the computers became busy. I spent much of our time together in exploring the network of computers and the systems that they contained. At other times of the day I continued my interest by reading manuals, scrutinising printouts, learning new programming languages. My knowledge grew rapidly.

I still walked to the pub in the evenings, but now I went for the exercise rather than from bordeom. My mind tended to remain engaged with some aspect of computing even when I was drinking or walking. One evening I was passing a branch of the bank when I realised that the time had come to apply my expertise to a career, to start turning the key to the future. The very doors of the bank suddenly suggested an opening into a prosperous future.

During the next few weeks I studied the programs stored in all the computers of the bank, and took copies of the ones that I thought useful. I gave particular attention to those forgotten systems in my computer which had been used for transactions of dubious legality, those which revealed the less creditable image of banking.

Then I applied for a position with the bank. My history and references as an executive were respectable enough and I could manage a business lunch as astutely as anyone else. But because I had no formal background in computer banking systems I needed to prove my ability by signs and wonders, like Moses demonstrating to the Pharaoh.

I did not need to go so far as to part the waters of the river that flowed near the headquarters of the bank. A small manifestation of computer plagues convinced the directors, to whom I demonstrated on their own computer display screens. First, I called up summaries of true profits for recent years and displayed them together with the profits that had been declared for tax purposes. The contrast between the two sets of figures was enhanced by my technique of colour display. Next, I showed the annual incomes of certain charitable trust accounts which the bank looked after. These figures were compared with the better incomes that other, less lethargic managements could have generated. In my final presentation most of the directors were surprised to learn the details of certain foreign currency transfers that would also have surprised the Treasury, had the Treasury known. I presented this information in the form of a typical tabloid newspaper article, complete with headlines.

Immediately after my presentation the directors held a special board meeting of which no minutes were taken. Everyone present agreed that the bank computer system needed better security, and that I was the person who could best provide it.

I now have an executive office suite to myself. The door displays my title as Director of Computing Services. I have furnished the rooms in an antique but comfortable manner, which focuses on the pleasant view across the City. The only hint of computing is the visual display unit, discreetly encased in real mahogany to match my desk.

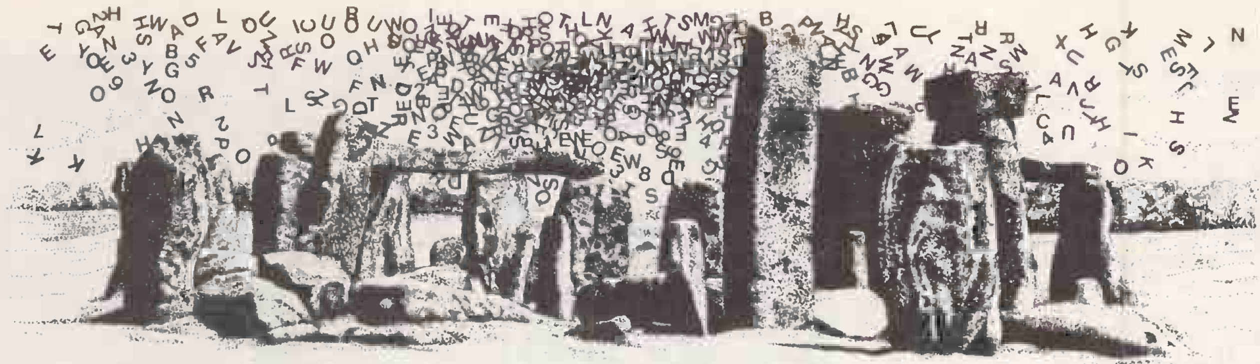
I am no longer bored, my days are as full or as empty as I care to make them. I have retained the morning habit of discourse with computers and I ensure that they are never bored. Good luncheons are baked into the lifestyle of a financial executive so the decor of my office is designed to be restful in the afternoon, and to give relief from the difficult decisions made about the lunch menu.

I am no longer redundant. The new security procedures that I have embedded into the computer systems not only protect the interests of the bank, they also protect me. I was given a free hand to design the new systems and I have made sure that my knowledge will always be vital. I am certainly not worried.

But the computer that initiated this successful career program of mine. Does it have a new job? No, because I generated figures that justified completely replacing that computer. The day before it was finally disconnected I received a card from the computer, in the post, just like our early communications. The message queried the changes that it had detected and ended with a last sad statement, "This is a worry".

A mercy killing really. Learning to read was clever, learning to worry was unnecessary. However, I am grateful to that first computer of mine for opening new doors in my life and I have ensured that it is not forgotten. The bank celebrates the achievements of that machine in our new slogan for automatic banking services, "Our Computers Care."

They do not really care of course. But then, neither do they worry.



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Memory matters

Introducing our 20-page feature, Jack Schofield looks at how storage media are changing to meet users' needs.

HOWEVER MUCH RAM you have, you can bet it's not enough. Five years ago, many people found 16K luxurious, and 64K was like owning a new car—and no cheaper. Now 16-bit micros make 256K sound normal and even eight-bit micros can, by using bank-switched memory, offer generous amounts of RAM.

In the same way, that 88K or 143K disc designed in 1979 seems limiting now. Serious disc discussions have abandoned kilobytes for megabytes of RAM. The future is measured in gigabytes.

And still it is not enough, because the applications requirements are expanding just as quickly as the hardware capacities. A database with half a dozen applications in daily use can grow, like Topsy, until it takes up so many floppies you need a disc just to index them. Integrated software packages like 123, VisiOn and Context need masses of RAM and storage, while Apple's Lisa eats up 2Mbyte of software and sits on a 5Mbyte hard disc before you start to add any data of your own.

RAM is thus becoming increasingly important. First, RAM is needed to provide a more user-friendly operating system, and thus make the micro more accessible to the ordinary person. Second, RAM is needed for high-resolution colour graphics—from 64K to 256K can easily be used. Third, programs are becoming more sophisticated and need losts of RAM even if, like WordStar and Lisa, they keep parts of the program on disc instead of in main memory. Users want error checking and help levels, and everything takes more space.

At the moment, in the microcomputer world, 5.25in. floppy discs are the most common method of mass storage. There are many other disc options, as explained in the following article. But in the future, other types of storage will make a significant impact on the market. Currently the following areas are being explored: RAM discs, bubble memories, video and other tapes, video discs and laser cards.

Discs and databases, as described in the rest of this special section, are the cutting edge of today's technology. They are making new things possible. But remember they represent only the start of something that is very much bigger — megabytes and gigabytes and terabytes bigger.

RAMdiscs or "virtual discs" are sets of random-access memory chips that look to the operating system like a disc drive. Examples are the 128K Ramd Axlon RAMdisc for Apple and Atari micros, and the M-Drive from Compupro. The advantage is that memory can be accessed without the delays involved in reading a disc mechanically. The disadvantage is that RAM is volatile, so the data disappers if the power is turned off. RAMdiscs are therefore useful only to people who already have conventional discs to provide back-up storage for programs and data.

Bubble memories work like RAMdiscs but are less fragile, much smaller, only a little slower, and non-volatile. Fujitsu and Grid Systems have already started selling bubble-memory micros, and you can get a bubble-board for the Apple II. At the moment the technology is still too expensive for general use, but Intel has scheduled a 4Mbit bubble for delivery this year, and expects the cost to drop from $1,500 now to $600 in 1984 and $150 in 1986.

Video tapes have the advantage that they can provide masses of storage, and the disadvantage shared by all tapes — it is time-consuming to use them. Video tape is used by the Corvus Mirror and Alpha Micro systems to backup hard discs, but it now looks as though cartridge-loaded hard discs could replace both video tape and conventional floppies for this purpose.

Video discs have the advantages of massive capacities — 2,000Mbyte is a figure often mentioned — archival permanence, and low cost. The disadvantages are that it is hard to write to video discs, and even harder to erase and rewrite what you have once written. Video discs are read by lasers, and in that form they now come relatively cheap. However, they are also written by lasers, and that is still expensive.

Optical discs are currently available in two types — ones that play back movies and ones that play back music, the so-called "compact disc". Either could be used for computer data storage, or a new format might be developed. A video-type optical disc could probably hold up to 4Gbyte and you could have a stack of them handled by an automatic record changer. The Storage Technology Corporation, STC, has already had the idea of linking 500 of them to an IBM to provide 2 terabytes or 2,000,000Mbyte of on-line storage.

When such large amounts of storage are possible, the problem of erasing the media for rewritng becomes irrelevant. The disc is simply set to store every single keystroke — incidentally providing an audit trail beyond the wildest dreams of the accountant — the instant it is made. Saving to disc will be continuous and automatic. When a text is updated, you simply leave a pointer to the address of the newest version.

Laser cards are the storage medium of the future when it comes to packaging software, and may even replace books. The laser card has already been launched commercially by the Drexler Technology Corporation of Mountain View, California, and Toshiba has been the first to licence the technology. The card is read by a laser, like the disc, but the optical medium users silver halide particles, just like photography. A 12in. Drexon disc holds 1.25Gbyte per side. A laser card the size of a credit card holds 5Mbyte or so, enough for 10 novels of 100,000 words each. The cost of such cards is expected to drop to paperback prices quite quickly. Philips, Burroughs, Kodak and other companies are working on ways of achieving even greater packing densities.

Magnetic discs

From micro-floppies to Winchesters, Robert Parry reviews the field.

SO YOU ARE fed up with tape cassettes for your mass storage, tired of running past half a dozen programs you do not want before you find the one you planned to use. Certainly cassettes are cheap and cheerful, but it really is rather tedious finding out just where you ought to be on the tape — not to mention making sure that there was enough room for the whole thing when you saved it in the first place.

Disc storage does not have these time-wasting troubles. The drives are a lot more expensive, and the discs themselves cost more than tape cassettes, but for your money you get a much faster storage medium that can bring you more information in far less time.

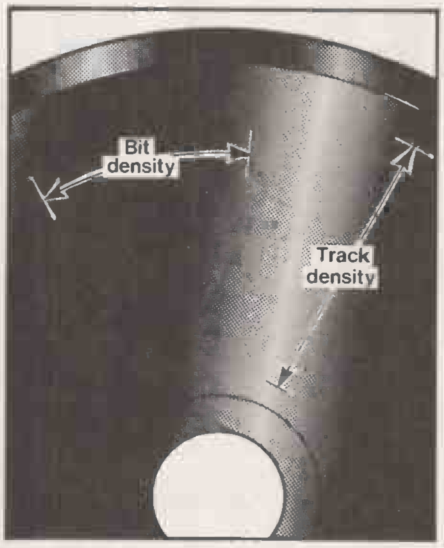
It is all very well talking generally about "discs" as though there were only one kind, but unfortunately that is not the case. Not only do the beasts come in a variety of different sizes, they come in two textures too — hard and soft.

The first kind that you are likely to come across as you move up from cassettes is the soft sort. These are floppy discs — or floppies, or diskettes, or mini-discs, or whatever you or the manufacturers call them. They are all much the same.

They come in three basic sizes, 8in. 5.25in. or 3.5in. diameter, though as we shall see later, this last size covers a multitude of sins under an umbrella title. All are round and all are flexible, but usually encased in cardboard or plastic sleeves to give them some measure of rigidity and protection. They can carry up to a megabyte or so of data.

The hard variety come in a range of sizes too, and share some characteristics with floppies. But their storage capacities — anything from 5Mbyte to 50Mbyte and above — and the price you have to pay for this high-volume high-performance memory put them into a very different category. You are unlikely to find hard discs without accompanying floppies, so before looking more intently at hard discs in general, and Winchesters in particular, back to the floppies.

Like cassette tapes, discs are coated with a magnetic material that can be arranged in two distinct states, giving the zero and one needed to record binary data. Unlike cassette tape, discs do not store the groups of characters one after another in a serial stream, which would be the case if the discs mimicked the gramophone record with its spiral groove. Instead the data is stored in concentric tracks, and the disc-drive head is free to jump from track to track to record or play back data.



Data is stored in concentric tracks, each divided into several sectors.

It is this random access, or better direct access, that gives the floppy disc its main speed advantage over cassettes. The drive head moves to the appropriate track before reading or writing, so in theory the disc only needs to make one rotation at most for the head to be over the right portion of data. Going back to the audio analogy, it is like moving the stylus over the record to the start of the particular item you want to hear.

There are usually around 40 tracks on a standard 5.25in. single-sided disc, and 77 on a standard 8in. Each track is divided into discrete sectors — blocks of data usually 256 or 512 bytes long. The division can be done by the computer itself or by microprocessor logic built into the drive. There are two ways for the read/write head in the drive to find its place over a particular track, called "hard sectoring" and "soft sectoring".

A hard-sectored disc has holes punched at intervals all the way round the central hole into which the drive spindle fits to spin the disc. Each hole represents the start of a sector. In soft sectoring there is only one index hole marking the start of the track. The length of each sector is set by the software programming of the machine itself.

The number of tracks used and the number of sectors per track vary from drive to drive. Indeed some drives have read/write heads for both sides or a disc at once, introducing yet another source of variation. Not only do the discs come in different sizes, but within each size you can get the four permutations of single and double sided, single and double density formats.

Robert Parry is Micro Editor of *Computer Weekly*

Most floppy drives you will come across can only handle one particular combination of sides, tracks, sectors and density, and as a general rule the more you pay, the more storage you get. Single-sided single-density, SSSD discs give you upwards of 50K with 5.35in. discs, 200K with the larger 8in.

These are both very much lower limits, and with the technological skills used by disc-drive and media makers to squeeze more into each disc, capacities are more commonly around 300K per side for a double-density 5.25in. mini-floppy and double that for an 8in. floppy.

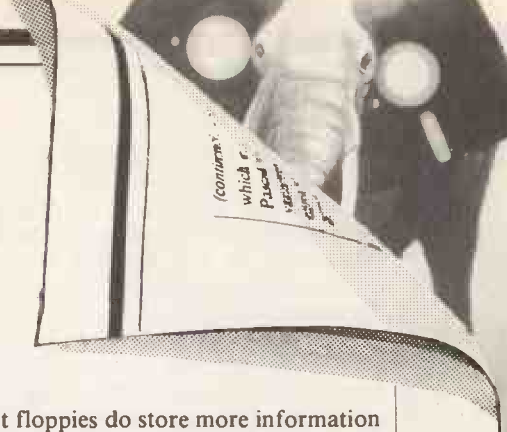
Surprisingly, perhaps, the newcomers around 3.5in. in diameter, the micro-floppies, do not carry noticeably less data than their bigger brothers. They have come along late enough to take advantage of the clever technological tweaking.

The actual discs from the various manufacturers arrive blank, unsullied by any particular format. But they do come with labels, specifying a particular number of tracks, or single or double density, which indicate the sort of drives they are designed to fit.

If you want to put more data on a disc, as in double-density drives, the quality of the disc recording surface needs to be better, which inevitably means that the disc will be more expensive. The term "double density" refers to the packing of data along the tracks, not the number of tracks across a disc.

The drive unit itself is just a box that holds the disc and spins it at somewhere between 300 and 360 revolutions a minute, while a magnetic read/write head moves across its width, driven by a stepper motor. The square, protective cardboard envelope in which the disc spins has a slot cut in it to allow the head to get at the disc's recording surface.

A drive needs an electronic controller which translates a user's wish to read or write a particular piece of data into the required movement of the magnetic head. It is usually mounted on its own printed-circuit board within the main microcomputer, or sometimes in the drive box if it is added on as an afterthought. Controllers often are able to run several floppy drives, or mixtures of floppy and hard-disc drives, at the same time.



Software within the micro — the computer's disc-operating system or DOS — is what makes sure that the correct things happen at the right time. The operating system is usually stored on the first couple of tracks of a disc. One of them has several sectors put aside for a directory, a list of what items are stored where on the disc.

These days there is a move to store the disc-operating system in a ROM chip within the micro, rather than on a system disc. This eliminates the chore of loading the operating system from the disc into RAM — the process of booting up the system — and frees all the RAM area for user applications.

If you look around at the floppy-disc drives available, either as separate boxes to add on to a machine or as an integral part of the main microcomputer unit, you will see that they normally live in pairs. The reason they do so is tied up with that disc-operating system resident on a floppy. Systems that use this arrangement sometimes require such a systems disc to be permanently loaded, so that the parts of the DOS can be switched in as needed, and more of the internal RAM is freed for the user.

With this sort of set-up it is usually necessary to have a second disc to provide enough room for the programs and data you want to work with. Even if one disc is not permanently encumbered in this way it makes sense to keep programs and data files on separate discs.

The other main reason is one of security, a topic that becomes even more important when Winchester discs enter the picture. There are so many ways that data stored on a disc can be ruined — by mishandling the disc when loading it into a drive, spilling things over it, letting the cat at it or even through some internal electronic mishap within the machine — that it is essential to have a back-up copy.

The easiest and perhaps the only way if regular security copies are to be taken as a matter of course is to have two drives. You can then copy the information from a master disc in one drive on to a back-up disc in the other. The problem is then just one of housekeeping, making sure you cannot ruin both your copies at the same time.

The susceptibility of floppy discs to damage from prying fingers or inquisitive pets is a significant drawback compared with tape cassettes. You do have to look after them, and make sure not to leave them in a scrambled heap somewhere they will be affected by high temperatures or stray magnetic fields. Don't keep them on top of the TV monitor, for example. The drives cost a lot more than cassette drives too, from around £150 up to £300 or £400, compared to the £40 or so for a cassette drive. The discs themselves can be expensive, costing from around £2 each.

But floppies do store more information more quickly, and are really a lot easier to use than tape cassettes. It is not difficult to learn which way the discs go into the hole in the front of the drive, and that the drive door has to be shut before it will work. In theory they offer considerable scope for transportability of software among machines, though in practice this is beset with problems of format compatibility.

Like them or not, floppy discs are here to stay as the main mass-storage medium for microcomputers, and are going to continue to make up a large part of the system cost. Floppies came out of mainframe computers, used by real computer companies like IBM and CDC for microcoding machines. They have really come into their own with the micro. Personal computers took over 40 percent of all floppy drives by the beginning of last year, and the proportion is growing.

Ignore them if you will, but most people using microcomputers for serious business applications will not.

Floppies

THE FIRST floppy discs that saw light of day were eight inches in diameter. They stored around 250K and were used within mainframe computer companies, which by their nature tend towards standardisation. The 8in. floppies found today, years after they were first introduced, still carry this mainframe birthright — an IBM standard format.

True, there are the usual single and double sides and density variations, taking disc capacities up to 1.6Mbyte, but you can be sure that a micro that uses IBM 8in. discs will be able to read data produced by other machines employing the same disc format.

This might not seem a very big deal, until you start to look closely at the smaller brothers using 5.25in. or 3.5in. discs. There the multiplicity of different formats, sometimes specific only to one model of a particular manufacturer's range, making the idea of transportability of data or programs between machines seem like a pipe-dream.

This accepted recording standard should make the 8in. IBM-format floppy a genuine exchange medium within the data-processing industry.

The IBM format is industry standard for 8in. discs — but the PC has 5.25in. drives.

So why do so few micros use them as standard equipment, particularly at the lower, personal-computer end? As ever, the main reason is price. The 8in. drives, being bigger, are more expensive to build. They use more electrical power and so need bigger power supplies, which again adds to the cost of the micro. And in the personal-computer business, selling price is a key element in the design equation.

As systems become bigger and cost more — particularly as you add Winchester hard-disc storage holding tens of megabytes of data — the cost factor is diluted. The price differential between 8in.

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and 5.25in. drives is swallowed up in the greater system cost overall. In these cases the larger-diameter drives are found more frequently, as the benefits of media compatibility outweigh the price and space considerations.

Whatever software you want to buy for your micro, you are virtually certain of being able to get it on an IBM-format single-sided 8in. disc. The chances are more remote if you want it for some odd 5.25in. format. Add to that the relative comfort with which 8in. drives can carry over a megabyte of data, without having to move to the very highest data densities the drive and media manufacturers can squeeze in, and you have a reliable, versatile mass-storage medium.

Yet for all that, the 8in. floppy is on its way out. Some industry observers give it only till the end of the 1980s, when it will be forced into obsolescence by the cheaper 5.25in. floppy. All major manufacturers of the bigger drives have moved strongly into the 5.25in. market, and some have already dropped out of 8in. drives altogether.

The class is making a final technological fling with half-height units. They save space and weight and, perhaps more importantly, allow double the storage capacity in the same size hole without sacrificing the standardised format that sets them apart from their smaller offspring. Tandon and Shugart, both American companies, are the half-height leaders but are being joined by anyone that wants to stay in 8in. drives at all.

Choice of disc system

	Advantages	Disadvantages
8in. floppy	standardisation availability	high cost per K size and bulk
5.25in. floppy	standard media availability	low capacity of individual discs
5.25in. cartridge	small size per K high capacity	non standard lack of availability

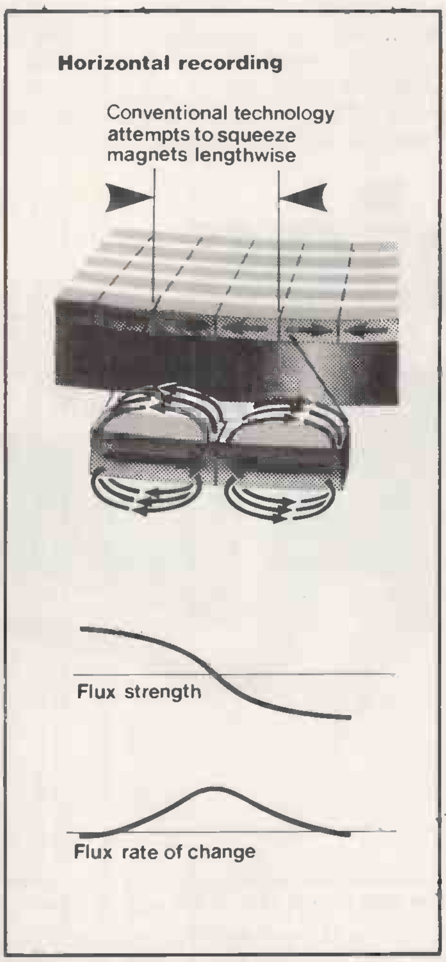
Mini-floppies

SAY "FLOPPY" in conjunction with personal computers and the chances are that the 5.25in. image springs to mind. Almost every machine you look at, certainly every machine that has any pretension to being a low-cost business system, has one or more 5.25in. mini-floppy drives attached to it. The problem is that as often as you see a different machine from a different manufacturer you find a different disc format, or so it seems.

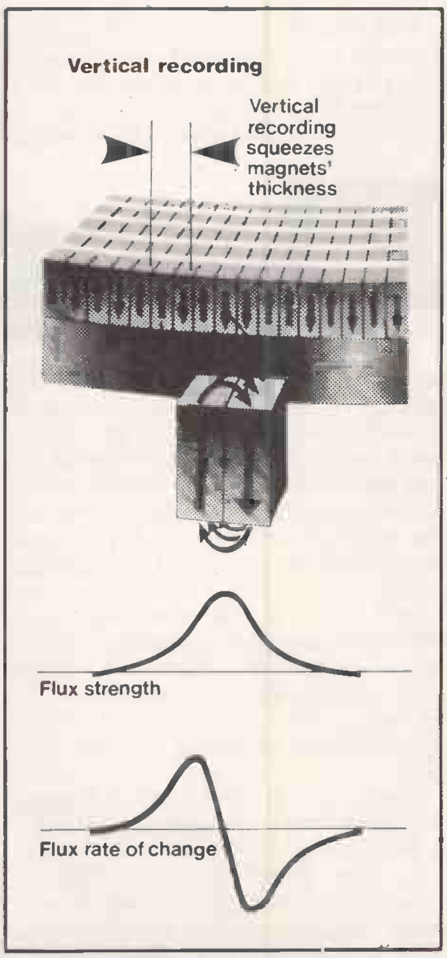
There are single-sided and double-sided discs, single-density and double-density formats — even quadruple densities now — with different numbers of tracks across the disc and different numbers of sectors around each track. Discs can carry anything from 80K to over a megabyte on each side. That top limit is still very much state-of-the-art cramming rather than run-of-the-mill mass production; 300K to 400K per side is more normal for mini-floppies at the present.

While everyone followed IBM with its format for 8in. drives, the introduction of the 5.25in. drive by Shugart opened the flood gates for popular micro manufacturers to go their own ways with a cheap mass-storage device. The variety of different formats makes it very difficult for software suppliers. They obviously want to be able to sell their wares to as many customers as possible, and so must cater for as many disc formats as possible. Stock offerings are of necessity limited to the most frequently found formats, or else turned over to someone to transfer from a standard format to whatever is needed.

It all adds up to extra cost, with charges for transferring between formats ranging from a fairly common £10 or so a disc to an outrageous £25 or £30. Much of it will be absorbed by a dealer, particularly if the



To increase disc storage capacity you need as many bits per inch as possible. But if you shorten the recording of each bit, the length-to-thickness ratio decreases and the bits, which are like little magnets, tend to demagnetise one another. Longer bits are betters because this keeps the poles apart.



With vertical recording, the magnetised bits are turned through 90 degrees, so that instead of lying along the surface they stand vertically in the magnetic material. This increases the maximum bit density without reducing the length-to-thickness ratio: in fact, as the width is squeezed, the ratio actually increases.

software is sold as part of a package, but in one way or another it is bound to get back to the buyer. For packages like operating systems or high-level languages, which run to several discs at a time, the format transfer can mount up to an extra £50 without too much trouble.

As well as the added costs, this process of distributing third-party software for the less-common 5.25in. formats can make it more difficult for software houses to keep a close rein on the quality of the media their software goes out on — and this can play a significant role in determining the success of a package. Bad media means bad reactions from customers when programs fail, and does little for a product's image.

With all the problems that the different disc formats cause for third-party software suppliers why have hardware manufacturers trodden their own paths? A large part of the reason lies in the question itself. It is perhaps becoming a cliche now, but it is true that it is not hardware that makes a particular micro better than one of many others for a given application, it is the software.

By using esoteric floppy-disc formats the manufacturers seek to lock customers into buying the software from them too, and not go to outside dealers. Because it is the software that makes the application, and users normally need a range of application packages, languages and operating systems, that is where the money lies.

Some of the stranger formats are attempts to push up the capacity of each floppy drive. That found on the Sirius, for example, changes the number of sectors per track and the rotation speed of the disc as the head moves nearer the centre of the disc.

Manufacturers of hardware are not being particularly sensible, particularly those who are reluctant to supply timely specifications of the formats used. It is only large-volume manufacturers that have the market clout to make software suppliers follow them. The smaller companies that try it just generate irritation and frustration in their customers, who have bought the machines but find their choice of packages restricted by the odd disc format.

But there is hope. A single, widely accepted standard format might not exist for 5.25in. floppies, but there are several shared by a number of machines, and there are micros that can handle a variety of formats. Early formats that found widespread favour were the Apple II and the Superbrain ones.

More recently the weight of IBM has begun to tell. The vast sales of the IBM PC in America have promoted a vast look-alike industry there, and software developers have concentrated their efforts on 16-bit applications for the IBM PC. Many machines coming out of the U.S. and developed here are now directly hardware compatible with the IBM 5.25in. format.

Yet by no means everyone is moving IBM's way. Major manufacturers continue to come up with new formats — sometimes even incompatible with previous ones of their own. A prime culprit is Apple, which recently brought out new add-on double-sided drives for the Apple III. Developed under the code name Twiggy, they are not only incompatible with the drive presently built into Apple IIIs, but are also incompatible in data format with the same Twiggy drives incorporated into Apple's Lisa machine. The two heads are located one each side of the centre spindle rather than directly opposite each other as in other double-sided drives, and need different disc media as well as different drive hardware.

The Sirius drives use standard disc media but also present this problem of incompatibility. Since the data is recorded at varying speeds and in different numbers of sectors across the disc, there is no hope of data compatibility between the Sirius and rival machines.

If you have already decided on a particular machine to buy or have already got one and are looking to add disc drives on, there is little you can do about picking a "best" format. The decision has been made for you. If you are adding on external drives, all you can do is shop around for the best-value units that will support the appropriate format to suit your equipment.

There are differences between similar units from different drive manufacturers. Some seem never to go wrong, others seem never to go right. Floppy drives have been around long enough, and leading suppliers like Tandon, Shugart and Micropolis have made enough of them, that the usual simple rules of thumb apply: never buy something less than six months old, so it can be shown to work: and always choose something one step down from the company's maximum density. If they can cram more bytes into their latest drives, the chances are they are quite good at the preceding model which should be correspondingly reliable.

If you are starting from scratch, however, there is something you can do to make life easier. Pick a widely used format, if you have the chance, in preference to one peculiar to the particular equipment manufacturer. On newer machines, this may well have the mark of IBM's heavy hand. Whatever else you think of IBM, there is little chance of it disappearing without trace, leaving you holding a machine for which you cannot buy software.

As with the 8in. drives, the history is of more storage in the same space for less money. Half-weight units are becoming common, taking up less space inside the computer box and the 5.25in. drives are facing competition from an even smaller-diameter family.

These 3.5in. micro-floppies are only just beginning to filter through to this country, so the threat is looming some way in the distance. For the moment, the common mass storage for personal computers is 5.25in. floppy disc and, within the limitations of computer manufacturers' choice of formats, you pay your money and take your choice.

(continued on next page)

As demand grows, the competition between disc suppliers intensifies.

Micro-floppies

JUST AS the exploding personal-computer market fuelled the rapid rise of 5.25in. mini-floppies, so the emerging portable-computer market is propelling even smaller floppies into the limelight. The units are lighter as well as smaller, and so need less hefty and thus cheaper power supplies. They are ideal contenders for space in micros you can take with you or use on crowded desks and tables.

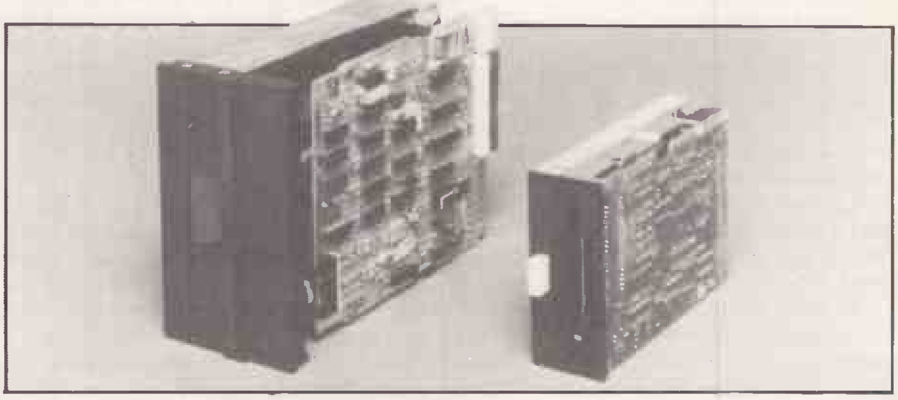
Already micro makers around the world are looking avidly at the units on offer. Some have even got as far as incorporating them in products but for the present the hallmark of the microfloppy arena is confusion. That confusion lies in the plethora of different drives. Not only do they adopt different formats for organising data on the discs, they do not even settle on a particular diameter of disc. We are also faced with the usual single/double sided, single/double density dilemmas that are normal with the larger discs. Sizes range from three inches to just under four inches.

First in the field was a 3.5in. unit from Japan's Sony, soon joined by a 3.25in. drive from Seagate and Tabor and 3in. units from Hitachi, Matsushita and Maxell. Canon is quietly pushing a 3.8in. disc and IBM hs a 3.9in. unit for which it is seeking drive and disc manufaturers.

As well as the main promoters, the various rivals have attracted bands of adherents drawn from the ranks of established disc-drive and media makers. Several of them have hedged their bets by signing up with more than one contender. While the shifting allegiances provide industry watchers with much scope for speculation — and serve to fill out the pages of the trade press from time to time — they do have a relevance beyond mere infighting.

Any standard that does eventually arise will do so because one particular micro-floppy finds success in the market place. Attempted imposition of order from outside by standards bodies like the American National Standards Institute is unlikely to be successful. A popular format will inspire copycat products from other manufacturers, just as IBM's 8in. floppy and Shugart's 5.25in. diameters have been widely adopted.

All the micro-floppies mentioned so far come from the U.S. or Japanese, though they count European companies among their backers. The battle for standard acceptance will be fought in their countries, but Europe has not been left behind completely in putting forward yet another format. Indeed its originator, the Budapest Radio Engineering Factory in Hungary, claims to have patented a simple 3in. drive in 1974. It just took rather a long time to realise that it had invented something marketable.



The newest microfloppies like Shugart's SA-300 pack 0.5Mbyte on to a 3.5in. disc.

Its Eastern European origin makes international and particularly U.S. acceptance seem a remote possibility but it has been quietly gaining friends at the low end of the U.K. personal-computer market. Samples have been supplied to many companies for evaluation and, according to its U.K. importer, the Hungarian company is poised to start churning out units by the thousand, and is trying to interest Dragon Data in manufacturing drives under licence.

Of the other contenders, Sony is the only one supplying units in this country, and has the only drive that can be found built into products from other companies. Hewlett-Packard signed up for bulk orders of the units last year, and is shipping single- and dual-drive units for its personal computers. Japanese micro maker Sord is also supplying various machines incorporating the Sony drives.

The story of personal computers has been one of continuing moves to more compact machines that retain the capabilities of their bigger brothers. In this respect the move to micro-floppies is no different. Although the discs are considerably smaller than current floppies, the quantity of data that can be crammed in covers much the same sort of range.

At the bottom end comes the Hungarian MCD-1, with 200K on its 3in. disc. There is only a single-sided verson and it looks likely to stay that way, though denser data formats are possible. The company already mass-produces audio-cassette drives, and reckons that the micro-floppy is easier to build.

The Hitachi drives are promised for summer delivery in the U.K. They squeeze 0.5Mbyte on a 3in. disc, and access it faster than most 5.25in. drives, if you believe Hitachi. The drives also use existing 5.25in. controllers, which makes the switch to micro-floppies relatively painless.

Sony's latest specification of its 3.5in. unit goes further still and will put 1Mbyte on a double-sided disc. Unlike the original 270K per side units signed up by Hewlett-Packard it will also be compatible with existing disc controllers and is accepted by an influential U.S.-based group — the self-styled Micro-floppy Standards Committee.

These three rivals have two things in common. They are already here — or are likely to be within a few months — and they all use similarly packaged discs. Rather than the conventional card jacket to protect the floppy disc itself from the perils of the outside world, these three come in plastic cassettes. The plastic protectors are shirt-pocket sized — almost one of the main design criteria for the disc size — and shield the magnetic medium with a spring-loaded shutter.

But the impact of the rigid floppy disc as presented to the outside world goes beyond this. Computers are rapidly invading High Street stores to be sold as standard consumer goods. There is already a bright market for software on tape cassettes or in ROM packs. Plastic-padded micro-floppies are set to join them as goods that retailers can readily display on shelves or stands, without having to add extra protective packaging.

For the time being companies will continue to push rival formats on the market, not daring to wait for a pronouncement from ANSI for fear of being left out of the final reckoning. That is what has happened with other floppy-disc formats, and it will probably happen again.

For me, the revised Sony format looks like becoming the *de facto* standard, adopted by major micro makers to build into machines or offer as add-ons to existing micros. Perhaps the Hungarians will make a showing too in the cheap end of the home-computer market for bolt-on goodies.

Winchesters

THE MOVE from cassette tape to floppy discs for mass storage was driven by the need for greater capacity which is accessible to the user more quickly. Floppy discs gave this, with megabyte disc capacities and loading times for programs in seconds rather than minutes. Random access to items of data also became possible. Now it is the requirements of applications calling for large volumes of data, perhaps accessible to several users, which have put the Winchester hard disc in the ascendant for business micros.

There are several types of hard disc about. They range from the massive gigabyte cartridges used with mainframe installations, to mere tiddlers carrying 5Mbyte. But for personal computer users, there is really only one type of hard disc that counts — the 5.25in. Winchester.

The 5.25in. part is easy to understand, the drives fit in the same size packages as mini-floppies. Winchester was the code name for a particular type of hard-disc development by IBM. In it the disc platters and magnetic heads are enclosed in a sealed container, safe from dust and smoke particles that would contaminate the disc surfaces and get between the head and the disc. Because all particles were excluded, the heads could fly close to the disc surface, allowing much denser packing of tracks and data on each track.

IBM introduced the first Winchesters in the early 1970s. They started off with a 14in. diameter, shrank to 8in. by the late 1970s and to 5.25in. by the start of the 1980s. At that point Seagate's electrical interfaces became adopted as standard and started a boom in 5.25in. drives that continues unabated.

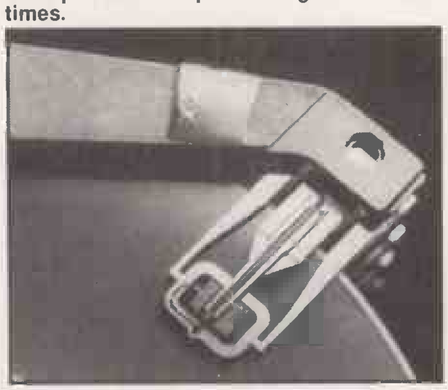
Winchester discs rotate 10 times faster than floppies, at something like 3,000 revolutions per minute. The data-transfer rate is commonly 625K per second or more, comparing well with the 125K to 500K per second from floppies. Access time to a particular piece of data is set by the speed with which the head an move across the disc to the correct track. In most drives in mass-production now, the head is moved across by a stepper motor to give average access times in the region of 90ms.

Newer methods of head positioning are cutting access times to 30ms. as well as almost doubling the number of tracks that can be used on a disc. The other way of adding to the capacity is to use disc platter and add more read/write heads. Drives can be extended in this way from the average 5Mbyte single-disc unit up to a massive 140Mbyte drive with eight discs in a single unit.

For the moment though, it is drives in the 5-10Mbyte bracket that you are likely to find built into a microcomputer unit or as external add-ons. For this capacity you can expect to pay around £1,500 over the price of a twin-floppy micro in which the 5.25in. Winchester replaces one of the floppy drives, or around £2,000 for an add-on box with its own power supply and interface.

Rodime's RO-208 5.25in. Winchester.

More precise head positioning cuts access times.



If someone moves over to a Winchester system, it is usually because they have large amounts of data in regular use, perhaps shared by several people. It soon becomes impossible to shuffle large numbers of floppies to get at the particular data file, or the files themselves outgrow the capacity of a single floppy. It is much easier to have all the data on one disc drive, ready for easy access.

It is here that one of the major problems with Winchesters comes in. Winchester discs are reliable pieces of equipment, but they are also precision engineered to very fine tolerances — the heads run only a few millionths of an inch above the disc surface. They are susceptible to mishandling, and it is vital that there should be a copy of the information stored if it is not to be accidentally lost.

Taking back-up copies of 10Mbyte of data can be a long process. If you are going to do it the easy way — easy to think of, that is — you will just copy the full contents of the drive to floppies. The chances are there will be a floppy drive on the machine anyway and though copying will take time and produce a lot of floppy discs which you have to keep safe, it is relatively cheap.

Complete images can be placed on streaming tapes to give back-up on more manageable tape cassettes, or on video-tape recorders. Some people back up on to other Winchesters, though you cannot then remove the copied data to a place of safety. Future options will include the removeable Winchester disc cartridges that are just starting to come onto the market.

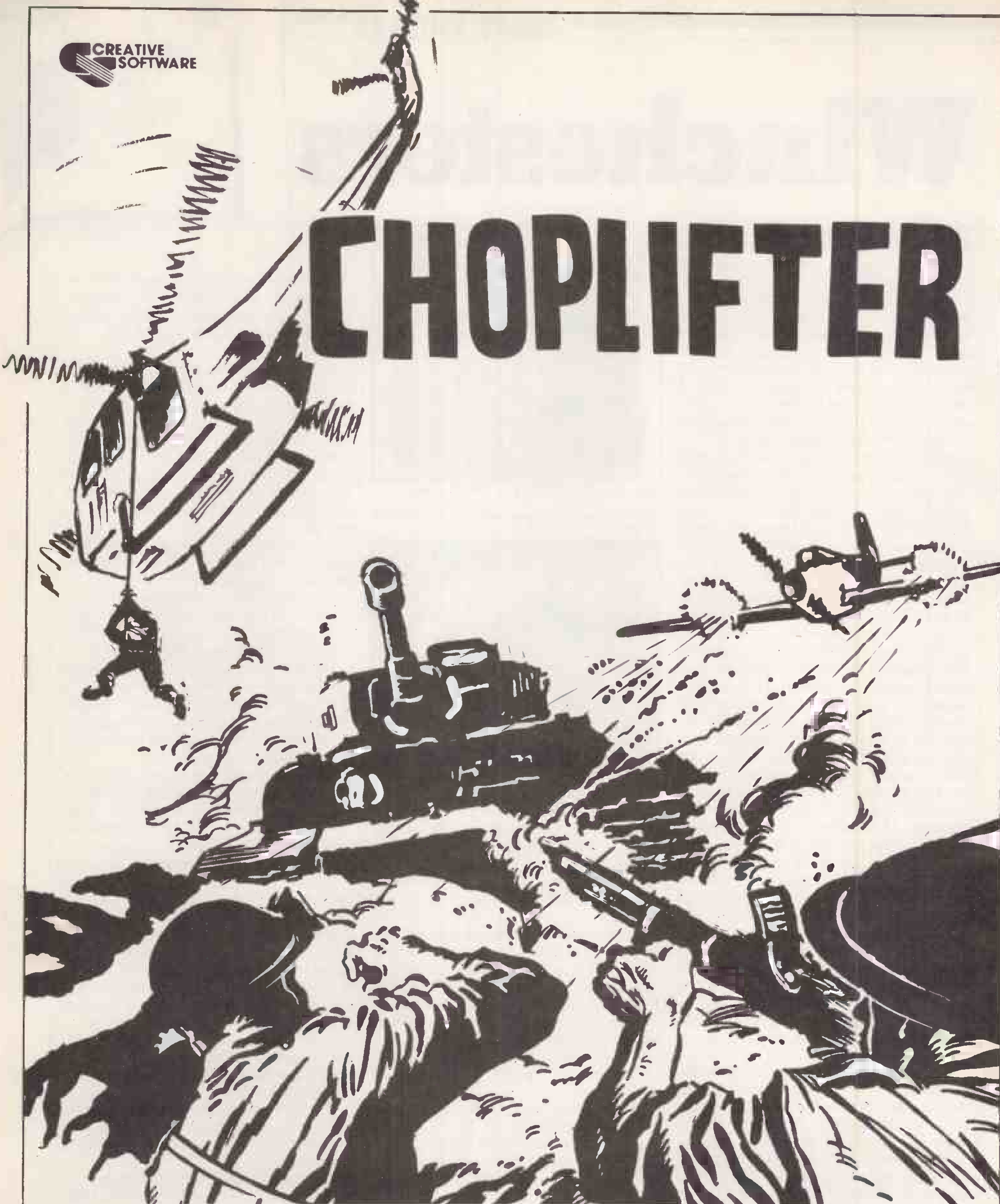
Copying the entire contents of the drive regularly is a lazy way of approaching the problem. You are very unlikely ever to change more than a small proportion of the files on the drive in any session, so a better approach is to copy only those files that have been altered. This will cut down dramatically the time required and make floppy back-up quick and convenient. It does require some software thought though, to enable the system to keep track of what has been altered and to copy just those files on to floppy.

The drive manufacturers all claim something like 8,000 to 10,000 hours as the mean time between failures for their Winchesters. For 5.25in. Winchesters particularly, the failure rate in practice is greater than expected, perhaps because it is this type which is most often found in desk-top units that can easily be moved about.

Even lifting the box to slide it across a desk can cause problems if you bump it down when you have moved it. If the disc is not spinning the jolt can cause a small dent in the disc surface where the head hits it. If the disc is running, you will get a furrow. But people become more careful with experience. Forking out £150 to have the Winchester repaired can make you a lot less heavy-handed.

The new plated disc media are thought to be less easily damaged in this way than the oxide media most frequently found at the present.

For the future, Winchesters look to be moving the same way as floppies. Half-height units and 3.5in. drives are both expected, and full-size drives are moving up in capacity. It is reckoned that 11Mbyte to 25Mbyte drives will be the most common in five years time. Access to the data is getting faster too. Unit prices are not likely to fall, but it does seem probable that in the future you will get more, faster bytes for your money.



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What exactly is a database?

The term has been applied too loosely, argues Mike Lewis.

THE WORD "database" is one of the most abused in the computer user's dictionary. In the world of micros it seems to take on a different meaning according to who is using it, and there is a mish-mash of packages that call themselves database systems. Many are very useful products, but they bear little resemblance to the clearly defined database concept that has been around for a couple of decades.

Back in the 1960s the typical data-processing department provided a central computing service for many of the company's other departments. Each department—accounts, sales, personnel, and so on—had its own suite of programs. Although some suites may have been linked to others, each application had its own files.

Dulication of data was inevitable. Typically, the accounts department would keep a list of customer names and addresses for invoicing, while the sales department would have a similar list for marketing purposes.

Worse, it meant that the structure of the files varied from one application to another. Each set of data would be designed specifically for the appliction that used it, and programmers had to be aware of its structure. So if a file changed — say to incorporate the customers' telephone numbers — extensive reprogramming might be needed.

It was partly to overcome these problems that the concept of the database grew up. The idea was to keep all the company's operational data in one central repository. Programmers would be able to dip into this data store for the items they wanted, without having to worry about how the data was organised.

This gave rise to the most important feature of a database system—the concept of data independence. In a true database, the method of storing and retrieving data is separate from the way in which the data is used. So you can introduce new types of data without affecting existing programs.

Another important feature is the idea of central control. Because all data is kept in one place standards can be enforced to make coding systems more consistent, to help data interchange between applications, and to prevent unauthorised access of confidential information.

The database also helps to reduce duplication, although it rarely eliminates it completely. For example, suppose a company runs internal training courses for its employees. In a conventional system there would be a file of the names of participants on these courses, even though these same names are already held on the personnel file. In a database system the names are only held once — in the central database.

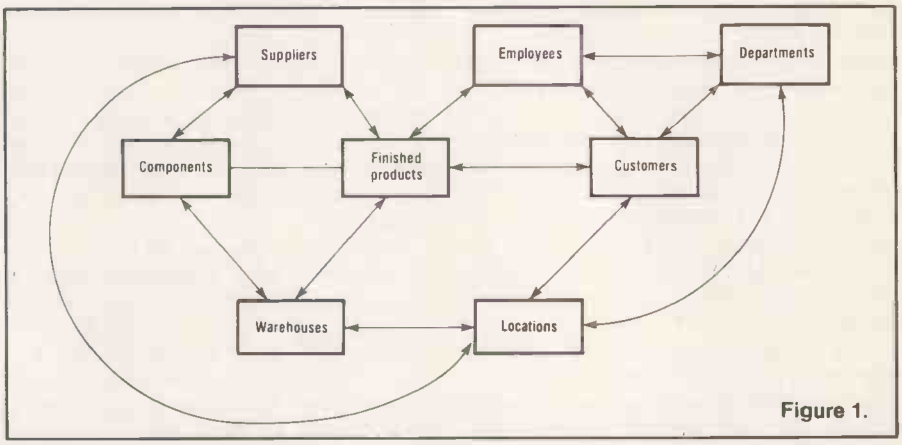


Figure 1.

Figure 1 shows a highly simplified view of the database of a typical manufacturing company. It contains details of components, suppliers, finished products, and all the other entities that make up the company's base of operational data.

But more important, the diagram shows something else — relationships. The entities in the database are connected in various ways: the suppliers supply components, the components make up finished products, employees work on the products, components are stored in warehouses, and so on. These relationships are as vital to the database as the actual data; most of the work of database design is concerned with finding a way of expressing these relationships.

There are three basic approaches to this problem. They are usually known as the relational, hierarchical, and network approaches. Most database-management systems use one of these techniques, although there is sometimes a certain amount of overlap. Other approaches have been proposed but not implemented.

The relational approach is the simplest of the three, and the one that is likely to be the most familiar to micro users. It views a database as a set of two-dimensional tables, such as those shown in figure 2. Thus we have a component table and a supplier table. A third table might be used for deliveries, and shows a link between suppliers and the components they sell.

(continued on next page)

SUPPLIERS

NO.	NAME	PAYMENT CODE	LEAD TIME	LOCATION
124	Medway Plastics	B	4	Rochester
125	USB Supplies	C	1	Brighton
126	Essex Packaging	B	2	Colchester
129	Speedi-Sales	D		
136	Bright Cleaners	A		
..	..	..		
..	..	..		
..	..	..		

COMPONENTS

PART NO.	NAME	COLOUR	WEIGHT	PRICE
A3410	Plastic Buckle	Blue	23.00	.67
A9191	Side Clip	White	5.56	.09
D0184	Polystyrene Box	White	4.72	.15
R9621	Twelve inch screen	None	19.25	.85
R9989	Coax Cable	Blac		
T2374	Terminal Cover	Blue		
T3291	Plastic Wallet			

DELIVERIES

SUPPLIER	COMPONENT	QTY	DATE
124	A3410	555	22 JAN
124	T3291	100	22 JAN
125	A9191	900	1 FEB
129	R9621	50	2 FEB
129	T2374	90	
..	..		

Figure 2.

(continued from previous page)

The relational view is similar to a conventional file. The table is like a file, the row is like a record, and the column is like a field which occurs in all records. But it is the ability to represent relationships that makes it a true database.

A more complex approach is the hierarchical one. Here the data and relationships are represented in a tree structure. Figure 3 shows a database of internal training courses. Each course can take place in several locations and each location has a number of students. The locations also have teachers and the courses also have prerequisite courses.

It is a feature of tree structures that each record must have exactly one superior record except the root, in this case the course record, which has none. Any record may have any number of subordinate records which do not all have to be of the same type. So a course has subordinate prerequesite courses and also subordinate locations.

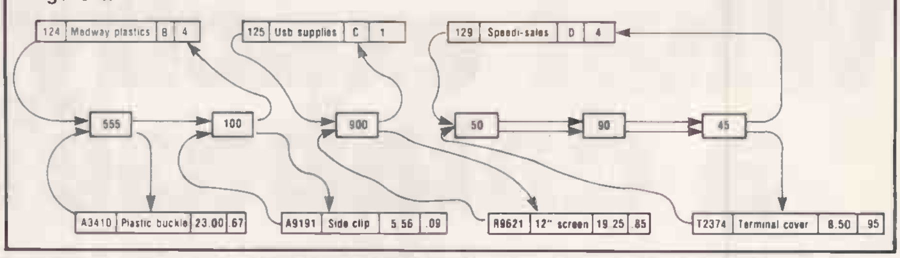
The third type of database, the network approach, is more complex still—see figure 4. Here the records may have any number of superiors and subordinates. The relationships are expressed by special records, called connectors, that lie on chains between the various entities. In our example the connectors hold delivery quantities that link suppliers and components.

All this is fine in theory but what does it mean to the average computer user? Because database design grew up with mainframe data processing, most true database systems are implemented as packages on mainframes, and to a lesser extent on minis.

IBM's IMS system is a hierarchical database widely used on the 370 series of computers. Tymshare's Magnum is a well-known relational system. Examples of network systems include Cincom's Total and IBM's DBomp. Another popular package is Adabas, which supports all three database methods.

These systems are intended primarily as tools for programmers, not for end-users. So a database package is, at its simplest, a set of subroutines. They are usually designed to be called from application programs in Cobol, Fortran, PL/1, etc. Their purpose is to get information from the database, add new data, amend existing data, and so on. Usually they can do much more — extracting all components that make up a certain product, say, or all employees who have been on a certain course.

Figure 4.



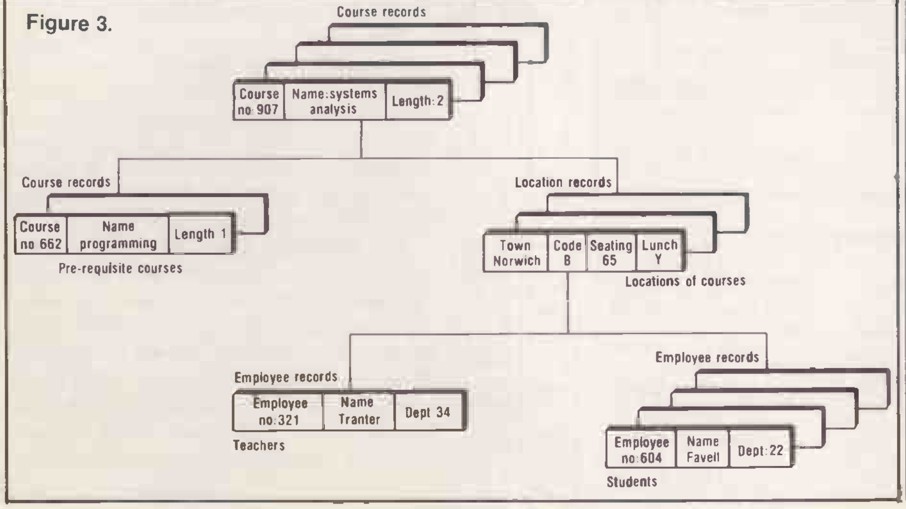
In fact many database packages include an additional layer of software aimed at letting the end-user access the database directly, without recourse to a programmer. It is usually known as a query language, and the best-known is IBM's Query-By-Example. It allows a non-technical person to specify a report by filling in a simple form on a VDU screen, which shows typical values of the type required.

Other terms that you might come across are distributed database and bibliographical database. A distributed database is one that is not stored in one place. In a banking system, for example, individual customer records may be held on small computers in the bank branches.

A bibliographical database is a special case of a hierarchical system, the stored data items are themselves index entries to words in a body of text. A good example is the Status system, developed by the Atomic Energy Research Establishment at Harwell and franchised to some 70 users throughout the world.

In this system there are two files. The text file contains a collection of articles, abstracts, research papers and other documents. The reference file contains pointers to every word in the text, except common words like "the" and "and". The user can find a piece of text simply by entering two or more words that are likely to occur close to each other in the given text.

Figure 3.



The principle has been adopted by a number of on-line data services. An example is the Lexis system, which allows lawyers to access a huge base of statute and case law. Some of these systems can handle text files in access of 100Mbyte.

So what can you expect from a micro database? Typically the systems are self-contained, that is they can be used for complete applications without any additional software. And they are generally aimed at the non-technical user, although many fail to achieve this objective. Beyond that the systems fall into one of three groups.

Firstly there are the single-file systems such as Micropro's Datastar and Caxton's Cardbox. They allow the user to define a record format, usually in terms of a screen layout. You can then add records to the file, call up existing records, amend or delete records, and carry out searches in a variety of ways.

The second group of packages are really closer to programming languages than to finished systems. They includes dBase II and FMS-80. To use these products effectively you really need to approach the job as a programming project, with proper design and testing too.

The advantage of these languages is that they are much more powerful than Basic and Pascal — at least for applications involving file handling, indexing, searching, etc. So you can expect to set up a working system in much less time than if you programmed it in the conventional way. But do not expect to be able to tackle a large job without some programming experience.

Finally there are a small number of micro packages that actually bear some resemblance to true relational database systems. They include Southdata's Superfile and Logica's Rapport and are basically sets of subroutines intended to be called from high-level languages like Basic and Fortran.

The database, at least on micros, has come a long way from the original concept of a central repository of operational data. Nevertheless, there are some excellent packages on the market that can help you set up useful working systems. The fact that they are not true databases is irrelevant; after all, it is really just a matter of terminology.

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● Circle No. 171

Databases side by side

What happens when you ask a silly question? Chris Bidmead looks at four packages trying to give a sensible answer.

I HAVE BEEN TAKING a look at a representative bundle of the more advanced database management packages consisting of Condor, Rescue, Superfile and dBase II. I have also had the opportunity to pore over the manuals for Logica's MicroRapport and a new offering from Aragon called DataAce. Feathers flying in a pillow-fight between U.K. vendors of FMS-80 have kept us from including this interesting offering in our present survey, but we have been promised the all-singing-all-dancing version 3.1 for review when it emerges.

In general the process of setting up and using a particular application is similar for each of the packages I have been looking at. They can be pigeon-holed under six headings:

- Designing the file layout
- Entering the data.
- Accessing the database directly.
- Writing routines to manipulate the database.
- Designing the layout of reports
- Making changes to the file structure.

Designing the database layout in complex applications is no simple task, and the more flexible the package the harder it is to decide on the design. All the packages are menu-driven at this stage in one way or another. Rescue's menus are the most comprehensive, but they have to be because the system uses 19 different data-encoding techniques, and the user has to choose which is most suitable for each field.

Like Condor and dBase II, Rescue begins by inviting you to set the date but, unlike the other two packages, usefully translates it into the day of the week for confirmation. It then leads you into a series of branching menus that take you through the whole process of establishing files and record lengths and data types within those files.

dBase II is considerably terser. Figure 1 shows the sequence, with my entries in lower case and the dBase responses and prompts in upper case. I have added comments after the semicolons. After constructing the field description enter an empty Carriage Return to signal you have finished, and dBase will respond with:

INPUT DATA NOW?

Figure 1.

```
. create                                          ;dBase standard command
ENTER FILENAME: customers
DESTROY EXISTING FILE? (Y/N) y                    ;dBase detects existing file
ENTER RECORD STRUCTURE AS FOLLOWS:
   FIELD      NAME,TYPE,WIDTH,DECIMAL             PLACES
   001        c:no,c,4                            ;character field called c:no, 4 wide
   002        name,c,25
   003        credit,$,7,2
BAD TYPE FIELD                                    ;I forgot there is no $ type
   003        credit,n,7,2                        ;dBase re-presents 003 prompt
   004        date,c,8                            ;no date type either, unfortunately
   005        paid,1,1                            ;logic type accepts only Y,N,T or F
   006                                            ; (upper or lower case)
```

	Superfile	dBase II	Condor	Rescue
Records per file	M L	65,536	32,767	32,760
Characters per record	22,000 approx.	1,000	1-2K	1K
Characters per field	M L	254	77	
Number of kinds of information	250	32	127	100
Number of fields/records	no limit	32	127	100
Handles repeating groups	Yes	No	No	No
Fixed-length fields	No	Yes	Yes	Yes
Index key fields/records	5,000 approx.	7	8	10
Sub-string searches	Yes	No	No	No
Phonetic searching	Yes	No	No	No
Multi-user	Yes + locking	No	Yes	No
Multi-file search	Yes	Yes	Yes	No
Interface to standard languages	Yes	No	No	No
Dedicated language	No	Yes	Yes	
Forms utility	Yes	Yes	Yes	Yes
Report generator	Yes	Yes	Yes	Yes
Sorting	Yes	Yes	Yes	Yes
Creates Mail-Merge compatible files	Yes	Yes	Yes	Yes
Made in England	Yes	No	No	Yes

An answer of Y takes you straight into data entry. The restrictions of data types to character, numeric or logical, helps to make dBase II easy to use and understand at this stage in an application development.

Condor is a little more complicated, partly because data types are more extensive, comprising alphanumeric, alpha only, numeric only, dollar — that is, money type — and date. Information about how the file is to be displayed on the screen is kept in a separate file, as are the rules for encoding the data. A fourth file, called Data. dic, the data dictionary, keeps track of the relationship between all the format, description and data files you are using.

Rather neatly Data. dic is accessible in much the same way as an ordinary Condor database file, which helps to make the relational logic of the system clear once you become more than a casual user. But the beginner can ignore its existence: the routine Define initiates a menu-driven process that sets up a new database and logs it into the

data dictionary without involving the user in the mechanics.

The Superfile kernel needs no special setting up before you can enter data because all the data is kept in the same way — in coded ASCII strings tied to tags. These tags correspond more or less to field names as used in the other packages.

The kernel has an elementary but surprisingly extensive database management facility built into it called /Look. Through /Look you create the tags by writing their names prefixed with an &. So if you want to set up a simple name and address file you might enter the following into /Look:

&FIRSTNAME
&SECONDNAME
&ADDRESS
&PHONE

To enter data by way of /Look you precede the first tag name with a plus sign and follow it with an equals sign and the data. Subsequent tags in the same record will be similarly stated as equations, but will not need the initial plus sign. As a Carriage Return is understood by /Look to mean you are terminating the entry for that record, field entries are divided by entering an up-arrow character, which is echoed on the screen as a new line.

I very much like this way of accessing a database without a lot of clever screen-handling and data-checking machinery to slow down the action. But for regular business use more upholstery is necessary, and so Supefile comes packaged with a pair of outer wrappers called Superform and Supertab. These essentially emulate the menu-driven form-and-file creation of the other database management systems.

In searching for a particular entry in the database all the packages use the common approach of requiring a model, which the database-handling software will attempt to match against a series of records to weed out the entries you are looking for. All four packages have facilities for ignoring upper- and lower-case differences in the model.

The rules for searching sometimes differ depending on whether you are looking up individual records or creating a subset of the database during batch processing. Rescue, for example, offers admirable flexibility for matching against an ambiguously defined model. But the facility is limited to the extraction of sub-files and the creation of reports — you cannot use it to look up individual records. When directly looking through the records the Rescue search model must match the search field exactly — a serious limitation. Rescue also only allows direct searching on fields that have been set up to be index fields.

Condor allows you to use a "wildcard" asterisk meaning "and any other trailing characters", so that Bus* will find Busstop, Bustard and Business & Office Management Weekly. A search for *Dairies* will throw up United Dairies Ltd and Express Dairies PLC as you might expect — but it is mixed in with every other record in the database, because after reading the first asterisk as "and any other trailing characters" Condor ignores the rest of the model string. The provision of ?, meaning "match any individual character", is no help in this common context of looking for a string whose precise location in the record cannot be guaranteed.

dBase II goes further, in permitting searches for internal substrings. The dBase command

LOCATE FOR 'BUS' $ name

will search the database for any record where the field called "name" contains those three letters juxtaposed in that order. Note that in dBase II skating over the difference between upper and lower case has to be arranged explicity, using the function !(<string>), meaning "convert <string> to upper case".

Superfile's search facilities are best of all. You can search for internal substrings with the intuitive model form *arch* to match Middlemarch, Monarch, Barchester and so forth. Additionally Superfile permits a search that looks for a lead-in consonant pattern, taking into account any initial vowel. To achieve this the model is prefixed with @, so that @Smith will conveniently track down any Smithes, Smythes and Smithers that happen to be lurking.

The manual calls this a sounds-like search, which might mislead you into

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The world according to Codd

Software vendors are able to pass off file-management systems as relational because nobody is very sure what the word means. One man who does know is E F Codd of IBM, because in 1970 he came up with the idea.

Codd's eureka has all the classic symptoms of a "brilliant idea". It is essentially simple to the point of common sense but actually very tricky to explain fully — its formalisation required the invention of a new branch of mathematics called relational calculus.

The insight was that there are only a finite number of sensible questions that can be asked of any given body of information. Pause here and consider — one implication of this is that there is something about the data that actually defines the set of askable questions.

I might want to know how many foreign invoices I have issued in the past two years for less than £100. It is a sensible question only if I have kept records over that period of how much I have charged and where my creditors live. The validity of the question depends on the data alone, not on the whim of the questioner, the form of my invoices, or the existence or non-existence of access aids like indexes and cross-linking pointers.

In instituting a database we tend to set out data in a way that anticipates particular questions we may want to ask, but that obscures the validity of other quite sensible questions we may want to ask later. "How many of these people live south of the river and have names of Hispanic origin?" I ask, handing you the London E-K telephone directory. You laugh — it is a silly question, but only because of the way the data is laid out.

Is there then a universal set of rules we can apply to any body of information that tells us how to lay it out so that it crystallises rather than obscures the relationship between the data and the set of all the sensible questions we can ask? Codd showed that there was, and called the process "normalising" the database.

Applied to micro software the description "relational" tells you negative things about the product. There will ne no pointers joining fields across files and nothing in the database except the data itself and rules for coding and decoding it.

Condor, dBase II and Superfile manage this much, but getting at the records requires some non-relational crutches like indexing and sorting. In a true relational database system there will be no need to sort files because the records are never stored in any particular order. In fact they are not files, but rather tables, with any given set of data being accessible to inquiring software procedures simply by inspecting the contents.

Yet implementing a true contents-accessible file system, CAFS, is no picnic on a heavy mainframe and on a micro is out of the question. Condor, dBase II, Superfile and Rescue each allow sub-string searches of the records, but only in ways that draw the user's attention forcibly to the sequential, that is very non-relational, ordering of the records. Search times become lengthy as the file becomes large.

Databases side by side

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thinking that @Tom will find Thompsons as well as Tommasino, but this is not necessarily the case. In practice the @ prefixed model is looking rather than listening, and is likely to be foxed by unpronounced consonants like "h" and "p" in such names.

Only two of the packages have their own built-in enquiry languages. For the programmer dBase is far and away the more comprehensive; Condor is simpler to set up.

If you have dBase already and wish it were more like Condor perhaps you need one of the many dBase code generators now available. I looked at Autocode from the house of Stemmos, a compiled MBasic front end to dBase that helps you set up an application by responding to a series of menus.

I hope Autocode is not typical of the other dBase fellow-travellers. The command line decoder is ill-mannered enough to ignore you if you do not talk to it in upper case. No error message or bell-tones — your entry just disappears and the prompt sits there waiting for you to read its mind and latch the caps lock. I thought this sort of thing went out with valve computers.

Autocode is simple to learn because it is simple. It builds a menu-driven single flat-file management program without even sticking a toe into the relational possibilities implicit in dBase's primary and secondary buffer handling. The generated code, which Autocode does not bother to indent for legibility, calls only a tiny subset of dBase's capabilities.

Condor

Condor highlights a grave deficiency in the other packages by including a Date type on which you can do such calculations as

Days since last invoice = Today's date
– Invoice date

A recent update of Condor has eliminated the silly limitation that prevented you using dates as constants in calculations. It thought 2/4/83 meant divide 2 by 4 and then by 83. But a serious howler remains: you cannot use the system date, held in a variable called $Today, for searches or calculations.

dBase II and Condor are close contenders in the fixed-field, quasi-relational stakes. Condor's strength is that an intelligent non-programmer can set up quite complicated multi-relational databases complete with help-sheets. Condor is very clean to use, its logic is clear and the command lines it expects and the responses it gives are in quite reasonable English. For example:

Select invoices where date is '10/12/82'
and payment is due

would be understood by Condor if the file Invoices.Dat included fields called Date and Payment.

The programmer who wants to tailor more intricate or more specialised packages will come up against the following shortcomings in Condor:

- Apart from system variables like $Today and those that store the statistics created automatically by Compute there are no variables outside the files themselves. The programmer will sometimes have to bodge it by using the powerful relational functions Join and Project simply to stick in and remove file variables in the form of temporary fields.
- There are extensive instructions to discriminate records and to alter fields, but Condor balks at doing both at once. For example, to change "Payment: due" to "Payment: overdue" for all records older than last Thursday requires a Select operation, followed by a Change operation, followed by a series of manipulations to recombine the file. dBase II happily does this in one move.
- Condor lacks a true run-time enquiry language. What you get is a job-control language that has to have all its conditionals satisfied before it starts looking at the files. It cannot, for example, take different courses of action depending on what it finds in the files. This is a large cross to bear.
- Condor cannot manipulate virtual files temporarily created in a purely notional sense out of sub-sets or unions of other files. In particular it is not easy to arrange an operator so that it sees only those fields that are relevant to a particular operation.
- dBase, Rescue and the Superfile front ends all recognise that modern terminals have facilities for discriminating field names from data entries through the use of highlighting, lowlighting or inverse video. Condor will have nothing to do with such fripperies, and goes out of its way to defeat attempts at patching in video control. Result — Condor's screens lose a trick in readability.
- The Condor package consists of a sprawling archipelago of files, practically one for each different function. It has the advantage that you can withhold functions from unauthorised users, but otherwise makes for cumbersome disc juggling.

Like Superfile, Condor "rides high" under CP/M, patching itself into the operating system and substituting its own command-line interpreter. This allows CP/M commands like Dir and disc-logging to be passed through transparently. CP/M .Com files may be called by prefixing the file name with a $. Whether they come when you call depends on whether they will fit into the reduced transient-program area left after Condor has taken its cut. $Ed calls Ed.Com which fits happily, whereas $WS produces the WordStar hillbilly message "Not enuf memory"

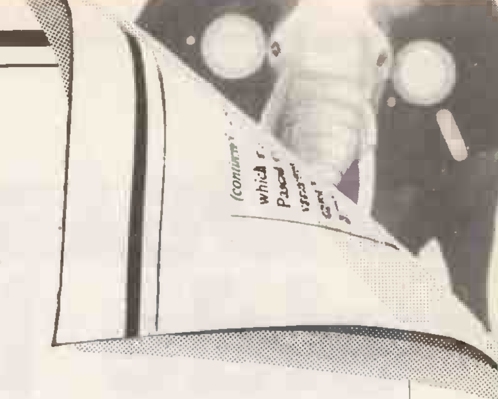
dBase — the language

Plus Points

- A simple structured language that may be read as a sort of pidgin English.
- Manipulates two buffer areas called primary and secondary, which may have a separate file in each. Search instructions bring selected records into a pair of current windows through which the field values may be accessed as variables.
- Records from the primary and secondary files can be windowed separately, like a "head and bodies" flick book with split pages. Alternatively two separate files may be paged through as one as if joined by their physical record numbers.
- Screen- and printer-handling is excellent, enabling elaborate Invoice forms to be set up relatively easily.
- Macros are permitted. It is complicated for the beginner to grasp, but becomes almost infinitely flexible once mastered. The concept enables a language instruction or part instruction to be stored in a variable. Such variables may be nested.

Minus Points

- Routines may be called from within the code, but only if those



What irritated me most about Autocode was the claim in the manual that "This is the world's first practical application of artificial intelligence, AI, programs in the area of automatic programming for microcomputers". Perhaps there are subtleties here I am missing, but if this is artificial intelligence I would hate to see Stemmos' ideal of genuine stupidity.

What Stemmos could usefully be aiming at is a front end to dBase II that makes it look more like Rescue. Rescue's RDefine program takes you through a menu-driven, hold-your-hand parameter-setting session that produces definition files, which will shape the database handling evoked when you call the main program. The possibilities of how the operator's menus look on the screen and how the reports are laid out on the printer are restricted to system standards, and Rescue handles only one file at a time, it is not even quasi-relational. But that said, the data-typing, entry checking, sorting, record selecting and reporting facilities seem to be extensive enough to cover most real office work.

Superfile's Superforms package copes with much the same sort of tasks, though less comprehensively than Rescue. A Sort facility is included in the Supertab package. It works by creating a file of sorted file pointers — the original database is left untouched.

Although Superfile is friendly and useful when viewed through the Superforms/ Supertab window I suspect that the real value lies with those prepared to tie Superfile into their own hand-crafted packages. Superfile lacks its own enquiry language, except at the rudimentary level of /Look, but it does include a comprehensive set of system calls accessible from machine-code level. Most high-level languages have a back door into machine code, and I found little difficulty building a machine-code interface to my favourite language, ProPascal.

If your favourite language is Microsoft Basic the manual gives comprehensive details of how to hook into Superfile. If it is

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routines are separate program files.

- Parameters can only be passed as global variables.
- Only one iteration instruction is permitted, Do-While. This and similar limitations of scope mean that coding in dBase tends to introduce sense-obscuring ingenuities.
- The potentially excellent in-built screen-based editor with simple WordStar-like commands seemed to crash out unexpectedly at odd moments. Fine for quick coding, but I would not trust serious work to it.
- Comments are allowed, but in most cases may not be appended to lines.

Superfile comments

Superfile keeps its data as coded ASCII strings. Fields are not fixed length, with the great advantage that no trailing spaces unnecessarily pad out your disc space. There are disadvantages to this approach, though. Individual records can never be revised, so that amendment becomes a two-stage process of marking the record as no longer valid and then appending the rewritten version to an overflow file.

The Superfile application packages Superforms and Supertab take care of this transparently, except that a search-and-amend operation will find any revised record twice as it scrolls through trying to match a particular model: once at the initial revision, and again when it discovers the amended version appended to the overflow file.

Anomalies like this point to the conceptual simplicity of the fixed-field approach, although there is no doubt that the wastage of space, and hence of search time, can be great. Southdata reckons to support Superfile under any of the multi-user operating systems.

Rescue: the Good, the Bad and the Ugly

The Good

If I were in the happy state of knowing nothing about microcomputer database management but had to get a moderately complex real-life project together by this time next week, I think Rescue would be the package I would reach for. I particularly like its true-to-life data typing, which includes an exemplary facility for creating a "dictionary" of allowable responses that can be tied to a field. A dictionary might consist of a list of names of firms dealt with, tied to a field called Customer.

Superfile has a similar facility, but only as a check against the validity of an entry. Rescue's dictionary allows the operator to type in only as much of the entry as is necesssary to define it uniquely.When the cursor is moved on to the next field the whole entry will be filled in automatically.

A second advantage is that the entries in the dictionary can be treated as Pascal-like scalars, having ordinality — first to last, best to worse. An estate agent could arrange for a field called Location to have a string of directory entries such as North Molesfield, Hacklesworth, Dinbury-cum-Witton and so forth. Not only would this save the operator's fingers — the entry "Ha" would be enough to pull in the whole of Hacklesworth — but if the estate agent had been ingenious enough to install the names for the areas in geographical order in the dictionary, north to south say, the properties could easily be sorted accordingly.

Rescue is the only package of the three that offers password security. Superfile promises it in future versions, and dBase and Condor presumably assume that you are surrounded by fine upstanding people, or that your files will contain nothing worth stealing.

Rescue incorporates a handy set of routines that will appeal to people who make it their business in life to send out mass mailed letters.

The Bad

Rescue insists on operating as an indexed database, and you can only look up entries if you know the precise form of one of the key fields. If your customer file is indexed on surnames alone a client by the name of Zarczyinski could become a hard man to get hold of. The other database management systems would let you look up the name as "Zar-something-or-other".

RDefine's menu has an entry for reading in foreign, that is non-Rescue, database data but in the version I am currently using this was not implemented. Rescue's problem is that the data-compression techniques it uses — good — are varied and complex — bad — requiring complex code to tangle and untangle data going in and out. The vendors do not recommend, for instance, that you try writing applications software to access Rescue-created data files.

The Ugly

Rescue is written in compiled MBasic, and the pre-BRun version at that, which means there is more code than there need be. It is evident in the slowness of response when overlays are called — the bulk of the MBasic library has to be dredged in each time. Having said that, I was very favorably impressed by the way the limitations of the language have been overcome to arrive at a highly professional package.

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not Southdata is ready to help you. But the Superfile function calls are modelled on the way CP/M handles BDOS calls, so the programming is fairly elementary.

Rescue treats report definition as part of the business of file design, but for Condor, dBase and Superfile it is a separate issue. In Superfile it is Supertab that takes care of the creation, storage and execution of report definitions. I found it friendly and well-designed, but because its prompting is not particularly verbose you need to work closely with the manual.

Condor permits simple reports to be created with the verb Print, on to which you are allowed to tack the Compute clause. As elsewhere in Condor, any record selection has to be done beforehand.

A comprehensive fancy report generator is also included in the full Condor package. The Create option allows you to use the rather primitive built-in screen editor to draw an approximation of your report. The routine then trots you through the report line by line, inviting you to approve or amend default values implied by the way you laid out the screen.

If you find the idea of a little elementary programming scary you can stick at this level. If you do not, dBase make it possible to produce exotic printed layouts, in effect the full screen handling transferred to paper. A separate program called Zip, helps you to draw up your reports on the screen and then converts them atuomatically into dBase code.

All the four packages acknowledge that there will come a time when you wish your files were arranged differently. Superfile makes the least fuss about reorganisation because it keeps all its data in the same way and is unconcerned about field lengths. The screen editor built into Superforms is even more rudimentary than Condor's and does not allow you to make on-screen insertions or deletions, but the simplicity of the rest of the process makes up for this.

Condor has a command called Reorg which will take you back into the screen editor and lead you through the process of reordering, adding or deleting fields. Altering field descriptions is rather more complicated and involves writing out the file in standard ASCII format and reading it in again. I found this process a little quirky, occasionally coming adrift for no apparent reasons.

Condor's Reorg is paralleled in dBase, although here you are always required to write out the data and read it in again. But it is a very simple and logical process.

```
Copy <database> to temp
Modify structure
Append from temp
```

Modify Structure warns you that all data will be lost, and asks if you want to proceed. Provided you have made the copy you reply Y and are then taken into a full screen representation of the record layout. Here WordStar-like editing controls may be used to revise field names, change field lengths, alter data types and insert or delete fields. If you alter the data type of a field without altering its name you are asking for trouble, but I was pleased to see that it only makes a mess of the one field. In fact Modify Structure responds robustly even to sillinesses like having several different fields all with the same name.

Conclusions

- **Those reading between the lines will detect my own leaning towards dBase II, with Condor and Superfile close runners up. Condor has gone through two revisions in the past few months I have been using it, and I have been impressed by the back-up given by Moms, the U.K. distributor.**
- **Superfile is its own man. I like the elegance of its central idea and the innovation that has gone into the surrounding bells and whistles. The set-up routine for customising to your terminal is a joy to use. I suspect I shall be using it more when the new manual comes out.**
- **Rescue, with its procession of menus, is not entirely my cup of tea, but it is a more recent arrival in my office and I shall be persevering with it.**
- **I apologise for being so rude about Autocode from Stemmos. Stemmos supplies specialised applications packages written in dBase, and Autocode has come about as an in-house development tool. Awkwardnesses of the user interface matter less in-house, and Stemmos' skilful programmers are no doubt used to patching the simple output from Autocode into complex multi-file handling routines.**

dBase II	**Ashton-Tate**	**£437**
Superfile	**Southdata**	**£500**
Rescue	**MBS**	**£295**
Condor I	**Moms**	**£195**
Condor II		**£375**
Condor III		**£650**

Condor comes in three versions. Level one is virtually a flat-file handling system, with the relational procedures like Join and Project being added at level 2. Level 3 includes the advanced Report Writer and the indexing facility. Southdata offers other Superfile add-ons as a cost option. For example there is a mailing-list program at £75.

Manuals

Setting up a database will frequently require discipline and patience. A useful tip, especially during the early stages, is to buy two manuals — one to throw at the wall and a second to keep for best.

Some manuals are too heavy to throw at the wall. I suspect the vendors forget that the word literally means a book you can hold in one hand for reference while engaged in some activity. The manual for Rescue, for example, weighs the same as two volumes of the *Encyclopaedia Britannica,* 14th edition.

The Superfile manual is lightweight in the wrong sense. There is no index and very little tabulation of information. The casual tutorial tone really needs to be heftily supplemented with sections that will serve for back-reference. Very little attention has been paid to the layout on the page, and the dot-matrix typeface with its many typographical errors does not help legibility. I understand from Southdata, the vendor, that a major redraft is on its way.

The Condor and dBase manuals share the idea of division into a tutorial section and an alphabetic arrangement of commands. It amounts to presenting the material twice, and Condor fares better because it has less to tell. In dBase the need to describe the very full programming facilities has resulted in something of a doorstop, but cross-referencing is good and there is a well-designed index.

The Rescue manual presents the reader with page after page of patchily photocopied Letter Gothic, relieved occasionally with bright-red header pages and stiff yellow section dividers. But once you overcome the initial stomach sinking induced by the look of the thing the explanations prove to be clear and well supplied with examples. A compact reference section and an index are appended for quick reference.

Apart from its physical representation the Rescue manual seems to be designed along the right lines. But I am left wondering why a menu-driven package aimed at the first-time user needs such a lumbering companion.

Database in Basic

Jim McCartney needed to keep track of a textile mill's stock — so he wrote his own suite of programs to do the job.

IT IS POSSIBLE TO construct your own database for your own program suite, written in Basic. Because it is in Basic it will be rather slow in operation but since it is constructed to your own needs this difficulty may be largely offset.

The examples given are in Commodore Basic for the 4032 machine. It will also do very well for the 8032 with 8050 discs. The DOS is verison 2.1. For really big files, where the Commodore disc size is likely to be exceeded, you should consider CP/M with a hard disc of some sort. It will give you files of up to 8Mbyte without having to mess about with disc volumes and the like.

In a typical stock list you will have the following headings, or something like them:

Name
Stock number
Amount in stock
Cost per unit

Each of these headings is the name of a field, and the complete set of fields for a single stock item is called a record. The set of records consisting of stock items of a similar type is called a file. Your stock list for items of a single type is the file for that stock. If you have another type of stock which needs different fields, then you will need to have it in another very small file like table 1.

This simple concept is often made more complicated in commerce by the need to keep details of stock movements over a reasonable period. In such a case each record will have to be expanded by a set of transactions. The record is then broken down into a header or master record and an attached set of transaction records such as table 2.

Most commercial databases do not deal with transactions in this way, though one notable exception is the Administrator. On the accounting side open item ledgers are of this type.

A simple file has records that are in no particular order other than the record number. In a few cases the stock code can be set as equal to the record number, but because stock items change it is not usually expedient. This sort of arrangement can cause confusion between an obsolete stock item and a new item bearing the same number. Without this problem it is easy to set up a system which will simply go straight to the record, given the record number.

Things can progress a stage further if you can calculate the record number from the name or stock code by a simple algorithm. It is easiest to add the record number to the stock code thus:

Widgets 12345/1
Thingys 54321/2

The record number can be extracted by a simple string manipulation. Other algorithms can act on the name string. They produce a random number and hopefully a sufficiently large file space, which will correspond to a vacant record when you are adding a new record. If it does not, search up the records until you find the first vacant space. It is called hash coding — see table 3.

This is the simplest method, but in the interests of storage efficiency a lot of variations can be made. The trouble with direct access and hash coding is that they can refer only to a single field. It means that if you know you want widgets but cannot remember the stock code number used as the key to the record, then you cannot access your record until you have found your stock-code list. Many people feel that computers ought to be smarter than this.

It is clear that in the example file either the name or the stock code could be used for access to the record. Any field so used is called a key field. To find a single record a key has to be unique to that record. It is no good having 10 different sorts of widgets with different stock codes and calling them all widgets if you want to access them by name. In such a case the stock code would have to be a secondary key, to be checked out after the primary key has been found. If you want to access the record either by the unique name or by the unique stock code, these are both primary keys and require a multiple-key file.

Assuming you want to find the key field called Widgets in one of a thousand or so records, and that the records are in no particular order, you can do various things to find the required record:

- Examine the entire file from end to end.
- Examine only the Name field in the file from end to end.
- Put the records in some sort of order.
- Leave the records as they are but make an index.

The first two stratagies are naturally very slow unless the whole file in in immediate

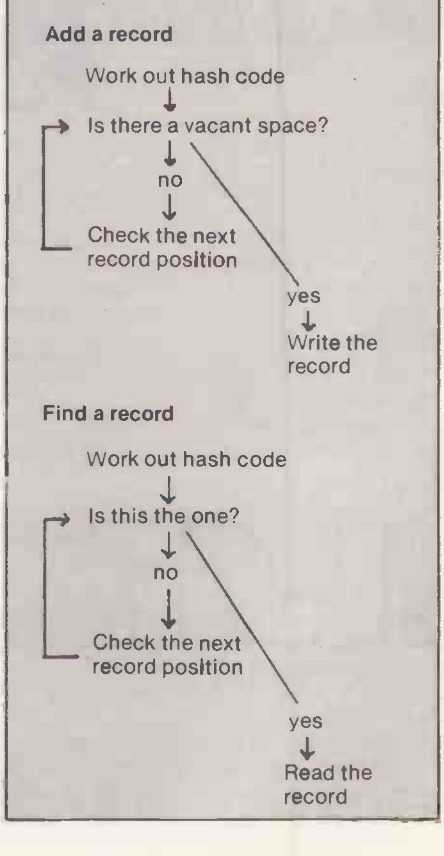
Table 1.

Field name Record no	Name	Stock Code	Amount	Value per unit
1	Widgets	12345	10	£ 1.25
2	Thingys	54321	2	£ 0.50
3	Gadgets	98765	213	£ 0.27
4	Wotzits	22222	16	£28.42

Table 2.

Header:	Name	Stock Code	Value per unit	
	Widgets	12345	£1.25	
Transactions:	**Issues**	**Receipts**	**Balance**	**Date**
1		15	15	18/08/82
2	3		12	19/08/82
3		10	22	19/08/82
4	12		10	20/08/82

Table 3.



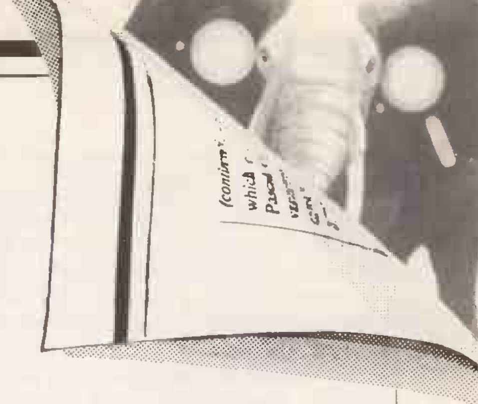


Table 4.

Search key = McCartney Set: Start = A 1 Bar End = Zund, JJ
Open the directory in the middle. Read Kelly, D
Kelly < McCartney < Zund.
Set: Start = Kelly, D End = Zund, JJ
Open the directory halfway between Start and End. Read Mulligan, ME
Kelly < McCartney < Mulligan
Set: Start = Kelly, D End = Mulligan, ME
etc, etc. Repeat until you find McCartney

memory, RAM, when they can be tolearble if you do not have to do it too often. They are used as an option in commercial databases if you want to find something but cannot remember any of the keys: for example, what are those things we have in stock which cost £28.42? People do occasionally ask daft questions and it is nice to think that the computer can answer them.

The third strategy is to arrange all your records physically as in a dictionary or telephone directory, but it has two drawbacks. First, though it is not impossible to sort out a file directly on a disc it is so appallingly slow as to be impractical. Secondly there can still be only one key field, unless you have a different file for every key. Nevertheless it has a greatly improved search strategy available. The search imitates the way you would look in a dictionary or directory and is known as the binary chop.

Suppose you want to look up a number in the telephone directory, proceed as in table 4. The binary chop enables you to double the number of records, yet only add one stage to the search. The search cannot exceed n stages, where n is the first integral power of two greater than the number of records. To find one record out of 2,000 takes only 10 percent longer than to find one out of 1,000, that is ((11 − 10)/10) − 1, since 1,000 is a little less that 2^{10}.

The object of arranging the directory in physical order is merely to facilitate this sort of search. What we really need is a system for finding the x^{th} record, where $0 < x < n$ and the records are arranged in a logical order. Here "logical" means more or less the opposite of "physical". It is now only necessary to determine that such and such a record is the x^{th} record in some sequence of keys, and to make a note of the fact elsewhere. You do not need to put the record in the x^{th} physical position.

The fourth strategy is where the notes of the position of the records are in an index.

(continued on next page)

```
100 GOTO2530
110 :
120 REM **** SUB DISC ERROR ****
130 IF DS<20 THEN RETURN
140 PRINT DS$:END
150 :
160 IF DS<20 OR DS=50 OR DS=62 THEN RETURN
170 PRINTDS$:END
180 :
190 REM **** SUB INSTRUCTIONS PAGE ****
200 PRINT"USING THE INDEX:
210 PRINT"KEY:   ACTION:
220 PRINT"?      TO DISPLAY THIS PAGE AGAIN
230 PRINT">      READS THE NEXT ITEM
240 PRINT"<      READS THE LAST ITEM
250 PRINT"$      TO SELECT A NEW ITEM
260 PRINT"=      TO AMEND AN ITEM
270 PRINT"+      TO ADD AN ITEM
280 PRINT"*      TO DELETE AN ITEM
290 PRINT"RETURN TO RETURN TO THE MENU
300 PRINT"PRESS RETURN TO PROCEED
310 GET Q$:IF Q$<>CHR$(13) THEN 310
320 RETURN
330 :
340 REM **** SUB WRITE INDEX ****
350 PRINT"          FILING INDEX: PLEASE WAIT
360 DOPEN#1,"@NUMBERS",D0,W:GOSUB120
370 DOPEN#2,"@NAMES",D0,W:GOSUB120
380 :
390 FOR J=1TORN
400 PRINT#1,IN%(J,0):GOSUB120
410 NEXT J
420 :
430 FOR J=1TORN
440 PRINT#2,IN%(J,1):GOSUB120
450 NEXT J
460 :
470 DCLOSE
475 KK=0:REM RESET FLAG
480 RETURN
490 :
500 REM **** PRINT LIST IN ORDER ****
510 IF MU=3 THEN H$="STOCK USAGE REPORT ":X=0
520 IF MU=4 THEN H$="NUMERICAL LIST      ":X=0
530 IF MU=5 THEN H$="ALPHABETICAL LIST   ":X=1
540 H$=H$+D$
550 :
560 OPEN1,4:OPEN2,4,1:OPEN3,4,2
570 PRINT#1,""
580 PRINT#3,F$
590 PRINT#1,,CHR$(1);H$:REM HEADER INC. DATE
600 PRINT#1:PRINT#1,H1$:PRINT#1
610 IF MU=5 THEN PRINT#1:PRINT#1,,CHR$(1);
    "A":PRINT#1:A=65
620 :
630 REM READ RECORDS IN ORDER
640 DOPEN#4,(DC$),D0:GOSUB120
650 FOR J=1TON
660 RECORD#4,(IN%(J,X)):GOSUB120
670 FOR F=1 TO 7
680 RECORD#4,(IN%(J,X)),(F%(F)):GOSUB120
690 INPUT#4,Q$:GOSUB120
700 Q$(F)=Q$+""
710 IF F=7 AND MU=3 THEN GOSUB 1040
720 REM RESET AFTER WEEKLY USAGE PRINTOUT
730 NEXT F
740 Q(1)=VAL(Q$(1)):Q(3)=VAL(Q$(3))
750 Q(6)=VAL(Q$(6)):Q(7)=VAL(Q$(7))
760 REM STOCK USAGE SUMS
770 IF MU=3 AND Q(7)=0 THEN 840
780 IF MU=3 THEN VU=VU+Q(6)*Q(7)/C
790 IF MU=3 AND Q$(4) ="CH" THEN VC=VC+Q(6)*Q(7)/C
800 IF MU=3 AND Q$(4)<>"CH" THEN VD=VD+Q(6)*Q(7)/C
810 REM PRINT RECORDS
820 IF X=1 THEN GOSUB980:REM LETTERS
830 PRINT#2,Q(1),Q$(2),Q$(5),Q(3),Q$(4),Q(6),Q(7)
840 NEXT J
850 IF A<91 AND MU=5 THEN GOSUB 990:REM FILL IN ALPHABET
860 :
870 REM PRINT STOCK USAGE
880 IF MU<>3 THEN 940
890 PRINT#1
900 PRINT#1,,VU$,(INT(VU*C+.5))/C:PRINT#1
910 PRINT#1,,VD$,(INT(VD*C+.5))/C:PRINT#1
920 PRINT#1,,VC$,(INT(VC*C+.5))/C:PRINT#1
930 :
940 PRINT#1,"":CLOSE1:CLOSE2:CLOSE3
950 DCLOSE:GOTO3290
960 :
970 REM SUB FOR LETTERS ON ALPHA LIST
980 IF ASC(Q$(5))=A THEN RETURN
990 A=A+1:PRINT#1:IF A>90 THEN RETURN
1000 PRINT#1,,CHR$(1);CHR$(A)
1010 PRINT#1:GOTO 980
1020 :
1030 REM SUB SCRATCH WEEKLY USAGE
1040 RECORD#4,(IN%(J,X)),(F%(7)):GOSUB120
1050 PRINT#4," 0"
1060 RETURN
1070 :
1080 REM **** SUB SCRATCH RECORD ****
1090 REM RE=RECORD NUMBER
1100 :
1110 FOR X=0 TO 1
1120 FOR R=1 TO N
1130 IF IN%(R,X)<>RE THEN 1190
1140 :
1150 FOR J=R TO N-1
1160 IN%(J,X)=IN%(J+1,X)
1170 NEXT J
1180 R=N
1190 NEXT R,X
1200 :
1210 IN%(N,0)=RE:REM PUT THE RECORD IN FREE SPACE
1220 IN%(N,1)=0:REM RESET THIS SO THAT 'N' IS READ CORRECTLY IN 10568
1230 N=N-1:REM DECREMENT N
1235 KK=1:REM FLAG TO REWRITE INDEX
1240 RETURN
1250 :
1260 REM **** SUB OPEN UP AND INSERT RECORD ****
1270 IF X=0 THEN RF=IN%(N+1,0)
1280 REM ASSIGN RECORD NUMBER FROM FIRST FREE SPACE, IGNORING RESULT OF'SEARCH'
1290 :
1300 FOR J=N TO R STEP -1
1310 IN%(J+1,X)=IN%(J,X)
1320 NEXT J
1330 IF R=0 THEN R=1:REM TO GET THE FIRST ONE
1340 :
1350 IN%(R,X)=RF:REM INSERT
1360 IF X=1 THEN N=N+1:REM INCREMENT WHEN DONE
1365 KK=1:REM FLAG TO REWRITE INDEX
1370 RETURN
1380 :
1390 REM **** SUB SEARCH RECORDS VIA INDEX. BINARY CHOP METHOD ****
1400 REM IF RECORD IS FOUND THEN IN%(R,X) ARE POINTERS AND RE IS THE RECORD NO.
1410 REM IF RECORD NOT FOUND.IN%(R,X) POINT TO THE NEXT HIGHEST RECORDS
1420 U=N:L=1:RE=0:R=0
1430 IF U<L THEN R=R+Y:GOTO1630
1440 R=INT((U+L)/2+.005)
1450 RE=IN%(R,X):REM RECORD TO COMPARE
1460 RECORD#4,(RE):GOSUB120
1470 :
```

(listing continued on next page)

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Referring back to the very small file, you can make an index for the stock names as in table 5. It is now easy to find the m^{th} record in the n^{th} index, and by applying the binary chop to any required index you can quickly get to the record, provided you are searching in an indexed key field.

The elements of the index array are called pointers because they point to the place where the record is stored. The pointer X(3,2) tells us that "the third record in the sequence of the second index is record number 2"— see table 6.

An index takes up a great deal less space than a record, so it is possible to have a substantial index in immediate memory and still have lots of room for a program as well. In particular, if your machine can store integers in two bytes, as with Commodore Basic, pointers can be stored very efficiently since they must be integers. A thousand items double-indexed will need only about 4K of RAM, whereas the actual records could easily occupy a full floppy disc.

Now that a way of finding things has been established, how can the pointer array be set up in the first place? It is easiest to explain this by an example in the very small file. Suppose you have to add an item called Nails to the index; it comes between Gadgets and Thingys, so the index has to be changed as table 6 shows. The second item in the list is now in record number 5. Record number 2 instead of being the second item is now the third, record number 1 is shifted from third place to fourth, etc. The elements of the array after the inserted item have all been shifted down one place.

Consider also what happens if we want to delete a record. It is not necessary to delete it physically. In order to forget Thingys just delete the pointer to record 2, and close the gap left. The pointers to the following records are therefore simply moved up one

Table 5.

The first record, in alphabetical order, is record number 3
The second record, in alphabetical order, is record number 2
The third record, in alphabetical order, is record number 1
The fourth record, In alphabetical order, is record number 4
Put this information into the array X(4) and you get the simple index array

X(1)	3
X(2)	2
X(3)	1
X(4)	4

If you want to store an index of the stock numbers as well, then a modest addition will suffice:

	X(m,1)	X(m,2)
X(1,n)	3	1
X(2,n)	2	4
X(3,n)	1	1
X(4,n)	4	3

(listing continued from previous page)

```
1480 IF X=1 THEN 1560:REM PEAD APPROPRIATE KEY FIELDS
1490 FUR F=1TO3
1500 PECORD#4.(RE),(F%(F))
1510 INPUT#4.Q$(F)
1520 NEXT F
1530 S$=LEFT$(Z$,(4-LEN(Q$(1))))+Q$(1)+Q$(2)
1540 GOTO 1590
1550 :
1560 RECORD#4.(RE),(F%(5))
1570 INPUT#4.S$
1580 :
1590 IF R$<S$ THEN U=R-1:Y=0
1600 IF R$>S$ THEN L=R+1:Y=1
1610 IF OF=1 THEN RETURN:
     REM USE FOR LOADING OLD FILES ONLY
1620 IF R$<>S$ THEN 1430
1630 PETURN
1640 :
1650 REM **** SUB WRITE NEW RECORD ****
1660 RECORD#4.(RF):GOSUB120
1670 FOR F=1 TO 7
1680 RECORD#4.(RF),(F%(F)):GOSUB120
1690 PRINT#4,F$(F):GOSUB120
1700 NEXT F
1710 RETURN
1720 :
1730 REM **** SUB REWRITE OLD RECORD ****
1740 RECORD#4.(RE):GOSUB120
1750 FOR F=1 TO 7
1760 RECORD#4.(RE),(F%(F)):GOSUB120
1770 PRINT#4.F$(F):GOSUB120
1780 NEXT F
1790 RETURN
1800 :

1810 REM **** SUB READ THE RECORD ****
1820 IF R<1 THEN R=1
1830 IF R>N THEN R=N
1840 RE=IN%(R.X)
1850 IF RE=0 THEN RETURN
1860 RECORD#4,(RE):GOSUB120
1870 FOR F=1TO7
1880 RECORD#4,(RE),(F%(F)):GOSUB120
1890 INPUT#4.F$(F):GOSUB120
1900 NEXTF
1910 RETURN
1920 :
1930 REM **** SUB DISPLAY RECORD ****
1940 PRINT"■■ CODE   SORT   CONC.
     CLASS■■■■■■■■■■PRICE■■■■■■USAGE
1950 FOR F=1TO7
1960 PRINT CM$(F);F$(F)
1970 NEXT F
1980 RETURN
1990 :
2000 REM **** SUB AMEND THE RECORD ****
2010 PRINT"■■■■■■■■■■■■■■■■■■■■■■■■
2020 PRINT"■■■■■■■■■■■■■■CHANGE RECORD AS REQUIRED.
2030 PRINT"■KEY ■RETURN■ TO ACCEPT
2040 PRINT"■TYPE ■<■ AND ■RETURN■ TO STEP BACK
2045 PRINT"■TYPE ■!■ AND ■RETURN■ TO ABORT
2050 KY=0:REM FLAG FOR KEY CHANGE
2060 :
2070 FOR F=1TO7
2080 IF MU=2 AND F=1 THEN F=6
2090 IF F<1 THEN F=1
2100 PRINTCM$(F);:INPUT"■■";Q$
2110 IF F=1 THEN Q$=LEFT$(Q$,5)
2120 IF F=2 THEN Q$=LEFT$(Q$,1)
2130 IF F=3 THEN Q$=LEFT$(Q$,4)
2140 IF LEFT$(Q$,1)="<" THEN PRINTCM$(F);F$(F):F=F-1:GOTO2090
2145 IF LEFT$(Q$,1)="!" THEN KY=0:PQ=0:F=7:GOTO2330
2150 Q=VAL(Q$)
2160 IF F=1 AND (Q<>INT(Q) OR Q<1 OR Q>9999) THEN 2440
2170 IF F=1 THEN Q$=MID$(STR$(Q),2)
2180 IF F=2 AND (ASC(Q$)<65 OR ASC(Q$)>73) THEN 2450
2190 IF F=3 AND (Q<>INT(Q) OR Q<10 OR Q>999) THEN 2460
2200 IF F=3 THEN Q$=MID$(STR$(Q),2)
2210 IF F=4 THEN Z=0:GOTO 2390
2220 IF F=4 AND Z=0 THEN 2470
2230 IF F=5 AND LEN(Q$)>35 THEN 2490
2240 IF F=6 THEN Q=(INT(Q*XX+.5))/XX
2250 IF F=6 AND Q>9999.9 THEN 2500
2260 IF F=6 THEN Q$=STR$(Q)
2270 IF F=7 THEN Q=(INT(Q*M+.5))/M
2280 IF F=7 AND (Q<0 OR Q>100000) THEN 2510
2290 IF F=7 THEN Q$=STR$((INT(Q*M+.5))/M)
2300 PRINTW$:"■
2310 IF F<6 AND Q$<>F$(F) THEN KY=1:REM FLAG FOR KEY CHANGE
2320 F$(F)=Q$
2330 NEXT F
2340 :
2350 GOSUB1940
2352 :

2354 REM CONFIRM
2356 IF PQ=0 THEN RETURN
2358 PRINT"■■■■■■■■■■■■■■IS THIS WHAT YOU WANT? (Y/N)"
2360 GET Q$:IF Q$<>"Y" AND Q$<>"N" THEN2360
2362 IF Q$="N" THEN PQ=0
2365 RETURN
2370 :
2380 REM CHECK VALID MATERIAL CODES
2390 FOR J=0 TO 17
2400 IF Q$=CO$(J) THEN Z=1:J=17
2410 NEXT J:GOTO2220
2420 :
2430 REM HELP MESSAGES
2440 PRINTW$;"DYE CODE MUST BE AN INTEGER BETWEEN 1   AND 9999        ":GOTO2100
2450 PRINTW$:"SORT CODE MUST BE A SINGLE LETTER       BETWEEN A AND I":GOTO2100
2460 PRINTW$;"STRENGTH CODE MUST BE AN INTEGER BETWEEN10 AND 999      ":GOTO2100
2470 PRINTW$;"DYE CLASS LETTERS MUST BE FROM THE      STANDARD SET   "
2480 FOR J=0TO17:PRINT CO$(J);"  ";:NEXT:GOTO2100
2490 PRINTW$:"DYE NAME IS TOO LONG                                    ":GOTO2100
2500 PRINTW$;"PRICE IN PENCE PER KG. BETWEEN 1 AND    9999.9          ":GOTO2100
2510 PRINTW$:"USAGE IN KG. BETWEEN 0 AND 99999.999                    ":GOTO2100
2520 :

2530 REM **** STARTUP ROUTINE ****
2540 DIM MU,MA,X:REM MENU,MATERIAL,KEY NUMBER
2550 MA$="":REM MATL. NAME
2560 Z$="0000"
2570 XX=10:C=100:M=1000:XM=10000
2580 F=0:J=0:K=0:REM COUNTERS
2590 Q$="":R$="":S$="":Q=0:Z=0:REM INPUT VARS
2600 P=0:R=0:U=0:L=0:Y=0:REM SORT & SEARCH VARS
2610 N=0:RE=0:RF=0:REM NO.OF RECS / REC NO./FREE RECORD NO.
2620 F$="        99999 A   AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA 9999 AA"
2630 F$=F$+" 99999.9 999999.999"
2640 H1$="          CODE    NAME                                 CONC    "
2650 H1$=H1$+" P/KG    KG.USED "
2660 W$="■■■■■■■■■■■■■■■■■■■■■■■■"
2670 H$="":D$="":REM HEADER,DATE
2680 RN=700:REM NUMBER OF RECORDS
2690 PQ=0:REM PEEK PARAMETER IN 11300 FF.
```

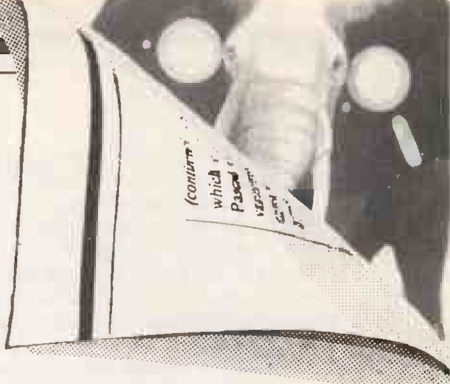

Table 6.

	Before	After
X(1)	3	3
X(2)	2	5
X(3)	1	2
X(4)	4	1
X(5)		4

place, giving the sequence 3, 5, 1, 4.

Meanwhile what is happening in X(5)? The element, and others higher than it, can be used to store the addresses of all the available records which are not in use; that is all those which have never been used, plus all those which have been deleted and can therefore be overwritten. These pointers are called free-space pointers, for obvious reasons. There is nothing to distinguish them from regular pointers, so you need to keep a tally of the number of records in use — call this number N — so that you know that the first N elements in the array are record pointers and the rest are free-space pointers. Then when you need a free space for a new record take the $(N+1)^{th}$ record, and afterwards set $N = N+1$. Conversely, when you delete put the deleted pointer into the N^{th} position, and set $N = N-1$. The changes to the index outlined in table 6 can now be completed — see table 7.

On examination you can see that when another new record is written, it will be put into record 2 and the existing record 2, Thingys, which is now redundant, will be overwritten.

There are plenty of other ways of keeping indexes, or of finding records. This one is suited to micro systems, where not more than one or two thousands records are involved. The advantages are:

- It is extremely compact. Having found a record, you know the address of the preceding and following records without having to have special pointers or links for the purpose.
- If a record does not exist, you can still search for it and find the next record instead. It eliminates those tiresome times when the computer tells you "record does not exist", without giving you any hint of what does exist.
- Multiple indexing is easy — you just need more array space.
- If the index or pointers are damaged or lost it is fairly easy to reconstitute them — you need a special bit of program which takes time.

The disadvantages are:

- The indexes must be in RAM if any additions or deletions are to be made. It means that you have to Read the index at the start of a session and Write it at the close.
- Pulling up and pushing down pointers after each entry or deletion is a slow job in Basic. If they are frequent the obvious thing to do is to store the various pointers above RAMtop and manipulate them in machine code. The principle is exactly the same as Basic.

(continued on next page)

```
2700 A=0:KY=0:KK=0:REM ALPHA LIST FLAG; KEY CHANGE FLAG TEMP & PERM.
2710 VU$="VALUE OF STOCKS USED, POUNDS:":VU=0:REM FOR WEEKLY SUM
2720 VD$="VALUE OF  DYES  USED, POUNDS:":VD=0
2730 VC$="VALUE OF CHEMS  USED, POUNDS:":VC=0
2740 DIM IN%(RN,1):REM X=0,NUMBER + FREE SPACE INDEX; X=1.NAME INDEX
2750 F%(1)=1:F%(2)=7:F%(3)=9:F%(4)=14:F%(5)=17:F%(6)=53:F%(7)=61:F%(8)=72
2760 REM 1ST CHAR IN FIELDS (EX LAST)
2770 OPEN1,4,10:PRINT#1:CLOSE1
2780 CM$(1)="":CM$(2)="":CM$(3)=""
2790 CM$(4)="":CM$(5)=""
2800 CM$(6)="":CM$(7)=""
2810 REM SCREEN LAYOUT STRINGS
2820 DC$="D&C RECORDS":REM FILE NAME
2830 DIM CO$(17)
2840 DATA"DR","AD","CT","CP","RE","VT","SU","BD"."AZ","PJ","BA","CH"."WL"
2850 DATA"NA","DD","DV"."DS","DH"
2860 REM MATERIAL CLASS CODES
2870.FOR J=0TO17:READ CO$(J):NEXT
2880 :
2890 REM **** READ INDEX FILES AND FIND N ****
2900 DOPEN#1,"NUMBERS",D0:GOSUB120
2910 DOPEN#2,"NAMES",D0:GOSUB120
2920 :
2930 FOR J=1TORN
2940 INPUT#1,IN%(J,0):GOSUB120
2950 NEXT J
2960 :
2970 FOR J=1TORN
2980 INPUT#2,IN%(J,1):GOSUB120
2990 IF IN%(J,1)=0 THEN N=J-1:J=RN
3000 NEXT J
3010 :
3020 DCLOSE
3030 :
3040 REM **** GET DATE ****
3050 IF PEEK(634)>0 AND PEEK(634)<21 THEN 3180
3060 PRINT"PLEASE TYPE TODAY'S DATE AND KEY
3070 PRINT"RETURN.
3080 INPUT"  ";Q$:IF Q$="" THEN PRINT"":GOTO3080
3090 D$=Q$
3100 :
3110 REM SAVE DATE IN 1ST CASS BUFFER
3120 POKE 634,LEN(D$)
3130 FOR J=1 TO LEN(D$)
3140 POKE(634+J),ASC(MID$(D$,J,1)):NEXT J
3150 GOTO3220
3160 :
3170 REM GET DATE FROM 1ST CASS BUFFER
3180 LE=PEEK(634)
3190 FOR J=1 TO LE
3200 D$=D$+CHR$(PEEK(634+J)):NEXT J
3210 :
3220 PRINT"     PLEASE MAKE SURE BACKUP DISC IS
3230 PRINT"IN DRIVE 1. PRESS SPACE BAR WHEN READY.
3240 GET Q$:IF Q$<>" "THEN 3240
3250 DOPEN#1,(DC$),D1
3260 IF DS>20 THEN DCLOSE:GOTO3220
3270 DCLOSE
3280 :
3290 REM **** MENU ****
3300 PRINT"   DYE AND CHEMICAL RECORDS PROGRAM
3310 PRINT"        J MCCARTNEY  MARCH 1982
3320 PRINT"PLEASE SELECT THE PROGRAM YOU REQUIRE
3330 PRINT"AND KEY RETURN.
3340 PRINT"1  SEARCH FOR / ADD / DELETE / CHANGE       ANY RECORD
3350 PRINT"2  CHANGE PRICES / QUANTITIES ONLY
3360 PRINT"3  PRINT OUT STOCK USAGE FOR THE WEEK.
3370 PRINT"4  PRINT NUMERICAL MATERIALS LIST
3380 PRINT"5  PRINT ALPHABETICAL MATERIALS LIST
3390 PRINT"6  RETURN TO MAIN PROGRAM
3400 INPUT"  ";Q$:MU=VAL(Q$)
3410 MU=INT(MU):IF MU<1 OR MU>6 THEN PRINT"":GOTO3400
3420 DCLOSE
3430 :
3440 IF KK=1 THEN GOSUB 330:REM REFILE INDEX
3450 ON MU GOTO 3480.3480,500,500,500,4230
3460 :
3470 REM **** INPUT ****
3480 DOPEN#4,(DC$),D0
3490 GOSUB 190:REM INSTRUCTIONS
3500 :
3510 PRINT"TYPE IN THE NUMBER OR THE NAME OF THE
3520 PRINT"MATERIAL YOU WANT AND KEY RETURN.
3530 PRINT"IF YOU ARE USING THE NAME. YOU DO NOT
3540 PRINT"NEED TO ENTER THE FULL NAME TO GET THE
3550 PRINT"FIRST MATERIAL WITH THAT NAME.
3560 INPUT"  ";MA$
3570 IF MA$="" THEN PRINT"":GOTO3560
3580 IF VAL(MA$)=0 THEN X=1:R$=MA$:REM NAMES
3590 IF VAL(MA$)>0 THEN X=0:MA$=LEFT$(MA$,4):R$=LEFT$(Z$,
     (4-LEN(MA$)))+MA$
3600 GOSUB 1390 :REM SEARCH
3610 GOSUB 1810 :REM READ
3620 :
3630 REM **** DISPLAY & ACTION ****
3640 GOSUB 1930 :REM DISPLAY
3650 PRINT"CONTROLS:
     [illegible] @ + # RETURN"
3660 PQ=PEEK(151)
3670 POKE 158,0
3680 IF PQ=255 THEN 3660:REM NULL
3690 IF PQ=13 THEN 3290:REM RETURN. MENU
3700 IF PQ=63 THEN GOSUB190:GOTO3640:REM ?. HELP
3710 IF PQ=62 THEN R=R+1:GOTO 3610:REM >.FORWARD
3720 IF PQ=60 THEN R=R-1:GOTO 3610:REM <.BACK
3730 IF PQ=64 THEN 3790:REM @, AMEND
3740 IF PQ=43 THEN 4000:REM +. ADD
3750 IF PQ=36 THEN 3510:REM $, SEARCH
3760 IF PQ=35 THEN 4140:REM #. DELETE
3770 GOTO3660
3780 :
3790 REM **** AMEND ****
3800 GOSUB 2000:REM AMEND, DISPLAY, CONFIRM
3805 IF PQ=0 THEN 3640
3810 IF KY=1 THEN 3860:REM KEYS HAVE BEEN CHANGED
3820 :
3830 GOSUB 1730:REM RE-WRITE
3840 GOTO 3960
3850 :
3860 GOSUB 1080:REM SCRATCH
3870 :
3880 FOR X=0 TO 1
3890 IF X=0 THEN R$=LEFT$(Z$,(4-LEN(F$(1))))+F$(1)+F$(2)
3900 IF X=1 THEN R$=F$(5)
3910 GOSUB 1390 :REM SEARCH
3920 GOSUB 1260:REM OPENUP
3930 NEXT X
3940 GOSUB 1650:REM WRITE NEW
3950 :
3960 IF VAL(MA$)=0 THEN X=1:REM NAMES
3970 IF VAL(MA$)>0 THEN X=0:REM NUMBERS
3980 GOTO 3640: REM DISPLAY
3990 :
4000 REM **** ADD NEW RECORD ****
4010 F$(1)=""
4020 F$(2)="A"
```

(listing continued on next page)

(continued from previous page)

- Because of these restrictions the method becomes increasingly cumbersome for files of more than a few thousand records. It is not of much interest for very large files such as might be used on minis or mainframes.
- The search does not give direct access to any record. Usually the program has to examine several before hitting on the right one or determining that it does not exist. The speed of access depends on the DOS, regardless of whether a Winchester is used, and the size of the disc buffer — a lot of searching can be done on a sufficiently large buffer — but is typically some seconds with Basic, floppies, and 1,000 records.

The four fundamental database functions are:

View or Print a record
Add a record
Delete a record
Change a record.

Changing a record breaks down into two types of change:

Changing key data in a record, such as name, stock number
Changing non-key data such as stock, price.

If key data is changed, the record has to be re-indexed, so the total operation is equivalent to Delete + Add.

These functions can be broken down into a number of procedures, some of which can be grouped together. Groups which go together are underlined in table 8. The procedure Action? means the machine is waiting for instructions. Scratch implies simply closing up the index. Action may vary but I have found the following options most convenient:

The four functions
Return to menu
Help
Display next record
Display previous record

The menu is likely to contain a number of things to do with the data, such as give various printouts and return to the main program, which is using the database for other purposes. Useful auxiliary functions not generally accessible from the menu are: Scratch and Rewrite the program, the main file, the indexes; Copy and Index records from another disc; dump the file to the printer. These are useful in the construction and testing of the program, and also for reconstituting data from a bad disc. ■

Table 7.

	Original	Add "Nails"	Delete "Thingys"
X(1)	3	3	3
X(2)	2	5	5
X(3)	1	2	1
X(4)	4	1	4
X(5)	5	4	2
X(6)	6	6	6
X(7)	7	....etc.	
N =	4	5	4

Physical records:

	Original	Add	Delete
1	Widgets	Widgets	Widgets
2	Thingys	Thingys	Thingys
3	Gadgets	Gadgets	Gadgets
4	Wotzits	Wotzits	Wotzits
5	null	Nails	Nails
6	null	null	null
7	null	.....etc.	

Table 8

View Input key — search — read — display — action?
Delete view — confirm? — scratch — Display(next) — action?
Add Null fields — display — amend — display — confirm? — search — open up index — write new record — display — action?
Change view — amend — display — confirm? — rewrite record — display
(key) — action?
Change view — amend — display — confirm? — scratch — search —
(non-key) — open up index — write new record — display — action?

(listing continued from previous page)

```
4030 F$(3)="100"
4040 F$(4)="_"
4050 F$(5)="%"
4060 F$(6)="%"
4070 F$(7)="0"
4080 REM NULLFIELD
4090 :
4100 GOSUB 1930:REM DISPLAY
4110 GOSUB 2000:REM AMEND, DISPLAY. CONFIRM
4115 IF PQ=0 THEN 3640
4120 OOTO3880:REM SEARCH, OPENUP, WRITE NEW. DISPLAY.
4130 :
4140 REM **** DELETE ****
4150 PRINT"";
4160 PRINT"ARE YOU SURE YOU WANT TO DELETE THIS    RECORD (Y/N) ";
4170 INPUT"  Y";Q$
4180 IF Q$<>"Y" THEN 4210
4190 GOSUB 1080:REM SCRATCH
4200 :
4210 GOTO 3580:REM WILL DISPLAY NEXT RECORD
4220 :
4230 REM **** BACKUP AND CHANGE PROGRAM ****
4240 BACKUP D0 TO D1
4250 PRINT"PRESS RETURN TO RELOAD MAIN PROGRAM.
4260 GET Q$: IF Q$<>CHR$(13) THEN 4260
4270 :
4280 PRINT"DLOAD";CHR$(34);"BADR 1/1";CHR$(34);",D0"
4290 PRINT"RUN
4300 PRINT""
4310 POKE 158,2:POKE 623,13:POKE624,13
4320 NEW
4330 END
60000 :
60010 REM **** SCRATCH AND SAVE PROG ****
60020 XX$="MATL.FILE*":XZ$="MATL.FILES 3"
60030 SCRATCH(XX$),D0:DSAVE(XZ$):VERIFY(XZ$),8:DIRECTORYD0
60040 OPEN1,4,10:PRINT#1:CLOSE1
60050 OPEN1,4:PRINT#1,"":PRINT#1,XZ$
60060 PRINT"LIST":PRINT"GOTO60080"
60070 CMD 1:END
60080 PRINT#1,"":CLOSE1:END
60090 :
60100 REM **** SCRATCH & INITIALISE FILE ****
60110 OOTO60140
60120 IF DS<20 OR DS=50 OR DS=62 THEN RETURN
60130 PRINT DS$:END
60140 PRINT"THIS ROUTINE WILL DELETE EXISTING
60150 PRINT"FILE AND REWRITE A BLANK FILE OF 700
60160 PRINT"RECORDS. FILE NAME IS 'D&C RECORDS'
60170 PRINT"RECORDS ARE WRITTEN ON D0
60180 PRINT"PRESS SPACE BAR TO GO AHEAD.
60190 GET Q$:IFQ$<>" "THEN 60190
60200 SCRATCH (DC$),D0:GOSUB60120
60210 DOPEN#4,(DC$),D0,L71:GOSUB60120
60220 RECORD#4,700:GOSUB60120
60230 PRINT#4,CHR$(255):GOSUB60120
60240 DCLOSE
60250 DIRECTORYD0
60260 PRINT"FINISHED
60270 END
60280 :
60290 REM **** SCRAICH & GENERATE INDEX ****
60300 SCRATCH"NUMBERS",D0:SCRATCH"NAMES",D0
60310 FOR J=1TORN:FOR X=0TO1
60320 IN%(J,0)=J:IN%(J,1)=0:REM FREE SPACE POINTERS IF X=0
60330 :
60340 DOPEN#4,"@NUMBERS",D0,W:GOSUB160
60350 FOR J=1TORN:PRINT#4,J:GOSUB160:NEXT
60360 DCLOSE
60370 DOPEN#4,"@NAMES",D0,W:GOSUB160
60380 FOR J=1TORN:PRINT#4,0:GOSUB160:NEXT
60390 DCLOSE
60400 STOP
60410 REM LOAD OLD FILES
60420 N=0:REM NUMBERS OF RECORDS USED
60430 OF=1:REM FLAO FOR OLD FILES
60440 :
60450 DOPEN#4,(DC$),D0:GOSUB120
60460 FOR J=1TORN:PRINT"RECORD ";J
60470 RECORD#4,(J):GOSUB120
60480 GET#4,Q$:IF Q$="π" OR Q$="*" THEN IN%(J,0)=J:GOT060710
60490 FOR F=1TO7
60500 RECORD#4,(J),(F%(F)):GOSUB120
60510 INPUT#4,Q$(F):GOSUB120
60520 NEXTF
60530 X=0:N=.I+1
60540 IF X=1 THEN R$=Q$(5):GOTO 60560
60550 R$=LEFT$(Z$,(4-LEN(Q$(1))))+Q$(1)+Q$(2)
60560 U=N-1:L=1:RE=0:R=0
60570 IF U<L THEN R=R+Y:OOTO 60620
60580 GOSUB 1440
60590 IF R$<>S$ THEN 60570
60600 :
60610 REM PULLUP
60620 IF X=1 THEN J1=N:GUT060640
60630 J1=J
60640 FOR K=J1 TO R+1 STEP -1
60650 IN%(K.X)=IN%(K-1,X)
60660 NEXT K
60670 IF R=0 THEN R=1:REM TO POSITION THE FIRST ONE
60680 IN%(R.X)=J:REM THE R'TH RECORD IS J
60690 IF X=0 THEN X=1:GOT060540
60700 :
60710 NEXT J
60720 :
60730 DCLOSE
60740 :
60750 REM WRITE INDEX
60760 GOSUB 350
60770 END
READY.
```

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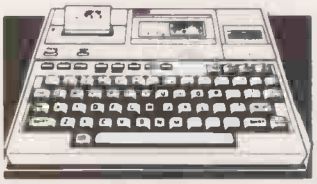

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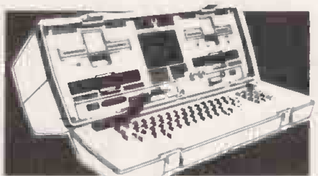

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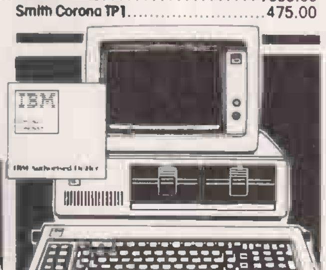

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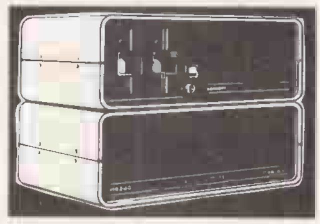

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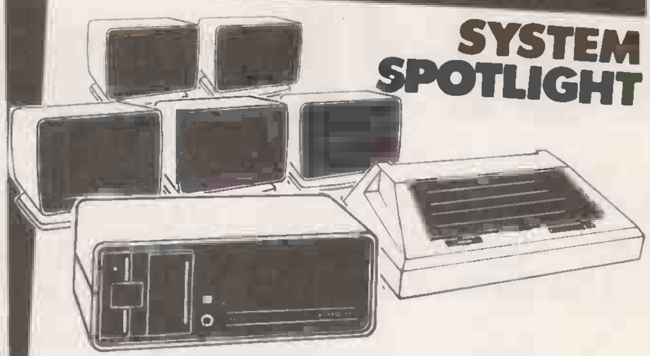

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Not the place for

Even a medium-sized voluntary organisation benefits from professional advice when putting its records on to a computer. Ian Stobie visited the National Association for Gifted Children to hear how Compsoft's DMS now keeps it in touch with its 4,000 members in 50 branches around the country.

INTRODUCING a microcomputer system into an office to replace a working manual system is, at best, time consuming. At worst it can be disastrous. Usually only the rosy side of the picture is painted, suggesting you can have "all the information you need at the touch of a button".

It is not only commercial advertisements but also officially originated Information Technology literature which can promote this complacency. When you buy a computer you are unlikely to find any government health warning stamped on the side of the box.

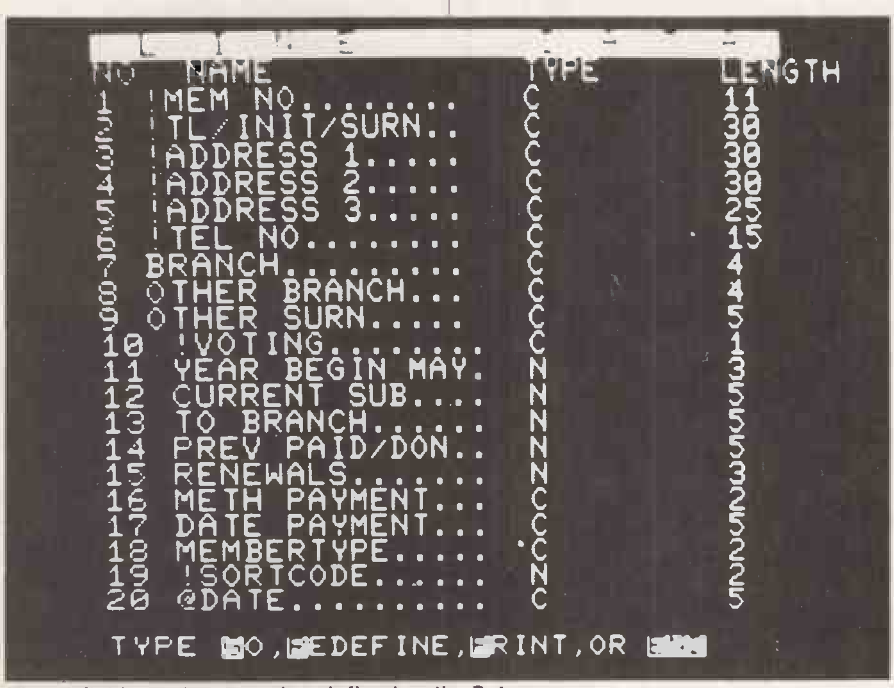
All the same, many small organisations, both commercial and non-commercial, do set out in pursuit of the benefits of computerising. And they have many hazards and adventures along the way.

The National Association for Gifted Children is a registered charity. Its aim is to assist children with outstanding gifts and talents to fulfil their potential, and to give support to parents and teachers and others professionally involved with them. For over two years it has been using a Commodore Pet and the Compsoft DMS record-handling package—generally successfully but not without having to overcome few problems along the way.

The association has around 4,000 members organised into 50 regional branches, and a small head office in London. The membership consists mostly of parents, along with professionals involved in childcare and institutions like schools and child-guidance centres. The children the association deals with, although talented in some way, can often become withdrawn and difficult, deliberately under-achieving at school because they feel frustrated and out of place. No details on the children themselves are kept on the computer; in any case children's activities are mostly organised at branch level.

Members pay a subscription direct to head office, so the main task for the computer is keeping track of where members live and whether they have paid the right amount. The association also sends its members various mailings during the year, and so needs to produce mailing labels. Periodically, each of the 50 branches is sent an up-to-date list of members living locally.

All these tasks are now done on the Pet system, a Commodore 3032 with 3040 twin floppy-disc unit and Commodore dot-matrix printer. Use of the computer is thoroughly integrated into the organisation of the office, and routine administration works to a timetable centred round the Pet.



The 20-field member record as defined on the Pet screen.

When I visited the association's London headquarters the staff were in the middle of producing the branch lists. This is the most tedious task, as the membership records spread over 15 discs. Searching out the appropriate members for each branch 50 times over involves 750 disc changes all told.

In spite of the difficulties, Letitia Berry, who is General Secretary of the association, and Barbara Cox, the person in charge of the computer, seem pleased with the system. It is a big improvement over the way they used to have to do things.

Plastic cards and stencils

Letitia Berry described their previous system. "We used to use Addressograph-type cards, plastic cards with stencil inserts. We used the card both as our record and to print envelopes for subscription and newsletter mailings. We had a hand machine, and it would take all day to do one set of mailings."

Later on they invested in an electric machine which used bigger cards, but they were thinner and easily damaged. "As the card was the only record you were in trouble if you lost it," recalls Letitia Berry. So the next stage was to transfer the subscription record into small, bound paper ledgers. The problem here was that any change to a member's record had to be made in more than one place. Not only was this extremely time consuming, but also liable to error.

There had been suggestions at least twice over the years that the office should computerise, but at that stage it meant going to a bureau. Like many charities, the National Association of Gifted Children places a strong emphasis on the privacy of the information given to it. Many members do not want it generally known that they belong—they want to avoid having their child labelled as "gifted"—and some members receive financial help which obviously should be confidential. It is essential for the association to have control over its own records.

In 1979 the association decided to go ahead and buy its own computer. The

gifted amateurs

Barbara Cox with the NAGC's system: "You do need to be able to shout 'Help' to someone."

scheme was put forward by a branch membership secretary who happened to be familiar with computers. The Association bought the hardware, and he started working on a program to handle membership records. At that point he then moved to the West Country, and according to Letitia Berry, "This is where things started to get difficult, because we had our computer and our disc drive and our printer, and no programs."

The association then called in someone who was very keen and enthusiastic but not experienced with the particular problems that were likely to crop up. He worked on the program and actually got as far as entering the data, but it did not work.

So far things had not gone very well, though at least the cost was not as high as a commercial organisation would have sustained, as both these people were unpaid volunteers. The third person to act as unpaid consultant appeared on the scene during 1980. Claire Peach, another local branch secretary, happened to have worked with computers. According to Letitia Berry, "She was more knowledgeable, and I suppose by this time more things were available. She found the Compsoft program for us. This produces exactly what we want."

Conceptually the association's system is very simple. A single file holds membership records. There is one record per member; each record has 20 fields holding all the address and payment details needed. It also indicates which branch the member is in, so no separate branch record is used. Processing amounts to little more than maintaining this single set of records and sorting them in various different ways.

The major problem with the system is the amount of information you can put on a Pet disc. Barbara Cox has most experience with using the computer at the Association. Theoretically you can store 500 records on a disc, but in practice it was found that if you exceed about 350 you will have problems.

The records are held in alphabetical name order. That is why doing the branch lists is so irritating, because you have to go through the alphabet picking out everybody in, say, Shropshire—with all 15 discs. This process has to be repeated for each of the 50 branches to produce a complete set of branch lists.

According to Letitia Berry, "We considered the alternative of having discs for each branch, but we rejected it because it's easier for us to look up people alphabetically." The version of Compsoft DMS the association uses only allows single file processing, so there was no possibility of solving the problem with a more sophisticated file structure.

Fantastically easy

Barbara Cox adds: "Although the branches thing seems quite cumbersome, the national mailing, when we send out the newsletter to all members, is fantastically easy now. You just run off the labels, and everybody who has paid gets a newsletter; if they haven't paid they don't get a label and that's it." It now takes two days instead of a week to send out over 4,000 newsletters, including the time taken stuffing envelopes.

Typing all the membership records into the machine was a major task, "It took

(continued on next page)

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me three or four days a week doing nothing else for about six months," says Barbara Cox. "It was a slog, anybody who is going to computerise should realise that. It was very tedious."

The Pet was bought from Sumlock-Bondain, and both Letitia Berry and Barbara Cox feel the company has been very helpful. The association took out a maintenance contract and would recommend anybody else to do the same. Problems do crop up unexpectedly. "When printing the labels for mailings we had an old batch of labels that kept coming unstuck in the printer," Barbara Cox remembers. "You just had to get an engineer in to destick it. A couple of vestigial labels are still on the roller."

The software support the association received from Compsoft was also good. "Their after-sales service is very good," says Barbara Cox. "They were fantastically helpful when we were first using DMS. We used to be able to just ring up and say 'help' and they would give us advice over the phone." This was in the early days of the DMS package and the service came free. Users now pay a subscription of £100 to join the Compsoft DMS User Club, which entitles them to support and updates of software. The association is a member, and seems very happy with the arrangement.

Barbara Cox describes one problem they had in the early days: "Mysterious corruption was appearing on our discs. It was something to do with the fact that we were leaving the machine doing things overnight. It was actually the guy at Compsoft who suggested that it was the voltage altering. Given this area, the West End, with all the hotels and everything it seems very likely, so we just stopped doing things overnight and have had no problems since."

The version of DMS the association uses is an early one, and does not have a disc-level copying facility, only a much slower file-by-file copy. According to Barbara Cox, "This is actually a disadvantage because it discourages you from doing duplicates often enough to be safe."

To get round the problem the association tried using the standard Commodore-supplied disc-copying utility, but ran into problems. "We had terrible trouble to start up with, endless problems, with just doing a straightforward fast copy. It was something to do with the fact that DMS has a built-in system for initialising, and when you went out of that and tried to duplicate using the Commodore system disc, the two didn't mesh properly." The problem was eventually solved with help from Compsoft.

Compsoft is encouraging its long-established Pet users to move up to the latest data-campatible product, DMS Diamond. The association would get the software free as a member of the DMS User Club and is likely to make the change. DMS Diamond supports hard discs, and if funds become available Letitia Berry and Barbara Cox would like to upgrade to them at the same time. The higher capacity of a hard-disc system would solve the disc-changing problem, though it would mean buying a more sophisticated Pet.

Computer calendar.
May: subscription renewals
June: subscription renewals
July: branch lists in abbreviated form, two copies to branch
August: labels for mailing annual report and AGM
September: subscription renewals
October: subscription renewals; possibility of extra branch lists if requested
November: labels for mailing newsletter to paid-up members only; first full printout to show one previous year and current members
December: finish printout: start branch lists
January: full branch lists with addresses
February: branch list corrections
March: second full printout
April: labels for mailing, subscription reminders; transfer and update

Apart from the main membership records used for subscriptions and mailing, Barbara Cox has set up two other separate files using DMS. One she describes as "a soft of addressbook" which the Director and Education Officer use for their contacts; the other is a list of the officers in the different branches. They started off looking like trimmings, but both those discs have turned out to be really useful.

Another anticipated development is to use the system to generate financial information. "I think one of the things we are aware of is that we are not really exploiting the system to the full," says Letitia Berry. "There are lots of things we could do with it if we had the time to learn what else we could do."

At the branch level, computing of any description is one of the most popular activities for the children. As with many voluntary organisations, ingenuity is always being used to keep costs down. One West London branch is collecting cast-off ZX-81s—and any other Sinclair detritus people want to get rid of—to repair and then put to use. Nationally, the association ran an exhibition and conference in Birmingham last Autumn called Computer-based Learning at Home, which was well attended by members and commercial companies. It was combined with the Annual General Meeting, the idea being that members could bring their children along and find out what was available. The head-office Pet was used at the conference to produce name badges, which also served as entrance tickets.

What lessons can be learnt by other small organisations from NAGC's experience? Barbara Cox would summarise it as "Get a good consultant, and get a good program." She adds: "The impression I get from before I was here was that a lot of the problems were due to well-meaning enthusiasts. You are probably better off paying somebody who will give you an honest commercial opinion, rather than a well-meaning enthusiast who does not know their own limitations, or yours."

Letitia Berry agrees: "Unless you are very knowledgeable about what is available you have got to listen to somebody else. It's up to you really to choose what sort of somebody else you listen to. If you listen to hardware salesmen then they may well be biased in favour of one particular machine for other reasons than your own needs. I think we are very fortunate in having somebody like Claire, who understands the functions of the association."

This need for friendly advice goes beyond the initial purchase stage, according to Barbara Cox. "I think you do need to have somebody on call—either the software people or a consultant or somebody. If you have a whole office full of people who have no experience at all in handling computers you do need to be able to shout 'Help' to someone."

Both women agree that on balance the effort of computerising was worth it. "When we only had a record clerk he produced branch lists as and when he could. Now we produce them to a more specific timetable. And we have been forced to adopt a standard procedure. This is now known to four people, and the idea is that eventually everybody in the office will be able to do at least some of the tasks."

Barbara Cox agrees: "I am sure it's more efficient. For instance, sending out the national newsletter is quite expensive because it is a fairly bulky publication and the postage is quite high, and if you are sending it to about 500 people who don't belong any more it is a lot of money wasted.

"People have to become a bit more efficient, in a way, to put information into the machine. And I get the impression in a lot of charities that a Mrs Thing does the record and 'We don't want to ask her to change her ways'.

"A lot of people—particularly older people, to be honest—seemed very nervous about the whole idea of computerisation, and afraid that it was going to cause problems in the office—people would lose their jobs and that sort of thing. But to have a micro is just an everyday part of office equipment now.

"I thing it would be better now if the Pet went into the front office where we do the typing. It would then be all the little machines in there together. It is is really just one up from the typewriter."

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How to compute eigensolutions

M G Walker explains a technique which analyses the complicated vibrating systems found in engineering and architecture.

THE SYSTEM of lumped masses and massless springs in figure 1 could represent part of a car's suspension system, or an engine. If excited at some special frequencies the mass-spring system will resonate. This mass-spring system can be represented in terms of a five-by-five combined stiffness matrix K and a five-by-five diagonal mass matrix M by the equation:

$$M\underline{x} = (K/\omega^2)\underline{x}$$

The ωs are the resonance frequencies, known as natural frequencies, and the $\underline{x}$s are corresponding vectors or one-dimensional arrays of maximum relative displacements of the masses at each resonance frequency. They are termed mode shapes.

This simple vibration problem is an example of one of the many types of engineering problem which can be reduced to the matrix equation:

$$A\underline{x} = \lambda\underline{x} \qquad \text{equation 1}$$

where A is real N-by-N coefficient matrix, $\underline{x}$ is an N-by-N vector, and λ is a scalar. The equation actually has N solutions, known as eigensolutions. Each eigensolution consists of a value λ; the i^{th} eigenvalue, and a vector $\underline{x}_i$, the i^{th} eigenvector.

In the example the natural frequencies are the eigenvalues, and the mode shapes are the corresponding eigenvectors. Each eigensolution satisfies the property that the eigenvector pre-multiplied by the coefficient matrix yields a matrix proportional to itself; the constant of proportionality is the eignevalue.

The matrix equation has classically been solved by rearranging it to give:

$$(A - \lambda I)\underline{x} = \underline{0} \qquad \text{equation 2}$$

where I is an N-by-N identity matrix and $\underline{0}$ is a vector of zeros. The determinant $|A - I\lambda|$ is singular — it has the value zero — which shows that equation 2 cannot be solved to give a unique solution. It also shows the equation to be a set of homogenous linear equations, so that the relative values of $\underline{x}$ can be found.

The first step in this solution is to evaluate the determinant:

$$|A - I\lambda| = 0$$

to yield a polynomial of degree N in λ known as the characteristic equation. The N eigenvalues of matrix equation 1 are the roots of the characteristic equation. The N eigenvectors are found by substituting each eigenvalue in turn for λ in equation 2 and solving the N sets of N homogeneous linear equations which result.

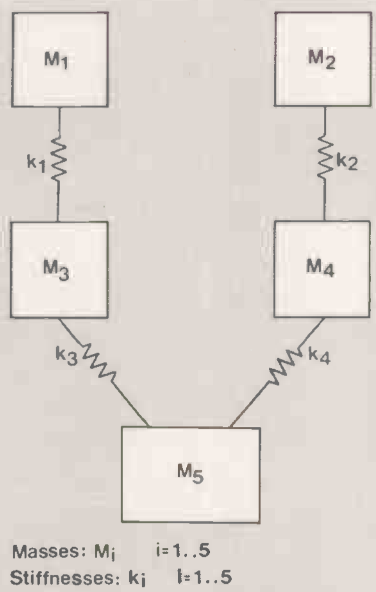

Figure 1. Typical vibrating system.

As an example of this analytical technique, consider the matrix equation:

$$\begin{bmatrix} 1 & 2 & 1 \\ 12 & 2 & -1 \\ -16 & -4 & 1 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \lambda \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} \qquad \text{equation 3}$$

Rearranging it gives:

$$\begin{bmatrix} 1-\lambda & 2 & 1 \\ 12 & 2-\lambda & -1 \\ -16 & -4 & 1-\lambda \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \underline{0} \qquad \text{equation 4}$$

and solving the determinant of this three-by-three matrix yields a cubic equation in λ, the characteristic equation for the problem:

$$\lambda^3 - 4\lambda^2 - 7\lambda + 10 = 0$$

It factorises to give:

$$(\lambda + 2)(\lambda - 1)(\lambda - 5) = 0$$

which has roots −2, 1 and 5, the eignevalues of the matrix equation 3.

To determine the first eigenvector, substitute the first eigenvalue λ_1 into the rearranged equation 4 to give the following

(continued on next page)

Listing 1.

```
1000 DEF PROC_shiftQR (N,ACCURACY)
1010 REM Determines the eigenvalues of an N x N symmetric tridiagonal matrix
1020 REM A to a specified ACCURACY using the shifted QR method. Eigenvalues
1030 REM are returned in the 1 x N array EIGVAL.
1040 LOCAL i% , j% , k% , approx . root , s , c , d , d1
1050 FOR i% = N TO 2 STEP -1
1060   REM perform transformation for i th. eigenevalue. compute approximation
1070   REM from 2 x 2 sub-matrix. Use d,d1 as temporary variables.
1080   d = (A(i%-1,i%-1) + A(i%,i%)) ^ 2
1090   d = SQR(d - 4*(A(i%-1,i%-1)*A(i%,i%) - A(i%,i%-1)^2))
1100   d1 = (A(i%-1,i%-1) + A(i%,i%) - d) / 2
1110   d  = (A(i%-1,i%-1) + A(i%,i%) + d) / 2
1120   IF ABS(d-A(i%,i%)) < ABS(d1-A(i%.i%)) THEN approx = d ELSE approx = d1
1130   REM shift matrix by eigenvalue approximation nearest to A(i%,i%)
1140   FOR j% = 1 TO i%
1150     A(j%,j%) = A(j%,j%) - approx
1160     NEXT j%
1170   FOR j% = 1 TO i%-1
1180     root = SQR(A(j%,j%)^2 + A(j%+1,j%)^2)
1190     c = A(j%,j%) / root
1200     s = A(j%+1,j%) / root
1210     REM apply transform, matrix must be tridiagonal
1220     FOR k% = 1 TO i%
1230       d  = c * A(j%,k%) + s * A(j%+1,k%)
1240       d1 = c * A(j%+1,k%) - s * A(j%,k%)
1250       A(j%,k%) = d   :   A(j%+1,k%) = d1
1260       NEXT k%
1270     FOR k% = 1 TO i%
1280       d  = c * A(k%,j%) + s * A(k%,j%+1)
1290       d1 = c * A(k%,j%+1) - s * A(k%,j%)
1300       A(k%,j%) = d   :   A(k%,j%+1) = d1
1310       NEXT k%
1320     NEXT j%
1330   REM shift matrix back by lowest modulus approximation
1340   FOR j% = 1 TO i%
1350     A(j%,j%) = A(j%,j%) + approx
1360     NEXT j%
1370   REM test convergence of eigenvalue
1380   IF ABS(A(i%,i%-1)) > ACCURACY THEN 1080 : REM iterate till converges
1390   EIGVAL(i%) = A(i%,i%)
```

How to compute eigensolutions

(continued from previous page)

set of homogeneous linear equations:

$$\begin{bmatrix} 3 & 2 & 1 \\ 12 & 4 & -1 \\ -16 & -4 & 3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \underline{0}$$

They are linearly dependent since the three-by-three matrix has a singular determinant. This means that x_1, x_2 and x_3 cannot be solved uniquely, but can be solved in terms of each other. If this is done, they exhibit the ratios:

$$x_1 : x_2 : x_3 = -2 : 5 : 4$$

Eigenvectors are usually normalised to unity, so divide the ratios by the value of largest modulus, 5 in this case, to give the first eigenvector:

$$\underline{x}_1 = \begin{bmatrix} -0.4 \\ 1 \\ 0.8 \end{bmatrix}$$

To find the second eigenvector substitute the second eigenvalue into the rearranged equation to obtain a second set of homogeneous linear equations:

$$\begin{bmatrix} 0 & 2 & 1 \\ 12 & 1 & -1 \\ -16 & -4 & 0 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \underline{0}$$

When solved, this gives the ratios:

$$x_1 : x_2 : x_3 = 1 : 4 : 8$$

which once normalised gives the second eigenvector:

$$\underline{x}_2 = \begin{bmatrix} 0.125 \\ 0.5 \\ 1 \end{bmatrix}$$

Substituting the third eigenvalue into equation 4, solving the set of homogeneous linear equations and normalising the solution produces the third eigenvector:

$$x_3 = \begin{bmatrix} 0.8333 \\ -0.6667 \\ 1 \end{bmatrix}$$

and completes the eigensolution of the original matrix equation 3.

This technique, known as the Newtonian method, is not suitable as a general method, particularly not as a computer algorithm. Deriving the characteristic equation is difficult, and computationally expensive and time-consuming. Solving it may prove awkward, and certainly the solution of the sets of homogeneous equations is expensive in processor time. However, there are two classes of practical methods which are also used to derive the eigensolution of a matrix equation — namely iterative methods and transformation methods. We consider each in turn.

Iterative methods are designed to find a single eigensolution of the matrix equation. The fundamental technique is called the power method and is used to find the eigensolution with the eigenvalue of largest modulus. It works by guessing a value for the eigenvector and using the property that multiplying the coefficient matrix by the eigenvector should give a vector proportional to itself.

The method uses the results of these multiplications to refine the eigenvector "guess". The power method may be summarised as follows:

$\underline{x}_1 = 1 : k = 1$
compute $y_k = A\underline{x}_k$
find d_k, the element of largest modulus in $\underline{y}_k$
$\underline{x}_{k+1} = \underline{y}_k / d_k$
If d_k and x_{k+1} are not accurate enough then $k = k + 1$: goto second step

and it can be shown that $k \rightarrow \infty, d_k \rightarrow \lambda$ the eigenvalue of largest modulus, and $\underline{x}_k \rightarrow \underline{x}$ the corresponding eigenvector.

A BBC Basic routine for the power method appears in listing 1. The routine starts by initialising the eigenvector, Eigvec, and the vector M used to test the convergence of the eigenvector. Having multiplied the matrices, the resulting eigenvalue Eigval is set to the approximate eigenvector's largest modulus element and used to normalise the array M.

Since the eigenvalue and eigenvector converge at different rates, they are checked separately. The eigenvalue is tested first as it is computationally quicker. If either convergence test fails, the latest guess at the eigenvector is stored in Eigvec and the process repeated.

The routine expects all its arrays to have been dimensioned and the coefficient matrix A to have been set up. It should be given the size of the coefficient array N and the desired precision of solution, Accuracy, as parameters. Given the example coefficient matrix and an Accuracy value of 0.000001

Listing 2.

```
1000 DEF PROC_iterate (N,P,ACCURACY)
1010 REM Given a coefficient matrix A(N,N) this routine finds the eigensolution
1020 REM with eigenvalue nearest to P with a precision of ACCURACY. Requires
1030 REM arrays Y(N), Z(N) and EIGVEC(N) (for the eigenvector); and variable
1040 REM EIGVAL (for the eigenvalue).
1050 LOCAL i% , j% , k% , temp , sum , converge
1060 REM Perform Crout factorisation of (A-PI) into L,U inside A
1070 FOR i% = 1 TO N
1080   REM Adjust coefficient matrix to produce matrix (A-PI)
1090   A(i%,i%) = A(i%,i%) - P
1100   FOR j% = 1 TO N
1110     sum = 0
1120     IF j% >= i% THEN 1190
1130     IF j%-1 < 1 THEN 1170  :  REM Because BBC FOR loops aren't right !!
1140     FOR k% = 1 TO j%-1
1150       sum = sum + A(i%,k%) * A(k%,j%)
1160       NEXT k%
1170     A(i%,j%) = (A(i%,j%) - sum) / A(j%,j%)
1180     GOTO 1240
1190     IF i%-1 < 1 THEN 1230
1200     FOR k% = 1 TO i%-1
1210       sum = sum + A(i%,k%) * A(k%,j%)
1220       NEXT k%
1230     A(i%,j%) = A(i%,j%) - sum
1240     NEXT j%
1250   NEXT i%
1260 REM Iteration scheme starts here, initialise eigensolution
1270 temp = 0
1280 FOR i% = 1 TO N
1290   EIGVEC(i%) = 1  :  REM any non-zero value would do
1300   NEXT i%
1310 REM Solve equation LZ=X by forward substitution
1320 Z(1) = EIGVEC(1)
1330 FOR i% = 2 TO N
1340   sum = 0
1350   FOR j% = 1 TO i%-1
1360     sum = sum + A(i%,j%) * Z(j%)
1370     NEXT j%
1380   Z(i%) = EIGVEC(i%) - sum
1390   NEXT i%
1400 REM Solve equation UY=Z by back substitution
1410 Y(N) = Z(N) / A(N,N)
1420 FOR i% = N-1 TO 1 STEP -1
1430   sum = 0
1440   FOR j% = i%+1 TO N
1450     sum = sum + A(i%,j%) * Y(j%)
1460     NEXT j%
1470   Y(i%) = (Z(i%) - sum) / A(i%,i%)
1480   NEXT i%
1490 REM Largest element of 'eigenvector' is approximate eigenvalue
1500 EIGVAL = Y(1)
1510 FOR i% = 2 TO N
1520   IF ABS(Y(i%)) > ABS(EIGVAL) THEN EIGVAL = Y(i%)
1530   NEXT i%
1540 REM Normalise Y() to give approximate eigenvector
1550 FOR i% = 1 TO N
1560   Y(i%) = Y(i%) / EIGVAL
1570   NEXT i%
1580 REM Test convergence of eigenvalue
1590 IF ABS(EIGVAL - temp) <= ACCURACY THEN 1650
1600 temp = EIGVAL  :  REM Prepare for next iteration
1610 FOR i% = 1 TO N
1620   EIGVEC(i%) = Y(i%)
1630   NEXT i%
1640 GOTO 1320
1650 REM Test convergence of eigenvector
1660 converge = TRUE
1670 FOR i% = 1 TO N
1680   IF ABS(EIGVEC(i%) - Y(i%)) > ACCURACY THEN converge = FALSE
1690   NEXT i%
1700 IF NOT converge THEN 1600
1710 EIGVAL = (1 + EIGVAL*P) / EIGVAL
1720 REM EIGVAL, EIGVEC now contain the required eigensolution
1730 ENDPROC
```

the routine converges to:

$$\lambda = 5.00000016$$

$$\underline{x}_1 = \begin{bmatrix} -8.3333347E-2 \\ -0.66666653 \\ 1 \end{bmatrix}$$

after 18 iterations. A lower precision gives faster convergence.

The routine can be implemented in other Basic dialects if the following changes are made:

- Remove all lines beginning with Defproc or Local
- Replace each Endproc with a Return
- Use the appropriate Gosub statement to call the subroutine

A modification to the power method produces the inverse iteration technique, which is used to find a single eigensolution whose eigenvalue is nearest to some prescribed value, P say. Hence if P = 0, this method produces the eigensolution with the eigenvalue of smallest modulus. If the general matrix equation is amended to give:

$$(A - PI)\underline{x} = \lambda \underline{x} \qquad \text{equation 5}$$

then the eigenvalues calculated are all shifted from those of the equation by an amount P. If equation 5 is rearranged to give:

$$(A - PI)^{-1}x/\lambda \qquad \text{equation 6}$$

and you calculate the eigenvalue of largest modulus $1/(\lambda - P)$, the eigenvalue of A nearest P. The equation 6 repeatedly solves a set of N equations to converge iteratively on the eigensolution, and consequently the inverse matrix is not derived. The technique is summarised:

$\underline{x}_1 = 1 : k = 1$
Solve $(A - PI)\,\underline{y}_k = \underline{x}_k$ to determine $\underline{y}_k$
Find d_k, the element of largest modulus in $\underline{y}_k$
$\underline{x}_{k+1} = \underline{y}_k/d_k$
If d_k and $\underline{x}_{k+1}$ are not accurate enough, then $k = k + 1$: goto second step

and it can be shown that as $k \to \infty$, $d_k \to 1/(\lambda - P)$ and $x_k \to x$, the corresponding eigenvector. Gaussian elimination could be used, but since the matrix (A − PI) does not change between solutions, a Crout factorisation is used so the second step reduces to computationally quick forward and backward substitutions.

The routine is shown in listing 2. The Crout factorisation is performed first, where the L and U triangular matrices overwrite the previous contents of A to save memory. The Eigvec array is set to its arbitrary starting value, and the solution of the Y vector, step 2, is performed in lines 1310 to 1480.

Again the eigenvalue and eigenvector converge at different rates, so they are tested separately in the same manner as the power method routine. Also as in that routine integer variables have been used for speed. The final step in the routine is to recover the converged eigenvalue from the $1/\lambda$ P expression in line 1710.

Both the iterative methods find a single eigensolution. Transformation methods are designed to produce the complete eigensolution in a single process, albeit a complex one. Although there are techniques to cope with non-symmetric matrices, we shall restrict ourselves to a symmetric matrix A since the methods are simpler and symmetric matrices are more common. Non-symmetric matrices can often be easily converted to symmetric form.

The transformation methods are so named because they rely on performing a series of similarity transforms on the symmetric matrix A, of the form:

$$A_1 = S_1 A S_1^{-1} \qquad \text{equation 7}$$

You pre-multiply A with an N-by-N matrix S and post-multiply the result by the inverse of S. Hence S must have an easily computable inverse. This is a similarity transform, since S is chosen fo the eigenvalues equal those of equation 7 are those of A, and the eigenvectors are of the form:

$$\underline{X}_1 = S_1\underline{x}$$

The value of $\underline{x}$ is easily computed if S is well chosen.

The purpose of the similarity transforms is to convert the original symmetric matrix A into a tri-diagonal matrix, B say, with the form:

$$B = \begin{bmatrix} b_{11} & b_{12} & & & 0 \\ b_{21} & b_{22} & b_{23} & & \\ & b_{32} & b_{33} & & \\ 0 & & & & b_{n-1,n} \\ & & & b_{n,n-1} & b_{n,n} \end{bmatrix}$$

by gradually making all non-tridiagonal

(continued on next page)

Listing 3.

```
1000 DEF PROC_givens (N,ACCURACY)
1010 REM Performs a Givens tridiagonalisation of the N x N matrix A to a
1020 REM precision of ACCURACY on zero elements. The transformation components
1030 REM are retained in the unused positions
1040 LOCAL i% , j% , k% , root , s_theta , c_theta , d , d1
1050 FOR i% = 2 TO N-1
1060   FOR j% = i%+1 TO N
1070     REM calculate transformation compoents
1080     root = SQR (A(i%-1,i%)^2 + A(i%-1,j%)^2)
1090     s_theta = A(i%-1,j%) / root    :    c_theta = A(i%-1,i%) / root
1100     REM perform transform along rows i and j
1110     FOR k% = 1 TO N
1120       d = c_theta * A(i%,k%) + s_theta * A(j%,k%)
1130       d1 = c_theta * A(j%,k%) - s_theta * A(i%,k%)
1140       A(i%,k%) = d   :   A(j%,k%) = d1
1150       NEXT k%
1160     REM Perform transform down columns i and j
1170     FOR k% = 1 TO N
1180       d = c_theta * A(k%,i%) + s_theta * A(k%,j%)
1190       d1 = c_theta * A(k%,j%) - s_theta * A(k%,i%)
1200       A(k%,i%) = d   :   A(k%,j%) = d1
1210       NEXT k%
1220     REM Preserve transformation components
1230     A(i%-1,j%) = c_theta   :   A(j%.i%-1) = s_theta
1240     NEXT j%
1250   NEXT i%
1260 ENDPROC
```

Listing 4.

```
1000 DEF PROC_shiftQR (N,ACCURACY)
1010 REM Determines the eigenvalues of an N x N symmetric tridiagonal matrix
1020 REM A to a specified ACCURACY using the shifted QR method. Eigenvalues
1030 REM are returned in the 1 x N array EIGVAL.
1040 LOCAL i% , j% , k% , approx , root , s , c , d , d1
1050 FOR i% = N TO 2 STEP -1
1060   REM perform transformation for i th. eigenevalue, compute approximation
1070   REM from 2 x 2 sub-matrix. Use d,d1 as temporary variables.
1080   d = (A(i%-1,i%-1) + A(i%,i%)) ^ 2
1090   d = SQR(d - 4*(A(i%-1,i%-1)*A(i%,i%) - A(i%,i%-1)^2))
1100   d1 = (A(i%-1,i%-1) + A(i%,i%) - d) / 2
1110   d  = (A(i%-1,i%-1) + A(i%,i%) + d) / 2
1120   IF ABS(d-A(i%,i%)) < ABS(d1-A(i%,i%)) THEN approx = d ELSE approx = d1
1130   REM shift matrix by eigenvalue approximation nearest to A(i%,i%)
1140   FOR j% = 1 TO i%
1150     A(j%,j%) = A(j%,j%) - approx
1160     NEXT j%
1170   FOR j% = 1 TO i%-1
1180     root = SQR(A(j%,j%)^2 + A(j%+1,j%)^2)
1190     c = A(j%,j%) / root
1200     s = A(j%+1.j%) / root
1210     REM apply transform, matrix must be tridiagonal
1220     FOR k% = 1 TO i%
1230       d  = c * A(j%,k%) + s * A(j%+1,k%)
1240       d1 = c * A(j%+1,k%) - s * A(j%,k%)
1250       A(j%,k%) = d   :   A(j%+1,k%) = d1
1260       NEXT k%
1270     FOR k% = 1 TO i%
1280       d  = c * A(k%,i%) + s * A(k%,j%+1)
1290       d1 = c * A(k%,j%+1) - s * A(k%,j%)
1300       A(k%,j%) = d   :   A(k%,j%+1) = d1
1310       NEXT k%
1320     NEXT j%
1330   REM shift matrix back by lowest modulus approximation
1340   FOR j% = 1 TO i%
1350     A(j%,j%) = A(j%,j%) + approx
1360     NEXT j%
1370   REM test convergence of eigenvalue
1380   IF ABS(A(i%.i%-1)) > ACCURACY THEN 1080 : REM iterate till converges
1390   EIGVAL(i%) = A(i%,i%)
1400   NEXT i%
1410 EIGVAL(1) = A(1,1)
1420 REM EIGVAL now contains the eigenvalues of the given matrix A
1430 ENDPROC
```

How to compute eigensolutions

(continued from previous page)

elements zero. B is of a form where the QR algorithm can be applied to derive the eigenvalues. To produce the tridiagonal matrix, apply a series of similarity transforms:

$$B = A_m = S_m S_{m-1} \ldots S_2 S_1 A S_1^{-1} S_2^{-1} \ldots S_m^{-1}$$

This may seem a lot of work for a problem with, say, a four-by-four coefficient matrix, but for large problems it becomes an essential technique.

Thus transformation methods divide into four steps:

- Convert the original matrix A to a tridiagonal matrix B using a series of similarity transforms.
- Solve this matrix for the eigenvalues of itself and A.
- Use the eigenvalues in an inverse iteration algorithm to determine the eigenvectors of B.
- Apply the similarlty transforms in reverse order to produce the eigenvectors of the original matrix A from thoe of B.

As an example of a transformation matrix S, choose the givens matrix G, which has the form:

$$G_k = \begin{bmatrix} 1 & & & & & \\ & 1 & & & & \\ & & \cos\theta & & \sin\theta & \\ & & & 1 & & \\ & & & & 1 & \\ & & \sin\theta & & \cos\theta & \\ 0 & & & & & \end{bmatrix} \begin{matrix} \\ \\ i^{th}\text{ row} \\ \\ \\ j^{th}\text{ row} \\ \\ \end{matrix}$$

$$\qquad\quad i^{th} \qquad\quad j^{th}$$

It is easy to show that $G_k G_k^T = I$, that is, G_k^{-1} and hence G has an easily computable inverse. If θ is chosen so that:

$$\tan\theta = A_{i-1,j}/A_{i-1,i} \qquad \text{equation 9}$$

$$\sin\theta = A_{i-1,j}/r$$

$$\cos\theta = A_{i-1,j}/r$$

$$r^2 = A_{i-1,i}^{\ 2} + A_{i-1,j}^{\ 2} \qquad \text{equation 10}$$

then the transformation reduces elements $A_{i-l,j}$ and $A_{j,i-l}$ to zero at each stage. The value of i and j are chosen in the order:

(i,j) = (2,3) (2,4) -------- (2,N)
(3,4) -------- (3,N)

(N − 1,N)

to reduce all of A's non-tridiagonal elements to zero. The effect on a general four-by-four matrix is shown in figure 2. In general for an N-by-N real symmetric matrix a Givens method requires 0, $4/3n^3$ multiplications and 0, $\frac{1}{2}n^2$ square roots.

A routine to perform a Givens tridagonalisation is given in listing 3. The i% and j% loops step through the rows and columns of A, and c-theta and s-theta are the transformation components appearing in the equations. So that the eigenvectors can be recovered, we preserve the transformation components in line 1230.

Having produced the tridiagonal matrix, the QR method is used to extract its eigenvalues. This is an iterative process where we factorise the k^{th} approximation matrix B_k into an orthogonal matrix Q_k and an upper triangular matrix R_k and then multiply them to produce B_{k+1}. That is:

$$B_1 = B = k = 1$$

$$\left.\begin{array}{l}\text{factorise } B_k = Q_k R_k \\ \text{form } B_{k+1} = R_k Q_k\end{array}\right\} k = 1,2 \ldots m$$

After a few iterations we intend B_m to have the form:

$$B_m = \left[\begin{array}{cccc|c} x\,x & & & & 0 \\ x\,x\,x & & & 0 & \\ & x\,x & & & 0 \\ & 0 & & & \\ & & x\,x\,x & & \\ & & & x\,x & 0 \\ \hline 0\,0 & & & \ldots 0 & e \end{array}\right]$$

where e is the nth eigenvalue, the first to be evaluated. This is repeated using the main (N − 1) by (N − 1) sub-matrix of B_m to find the (N − 1)th eigenvalue, and so on. The transformations used to achieve this diagonalisation of B are of the Givens type, and are applied iteratively to reduce the off-diagonal elements to zero:

$$(i,j) = (1,2)\ (2,3) \ldots (N-1,N)$$

$$r^2 = b_{i,i}^{\ 2} + b_{j,i}^{\ 2} \qquad \text{equation 12}$$

$$\sin\theta = b_{i,i}/r$$

$$\sin\theta = b_{j,i}/r \qquad \text{equation 13}$$

This procedure is iterative until $b_{i-1,i}$ is zero to some tolerance in between six and eight iterations, and is accelerated by using the shifted QR algorithm:

$$B_1 = B \qquad k = 1$$

$$\left.\begin{array}{l}\text{factorise } (b_k - \mu_k I) = Q_k R_k \\ \text{form } B_{k+1} = R_k Q_k + \mu_k I\end{array}\right\} k = 1,2 \ldots m$$

where μ_k is the eigenvalue nearest $b_{i,i}$ of the two-by-two sub-matrix formed from rows and columns i and i − 1 of B_k. Using this modified technique convergence occurs in usually two to three iterations.

$$A = \begin{bmatrix} x & x & x & x \\ x & x & x & x \\ x & x & x & x \\ x & x & x & x \end{bmatrix}$$

$$\begin{matrix} i=2 \\ j=3 \end{matrix} \quad A_1 = \begin{bmatrix} x & x & 0 & x \\ 0 & x & x & x \\ x & x & x & x \\ x & x & x & x \end{bmatrix}$$

$$\begin{matrix} i=2 \\ j=4 \end{matrix} \quad A_2 = \begin{bmatrix} x & x & 0 & 0 \\ x & x & x & x \\ 0 & x & x & x \\ 0 & x & x & x \end{bmatrix}$$

$$\begin{matrix} i=3 \\ j=4 \end{matrix} \quad A_3 = \begin{bmatrix} x & x & 0 & 0 \\ x & x & x & 0 \\ 0 & x & x & x \\ 0 & 0 & x & x \end{bmatrix} = B$$

Figure 2. Effect of Givens tridiagonalisation on a general four-by-four matrix.

The algorithm appears as listing 4. The i% loop steps through the eigenvalues which are accumulated in the Eigval array. For each eigenvalue the first step is to compute the approximation μ_k in lines 1080 to 1120 which in lines 1140 to 1160 is used to shift the current i-by-i tridiagonal sub-matrix.

Using equations 12 and 13 the Givens transformation is applied in lines 1170 to 1320; note the reduced size of the outer j% loops. The matrix is shifted back by μ_k in lines 1340 to 1360 and the convergence of the eigenvalue is $b_{i,i}$, determined by testing how far the transformations have made $b_{i,i-1}$ zero. The transformations are repeated until convergence occurs.

This algorithm produces the eigenvalues of the original matrix A in Eigval, leaving only the eigenvectors to find. The first step is to determine the eigenvectors of the tridiagonal matrix, which can be accomplished using an inverse iteration technique exactly as discussed earlier, using each of the calculated eigenvalues as P. As we are dealing with a tridiagonal matrix, the Crout factorisation and forward and backward substitutions are simple since only the three main diagonals need be considered, and the L and U matrixes have a bandwidth of only 2. Since we supply the eigenvalues as P, convergence on the eigenvectors is very rapid.

To recover the eigenvectors of the original matrix we apply te original Givens transformations in reverse order as suggested by equation 8. It was for this reason that the transformation components were preserved. Applying these transformations gives the original matrix eigenvectors:

$$\underline{x} = G_1 G_2 \ldots\ldots\ldots G_m X \qquad \text{equation 14}$$

and completes the eigensolution.

A routine to produce the complete eigensolution of a real N-by-N symmetric matrix can be devised. Its input parameters are N, the size of the coefficient matrix which is assumed to be initialised, and Accuracy, the desired precision of the solution, typically 0.000001. The routine produces the eigenvalues in array Eigval and the normalised eigenvectors so the i^{th} eigenvector is in Eigvec, i, 1..N.

The routine requires additional storage arrays: B(1..N, 1..N) used to preserve the tridiagonal matrix and transformation components during the QR and inverse iteration stages, and Y(1..N), Z(1..N) used in convergence tests and in the forward and backward substitution operations.

A sample solution to the algorithm required 21 seconds to solve the six-by-six matrix. The routine occupies 5.45K which can be reduced to 2.7K by removing comments and using multiple statement lines. The details are machine dependent. In this reduced form, the solution required 18 seconds, and an eight-by-eight matrix was solved in 26 seconds.

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BM. 6.	18.7	23.5	35.4
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These figures are extracted from a recent article in, 'Personal Computer World' Publication.

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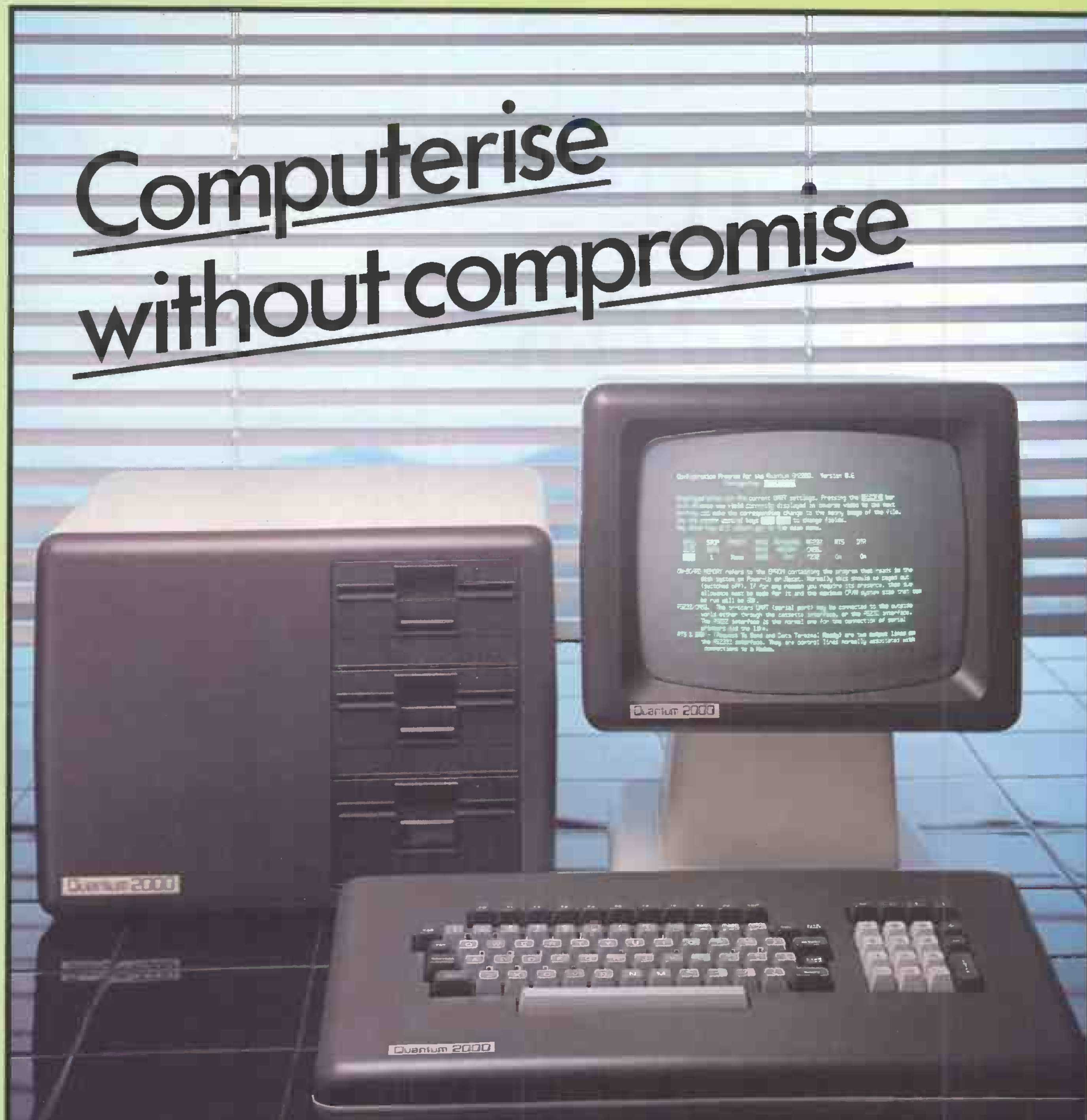

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Classroom traffic count

A fieldwork program for the TRS-80 by Frank Davies.

WHILE DOING FIELDWORK at school it became evident that if you have small groups doing individual studies, you can be faced with a barrage of questions all along the same lines. Breaking off discussion with a group can lead to unrest. A simple practical experience is that of the traffic count, but it is difficult to get any purpose out of this exercise other than data collection and representation.

The modern approach is hypothesis testing, and our first problem is how to use it without the children knowing, especially the less able. One solution is to give a simple piece of work which can be arranged so that they either draw very elementary conclusions or verify the obvious, perhaps even a hidden hypothesis.

Each child is given a Help sheet on which they can collect their data and a graph showing traffic at various times of the day on a major road — they are then encouraged to discuss PCUs or passenger car units. The traffic survey leads to simple points of discovery:

- The amount of traffic going in or out of a town at different times during a day, confirming the graph.
- Can the roads handle the amount of traffic?
- What would happen if a bridge or road was closed? Would the present system cope?
- How busy is the road near school/home? What type of traffic does it handle?

The children should be encouraged to

(continued on next page)

Program listing.

10-70	Titles
80-190	Inputs from operator, mugtrapped for irresponsible answers. Limited to 100 or 200 due to the fact that time is often 10-15min. maximum.
200-210	Convert to uniform time — 1 hour.
220-260	Convert to PCU
270-360	Determining if road is overcrowded.
370-480	Display of results, a summary of inputs.
500-540	What next?
550-780	Graphical display regardless of size of data input.
800-880	Printout routines.

Variables used in the program.

A$,AA$	Menu response
B$	Keyboard response
B,B1,B2	Number of bikes, bikes per hour, PCUs per hour
BZ1	Used in counter
C,C1,C2	Number of cars, cars per house, PCUs per hour
CZ1	Used in counter
D,D1,D2	Number of buses, buses per hour, PCUs per hour
DZ1	Used in counter
H,H1,H2	Number of HGVs, HGVs per hour, PCUs per hour
HZ1	Used in counter
L,L1,L2	Number of lorries, lorries per hour, PCUs per hour
LZ1	Used in counter
P$	Printing response
R	Type of road
R$	Description of road
R1$	Description of road
R2	PCUs carried by road
T	Time used in data collection
T1	Converted time to the hour
X$	Name of road
Y	PCU limit of road

Figure 1. Help sheet given to the children.

Traffice density in pcu (passenger car units)

pcu's per vehicle	
½ pcu	Cycle or motorcycle
1 pcu	Car or van
2 pcu	Bus or lorry
3 pcu	Very heavy vehicle
LIMIT	OVERCROWDING
375 pcu 2 lane road	
688 pcu 3 lane road	
1512 pcu dual carriageway	

Use a survey to record information and illustrate by means of various graphs— pie chart, histogram, flow graph.

Example of survey sheet

Place	Left Turn						Straight On						Right Turn					
Date	From To						From To						From To					
Time	1	2	3	4	5		1	2	3	4	5		1	2	3	4	5	
1 Cars 2 Lorries 3 Buses 4 Motorcycles + cycles 5 Heavy Lorries																		

(continued from previous page)

do the work individually, using the micro if they need its help. It is not meant to do the work for the child — hence no data storage — but purely as an aid.

The micro does help the less able as well as the naturally untidy. It gives the answers to mathematical calculations along with the required comparisons. It interprets data, so there is more time to discuss and draw conclusions, or even collect data if a large area is being studied.

The graphical display has the y-axis scale missing to try and encourage the children to describe the resulting bar chart in general terms and not just regurgitate the figures obtained. If it is going to be included in a piece of fieldwork the children still have to produce the mathematical working, graphical display, etc. The micro provides the instant feedback and summary facility to aid, check and encourage progression in the study.

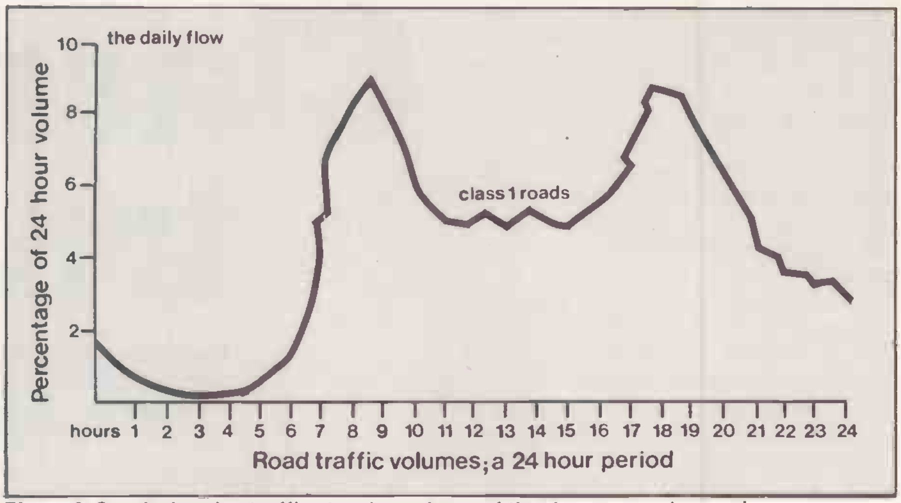
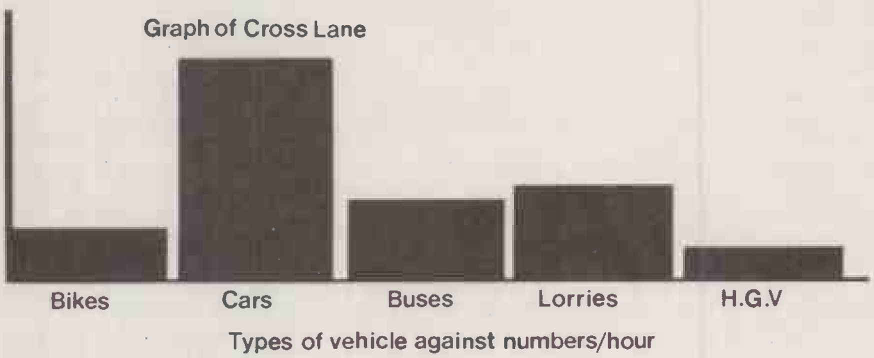


Figure 2. Graph showing traffic at various times of the day on a major raod.

Figure 3. The children are encouraged to relate the bar chart to their own results.

Cross Lane
Number of bikes and motorcycles 5
Number of cars and vans 25
Buses and lorries 18
Heavy goods 3
This is a two lane road with a maximum carriage of 31 PCUs.
Today you saw it handle 435 PCUs and so it is overcrowded.




```
10 REM****************************************
20 REM** TRAFFIC SURVEY II VERSION 3.5    **
30 REM**    BY COMPUTERCAT EDUCATIONAL    **
40 REM**          PROGRAMS, LEIGH         **
50 REM**     TEL. LEIGH 605730            **
60 REM****************************************
70 CLS
80 INPUT"HOW MANY MINUTES WAS THE DATA COLLECTED";T
90 IFT(0ORT)60THEN70
100 REM CONVERT TO HOUR
110 T1=60/T:T2=T*T1
120 REM GROUPS OF VEHICLES
130 REM NUMBER OF VEHICLES LIMITED
140 PRINT"TYPE IN THE NUMBERS OF VEHICLES FOR EACH GROUP :"
150 INPUT"BIKES & MOTERCYCLES";B:IFB(0ORB)100ORINT(B)()BTHEN 150
160 INPUT"CARS & VANS          ";C:IFC(0ORC)200OR INT(C)()C THEN 160
170 INPUT"BUSES                ";D:IF D(0 OR D)100 OR INT(D)()D THEN 170
180 INPUT"LORRIES              ";L:IF L(0 OR L)100 OR INT(L)()L THEN 180
190 INPUT"HEAVY GOODS          ";H:IF H(0 OR H)100 OR INT (H) () H THEN 190
200 REM CONVERT TO VEHICLES PER HOUR
210 B1=B*T1:C1=C*T1:D1=D*T1:L1=L*T1:H1=H*T1
220 REM ASSIGN PCU
230 FORN=1TO4:READX(N):NEXTN
240 RESTORE
250 DATA0.5,1,2,3
260 B2=B1*X(1):C2=C1*X(2):D2=D1*X(3):L2=L1*X(3):H2=H1*X(4)
270 PRINT"WHAT TYPE OF ROAD HAS BEEN STUDIED ?:"
280 INPUT"(1) 2 LANE ROAD  (2) 3 LANE ROAD    (3) DUAL CARRIAGEWAY  ";R
290 IFR(1ORR)3THEN280
300 IFR=1THENY=375
310 IFR=2THENY=688
320 IFR=3THENY=1512
330 REM ROAD CROWDED
340 R2=B2+C2+D2+L2+H2
350 IFR2(=YTHEN R$="NOT OVERCROWDED"
360 IFR2)YTHEN R$="OVERCROWDED"
370 REM RESULTS
380 CLS:PRINT"NAME OF ROAD";:INPUT X$
390 CLS:PRINTTAB(5);X$
400 PRINT"NUMBER OF BIKES AND MOTORCYCLES  ";B
410 PRINT"NUMBER OF CARS & VANS            ";C
420 PRINT"NUMBER OF BUSES AND LORRIES      ";(D+L)
430 PRINT"NUMBER OF HEAVY GOODS            ";H
440 IFR=1THENR1$="A TWO LANE ROAD"
450 IFR=2THENR1$="A THREE LANE ROAD"
460 IFR=3THENR1$="A DUAL CARRIAGEWAY"
470 PRINT:PRINT"THIS IS ";R1$;"  WITH A MAXIMUM CARRIAGE
OF ";Y;" P.C.U'S":PRINT:PRINT"TODAY YOU SAW IT HANDLE ";INT(R2);" PCU AND SO IT
```

```
IS ";R$
480 PRINT:PRINT"PRESS ANY KEY TO CONTINUE ";
490 B$=INKEY$:IFB$=""THEN490
500 CLS:PRINT@260,"DO YOU WANT :-"
510 PRINT:PRINT"        1)  ANOTHER ROAD
                2)  SEE GRAPH
                    3) END PROGRAM
                             4) PRINT OUT"
520 A$=INKEY$:IFA$=""THEN520
530 IFA$<"1"ORA$>"4"THEN500
540 ONVAL(A$)GOTO70,550,820,800
550 CLS:PRINTTAB(15)"GRAPH OF ";X$
560 GOTO620
570 PRINT@90,"PRESS 1-TO CONTINUE,2-PRINTOUT";
580 P$=INKEY$:IFP$=""THEN580
590 IFP$<"1"ORP$>"2"THEN580
600 IFP$="1"THENCLS:GOTO500
610 IFP$="2"THENPRINT@90,"PRESS SHIFT/DOWN ARROW/P       ";
620 X=5:FORY=5TO35:SET(X,Y):NEXTY
630 Y=35:FORX=5TO105:SET(X,Y)!NEXTX
640 SET(5,36):SET(25,36):SET(45,36):SET(65,36):SET(85,36):SET(105,36)
650 PRINT@774,"BIKES";:PRINT@783,"CARS";:PRINT@793,"BUSES";:PRINT@802,"LORRIES";
:PRINT@813,"H.G.V";
660 PRINT@915," TYPES OF VEHICLE";
670 PRINT@978,"AGAINST NUMBERS/HOUR";
680 IFB1<30ANDC1<30ANDD1<30ANDL1<30ANDH1<30THEN740
690 FORZ=2TO30
700 BZ1=B1/Z:CZ1=C1/Z:DZ1=D1/Z:LZ1=L1/Z:HZ1=H1/Z
710 B1=BZ1:C1=CZ1:D1=DZ1:L1=LZ1!H1=HZ1
720 PRINT@65,"Y-AXIS ALTERED";
730 IFB1<30ANDC1<30ANDD1<30ANDL1<30ANDH1<30THEN740ELSENEXTZ:GOTO700
740 Y1=35-B1:FORX=5TO25:FORY=35TOY1STEP-1:SET(X,Y):NEXTY:NEXTX
750 Y1=35-C1:FORX=25TO45:FORY=35TOY1STEP-1:SET(X,Y):NEXTY:NEXTX
760 Y1=35-D1:FORX=45TO65:FORY=35TOY1STEP-1:SET(X,Y):NEXTY:NEXTX
770 Y1=35-L1:FORX=65TO85:FORY=35TOY1STEP-1:SET(X,Y):NEXTY:NEXTX
780 Y1=35-H1:FORX=85TO105:FORY=35TOY1STEP-1:SET(X,Y):NEXTY:NEXTX
790 GOTO570
800 CLS:PRINT"DO YOU WANT A PRINTOUT OF :-
                1) DATA SUMMARY
                2) GRAPH
810 AA$=INKEY$:IFAA$=""THEN810
820 ONVAL(AA$)GOTO830,550
830 REM PRINTOUTS
840 LPRINTX$:LPRINTSTRING$(LEN(X$),"="):LPRINT"NUMBER OF BIKES AND MOTORCYCLES "
;B:LPRINT"NUMBER OF CARS AND VANS           ";C:
850 LPRINT"BUSES AND LORRIES                 ";(D+L):LPRINT"HEAVY GOODS
      ";H:LPRINTCHR$(10)
860 LPRINT"THIS IS A ";R1$;" WITH A MAXIMUM CARRIAGE OF ";:LPRINTY;" P.C.U'S.":L
PRINT"TODAY YOU SAW IT HANDLE ";INT(R2);"P.C.U'S AND SO IT IS ";R$
870 GOTO500
880 END
```

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TI99/4a games

Jack Schofield casts a scathing eye over some of Texas Instruments' own games.

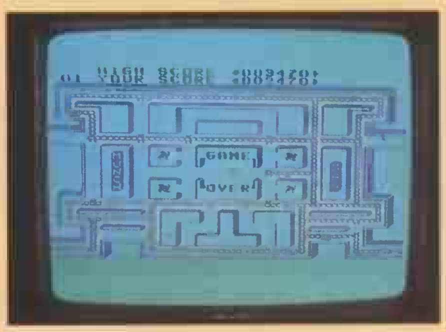
THE TEXAS INSTRUMENTS TI-99/4a arrived almost three years ago as the /4. It carried a price tag of £990 — which included a colour monitor. Now that the revised version has finally reached a competitive price of about £150 it seems to be selling. It still has several limitations — one of which is the shortage of independent software — but for those tempted to buy the machine, I looked at a selection of TI's own plug-in ROM cartridges bearing games.

The ROM packs are very simple to load — they just slide in. A title page appears, then a menu offering TI Basic or the game. Each game also has its own title, and often menu screens too, so several stages must be gone through to load and run a cartridge.

Munch Man

THIS IS TI'S version of Pacman but played in a greatly simplified maze. You are a C shape instead of a piece of pizza with a slice out — Pacman comes from the Japanese for "gobble gobble".

Instead of you gobbling up energy pills, you leave behind you a chain-like trail. Either way you have to traverse the whole maze to reach the next screen. Gobbling up a TI logo — used instead of a fruit — enables you to gobble up a gobbler for bonus points. On the TI-99/4a it is one game that runs smoothly and very fast, presumably achieved through using sprite graphics.



The Attack

IN THIS CURIOUS GAME you are a wing-nut shaped mobile blaster in a playfield of wiggly crosses that look, en masse, like seaweed. You blast the weed, which tends to clump together. When a clump has formed, it turns into a spider-like insect that comes and bites you unless you blast it first. The catch is that blaster movement is rather sluggish, and you are not allowed to fire in the direction from which the spiders approach.

After you have destroyed a couple of waves of attackers, the game becomes unbearably tedious too. The problem is that the play is so simple you can see exactly what you need to do to win, but the sluggishness of the display is what limits your progress. In good games, exactly the reverse applies.

Blasto

YOU CAN TELL from the name what a mind-expanding game this is. It is almost the same as The Attack, except you are a tank and you clear a field of stationary mines. It is childishly easy. Only the race against the clock keeps it interesting for a few minutes at least.

You can set the game speed to be what Texas calls, with commendable honesty, "sluggish", rapid or full tilt, though even full tilt is not that snappy.

Unlike The Attack, Blasto can be played by two players, with the second player getting a white tank. Hitting it with one of the orange blobs the tank fires gains 1,000 bonus points. The same game can be played on a blue obstacle course without the mines.

As with The Attack, the TI mercilessly grinds out an organ medley of tunes you never want to hear again. When time runs out the game simply stops, so there is no tangible reward. It is a very feeble piece of games design.

TI Invaders

THE STANDARD Space Invaders with a choice of two levels. The invaders can be "merely aggressive" or "downright nasty", though the practical difference is marginal.

You have three lives and four bases, and there are five rows of invaders in a wave — two red, two blue, one green. The firing, and indeed the whole invader movement, is slow, though not down to the slothful Spectrum standard. The sound is reasonably good.

The best part of the game is when you lose. The remaining invaders jump up and down, arms and legs waving, in obvious glee. It's bad game design when you get more fun from losing than from clearing a wave.

Video Chess

TI'S VIDEO CHESS presents a nicely drawn blue and white board against a brilliant lime-green background. The black pieces are black; the white ones are only outlines. Moves are entered algebraically. The screen lists the last two moves made, the move number, and how much time each player has taken.

You can play a beginner's game, choose a level, use the board without the computer playing, set up a problem, play up to nine games simultaneously, or load a game from cassette. According to level you can set it to play normally, aggressively or defensively, and set the computer's "thinking" time from 30 to 200 seconds. The only function Video Chess lacks is the one it really needs: the ability to resign.

Nowhere does it threaten to play well: it is hopeless at openings, mediocre at the middle game, and an unknown quantity at endings — I doubt if it has seen many. For example, here's how it can lose both knights in 10 moves, while playing normally at its top level with 30 seconds a move, against the dynamic and original P-K4. Video Chess is black: 1 P-K4, N-QB3. 2 N-KB3, N-KB3. 3 P-K5 N-KN5. 4 P-Q4, P-KN3. 5 P-KR3, N-R3. 6 P-Q5, N-R4. 7 P-QN4, N-B3. 8 PxN, P-K3. 9 B-KN5, B-K2. 10 BxN BxP Ch. 11 P-QB3, B-B1. 12 B-N5, B-K2. 13 PxQP, BxP. Video Chess then watches the white QN travel to F6 and paralyse its position.

Conclusions

- **The TI games tested are way below the Atari, BBC and Apple level in both design and content.**
- **They compare favourably with Vic-20 and Spectrum games for graphics and sound, but lose out to the playability, price and sheer quantity of the better Vic and Spectrum games.**
- **The TI-99/4a gains in being easy to load and use so it might be suitable for a child, or for an adult who only plays video games when blind drunk.**

	Players	Price	Rating
The Attack	1	£21.95	9/20
Blasto	1/2	£21.95	6/20
TI Invaders	1	£21.95	10/20
Munch Man	1	£31.95	14/20
Video Chess	1-9	£42.95	7/20

Sinclair ZX Spect

16K or 48K RAM... full-size moving-key keyboard... colour and sound... high-resolution graphics...

From only £125!

First, there was the world-beating Sinclair ZX80. The first personal computer for under £100.

Then, the ZX81. With up to 16K RAM available, and the ZX Printer. Giving more power and more flexibility. Together, they've sold over 500,000 so far, to make Sinclair world leaders in personal computing. And the ZX81 remains the ideal low-cost introduction to computing.

Now there's the ZX Spectrum! With up to 48K of RAM. A full-size moving-key keyboard. Vivid colour and sound. High-resolution graphics. And a low price that's unrivalled.

Professional power–personal computer price!

The ZX Spectrum incorporates all the proven features of the ZX81. But its new 16K BASIC ROM dramatically increases your computing power.

You have access to a range of 8 colours for foreground, background and border, together with a sound generator and high-resolution graphics.

You have the facility to support separate data files.

You have a choice of storage capacities (governed by the amount of RAM). 16K of RAM (which you can uprate later to 48K of RAM) or a massive 48K of RAM.

Yet the price of the Spectrum 16K is an amazing £125! Even the popular 48K version costs only £175!

You may decide to begin with the 16K version. If so, you can still return it later for an upgrade. The cost? Around £60.

Ready to use today, easy to expand tomorrow

Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

Employing Sinclair BASIC (now used in over 500,000 computers worldwide) the ZX Spectrum comes complete with two manuals which together represent a detailed course in BASIC programming. Whether you're a beginner or a competent programmer, you'll find them both of immense help. Depending on your computer experience, you'll quickly be moving into the colourful world of ZX Spectrum professional-level computing.

There's no need to stop there. The ZX Printer – available now – is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232 / network interface board.

Key features of the Sinclair ZX Spectrum

- Full colour – 8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound – BEEP command with variable pitch and duration.
- Massive RAM – 16K or 48K.
- Full-size moving-key keyboard – all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution – 256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
- ASCII character set – with upper- and lower-case characters.
- Teletext-compatible – user software can generate 40 characters per line or other settings.
- High speed LOAD & SAVE – 16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC – incorporating unique 'one-touch' keyword entry, syntax check, and report codes.

um

ZX Spectrum software on cassettes – available now

The Spectrum software library is growing every day. Subjects include games, education, and business/household management. Flight Simulation...Chess...Planetoids...History...Inventions...VU-CALC...VU-3D...Club Record Controller...there is something for everyone. And they all make full use of the Spectrum's colour, sound, and graphics capabilities. You'll receive a detailed catalogue with your Spectrum.

ZX Expansion Module

This module incorporates the three functions of Microdrive controller, local area network, and RS232 interface. Connect it to your Spectrum and you can control up to eight Microdrives, communicate with other computers, and drive a wide range of printers.

The potential is enormous, and the module will be available in the early part of 1983 for around £30.

sinclair

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

The ZX Printer – available now

Designed exclusively for use with the Sinclair ZX range of computers, the printer offers ZX Spectrum owners the full ASCII character set – including lower-case characters and high-resolution graphics.

A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your ZX Spectrum. A roll of paper (65ft long and 4in wide) is supplied, along with full instructions. Further supplies of paper are available in packs of five rolls.

The ZX Microdrive – coming soon

The new Microdrives, designed especially for the ZX Spectrum, are set to change the face of personal computing by providing mass on-line storage.

Each Microdrive can hold up to 100K bytes using a single interchangeable storage medium.

The transfer rate is 16K bytes per second, with an average access time of 3.5 seconds. And you'll be able to connect up to 8 Microdrives to your Spectrum via the ZX Expansion Module.

A remarkable breakthrough at a remarkable price. The Microdrives will be available in the early part of 1983 for around £50.

How to order your ZX Spectrum

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day. BY FREEPOST – use the no-stamp needed coupon below. You can pay by cheque, postal order, Barclaycard, Access or Trustcard.

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

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

Qty	Item	Code	Item Price £	Total £
	Sinclair ZX Spectrum – 16K RAM version	100	125.00	
	Sinclair ZX Spectrum – 48K RAM version	101	175.00	
	Sinclair ZX Printer	27	59.95	
	Printer paper (pack of 5 rolls)	16	11.95	
	Postage and packing: orders under £100	28	2.95	
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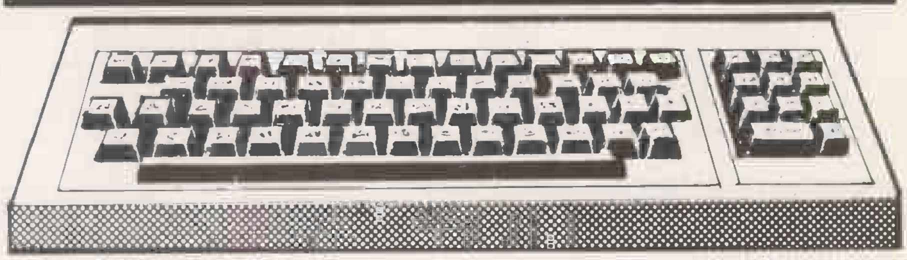
Open File

This regular section of *Practical Computing* appears in the magazine each month, incorporating Tandy Forum, Apple Pie, Sinclair Line-up and other software interchange pages.

Open File is the part of the magazine written by you, the readers. All aspects of microcomputing are covered, from games to serious business and technical software, and we welcome contributions on CP/M, BBC Basic, Microsoft Basic, Apple Pascal and so on, as well as the established categories.

Contributors receive £30 per published page and pro rata for part pages, with a minimum of £6. Send contributions to: Open File, *Practical Computing*, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.



Guidelines for contributors

Programs should be accompanied by documentation which explains to other readers what your program does and, if possible, how it does it. It helps if documentation is typed or printed with double-line spacing — cramped or handwritten material is liable to delay and error.

Program listings should, if at all possible, be printed out. Use a new ribbon in your printer, please, so that we can print directly from a photograph of the listing and avoid typesetting errors. If all you can provide is a typed or handwritten listing, please make it clear and unambiguous; graphics characters, in particular, should be explained.

PLEASE send a cassette or disc version of your program if at all possible. It will be returned after use. For CP/M programs use IBM-format 8in. floppy discs.

TANDY FORUM

by John Wellsman

Basic structures

ONE OF the principal criticisms of Basic comes under scrutiny in a letter from T A Edwards of Northwood, Middlesex who offers some interesting solutions. As he says, one of the main objections to Basic as a language is that it is "not structured", and supporters of this argument will point to the fact that Basic does not have Do-Until and Repeat-While statements. Even this claim is no longer true, as BBC Basic has a Repeat-Until statement, and its opposite can always be simulated by replacing

REPEAT ..... UNTIL X = 0

with

REPEAT ...... UNTIL X < > 0

But what about other Basics? A substitute can be found, and for many the method for the Do-Until command is to break a For-Next loop as in listing 1.

This will work sometimes and on some computers, but the breaking of a loop can cause problems. If it works for you, use it. It leaves open the question of how big the upper limit of X should be to avoid premature termination. The solution in list 2. is much neater.

The inverse or Repeat-While simulation is similar in structure. The only problem with these two routines is that their working is not

(continued on next page)

Basic structure Listing 1.

```
1000 FOR X= 1 TO 256
1010 INUT L$(X)
1020 IF L$(X) = "." THEN 1040
1030 NEXT
```

Listing 2.

```
1000 FOR Q=0 TO 0 STEP 0
1010 X = X + 1: INPUT L$(X)
1020 Q = NOT (L$(X)=".") :NEXT
```

Listing 3.

```
1000 FOR Q = 0 TO 0 STEP 0
1020 X = X + 1: INPUT L$(X)
1020 Q = (L$(X) ()"."I): NEXT
```

(continued from previous page)
clear to the beginner. Line 1000 sets the loop counter Q to zero and increments it to zero. In other words, it does not do much.,

Line 1010 is the operation loop but line 1020 is the important one. It tests the value of the expression which compares L$(X) with the criterion for breaking the loop, in this case ".". If the condition is met, Q has a non-zero value and the loop terminates properly. Most Basics will logically compare strings but if yours does not, then use an equivalent as in list 3.

System save

We have P Barsby of Walsall to thank for a program which will write any area of memory as a system tape. He says: "I wrote it originally as I required a way of writing out a machine-code program I had written in a number of parts. Normally my Edtasm-Plus is great for the job, but this program was, firstly, too long for the source code to fit in the assembler in one go and, secondly, resident in low memory where the Z-Bug part of Edtasm-Plus is located. So I needed a routine to dump the program in one but which was itself resident in high memory."

Mr Barsby sent us an assembly-language source code and a Basic loader. We have printed the latter, which contains instructions to save itself as a system tape. These instructions are, of course, those required to save any block of memory in this way. The user will supply the start, end, entry point and name after the command Save #. In line 20 of the printed Basic loader, the command Save should be followed by a Shifted 3, not the £ sign shown.

Multiple save

P V Bamfield of Brighton, Sussex has sent in a very useful routine for making multiple tape copies of programs. As he says, after a long session at the keyboard, it can be a real chore having to type CSave"X each time in order to save multiple copies of a program to cassette. His little routine can take out some of the work, allowing you to sit back, relax and let the computer do its job.

Before starting work, CLoad the routine or append to an existing program. The high line numbers should make sure that there are no clashes with existing or proposed lines. When ready, just type Run 3000 and Enter. The screen clears and the prompts allow selection of a program label, the number of copies required and a leader delay.

The reply to the "leader" prompt should be Y if the tape has a leader, as this will induce a delay and saves having to hand-wind to the start of the actual recording tape. If using a tape that has no leader, answer N to bypass the delay. The final prompt allows the tape recorder to be set to record and pressing Enter will begin the Saving routine. The program will tell you when each recording is complete and will provide a space between each copy, allowing notes to be taken of the counter settings.

Regarding Mr Bamfield's last remark, a prompt to zero the counter would be a useful addition to the routine.

System save.

```
10 POKE 16561,244, POKE 16562,126:CLEAR 50:REM SET MEM
 SIZE TO 32500
20 FORI=32500 TO 32731 :READ A:POKEI,A:NEXT:PRINT"O.K.
 IT'S THERE. NOW INITIATE THE ROUTINE BY A SYSTEM
CALL TO 32500. I.E.
SYSTEM
*? /32500
.THEN SAVE AS
 A SYSTEM TAPE BY
TYPING SAVE 'SAVE£2500 TO 32731,
32500,";CHR$(34);"SAVER";CHR$(34);"' ";
30 PRINT"
AND ENTER FIRST MAKING SURE YOU HAVE SET UP
 A TAPE TO RECORD IT.WARNING THIS PROGRAM WILL BE
WIPED FROM MEMORY WHEN THIS IS DONE SO MAKE A COPY
 FIRST"
100 DATA62,195,50,160,65,33,2,127,34,161,65,195,231,0,
207,35,205,2,43,237,83,215,127,207,189,205,2,43,237,
83,213,127,207,44,205,2,43,237,83,217,127,17,178,127,
207,44,207,34,6,6,120,50,219,127,126,254,34,204,169,
127
110 DATA18,35,19,16,245,175,205,18,2,205,135,2,62,0,205,
100,2,62,85,205,100,2,33,178,127,58,219,127,71,126,
35,205,100,2,16,249,62,60,205,100,2,62,255,50,219,
127,205,100,2,42,215,127,125,79,205,100,2,124,129,
79
120 DATA 124,205,100,2,58,219,127,71,126,129,79,126,35,
205,100,2,16,246,121,205,100,2,34,215,127,42,215,
127,237,91,213,127,223,218,84,127,62,120,205,100,2,
42,217,127,125,205,100,2,124,205,100,2,205,248,1,42,
230,64,195,25
130 DATA 26,62,32,18,19,16,250,6,1,201,78,79,78,65,77,
69,34,32,59,83,80,85,82,73,79,85,83,32,78,65,77,69,
32,84,79,32,70,73,76,76,0,0,0,0,0,244,126,0,125,0,
125,6
```

Multiple save.

```
29999   'BASIC TAPE DUMP  BY PETE
BAMFIELD  MAR 1982
      FROM AN IDEA BY PHIL PAGE.
30000 CLS:A$="":PRINT@20,"( BASIC
PROGRAM DUMP )":PRINT
30001 PRINT"PROGRAM LABEL (A-Z OR 1-9)
--- ";:GOSUB30013:A$=B$:PRINTA$
30002
A=ASC(A$):IFA)64ANDA(91ORA)48ANDA(58THE
NC=A:GOTO30004
30003 PRINT:PRINT"* * ILLEGAL LABEL *
*":PRINT:GOTO30001
30004 PRINT"NO. OF COPIES (1-9)
----------
";:GOSUB30013:C$=B$:PRINTC$:C=VAL(C$)
30005 IF C=0PRINT:PRINT"* * ZERO
COPIES? * *":PRINT:GOTO30004
30006 PRINT"LEADER DELAY (Y OR N)
-------- ";:GOSUB30013:C$=B$:PRINTC$
30007 IF C$="Y" OR
C$="N"THEN30008ELSE30006
30008 PRINT"T/R TO RECORD &
(ENTER)":GOSUB30013:IFB$()CHR$(13)GOTO3
0008
30009 IFC$="Y"PRINT:PRINT"== LEADER
DELAY ==":FORB=1TO1500:OUT255,4:NEXT
30010 E=0:FORD=1TOC:PRINT"COPY
NO.";D;:CSAVEA$:PRINT" ++ DUMP
COMPLETED ++
30011 E=E+1:IFE=CEND
30012 PRINT"== SPACE
==":FORB=1TO1500:OUT255,4:NEXTB,D:END
30013
B$=INKEY$:IFB$=""THEN30013ELSERETURN
30014 END
```

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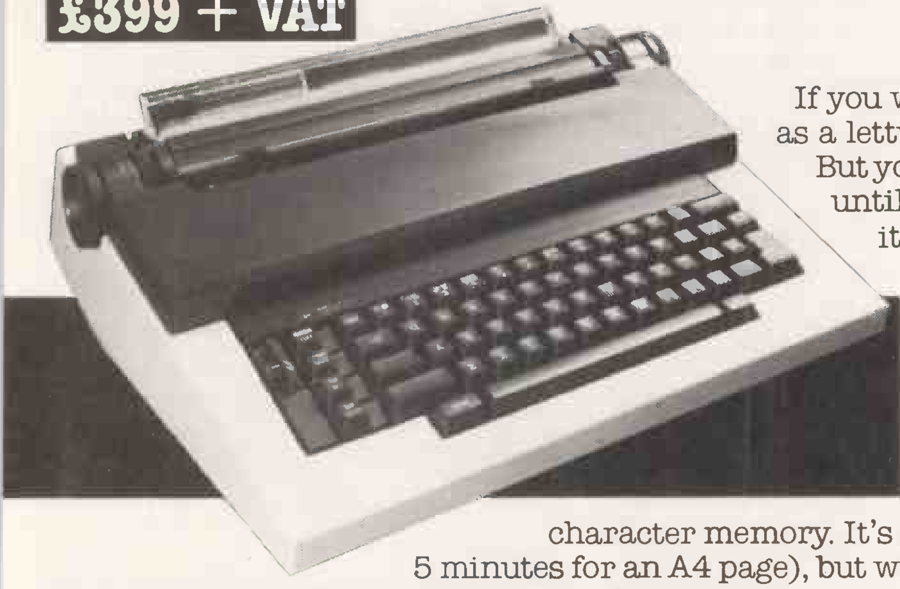

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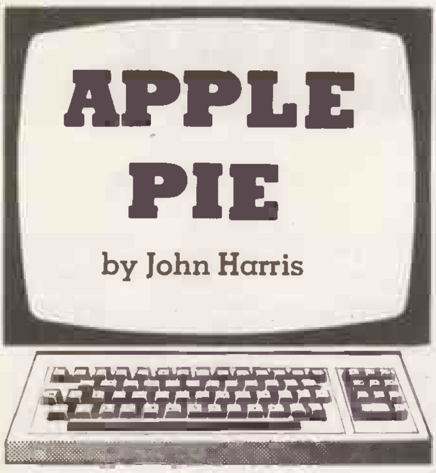

More security

GRAHAM WILSON'S security routine in the February column has generated considerable response in the form of enhancements and additions. There was even a very ambitious attempt to provide a coherent security structure, allowing multiple security levels across disc volumes as a whole.

Whether it is desirable to implement any degree of security must be decided in the light of individual circumstances. I tend on balance to spend more time breaking password and access-level mechanisms than feeling grateful for their presence. The only guarantee in the protection league is that there are no guarantees.

The first level required in this approach, by Roger King of the University of Surrey, is that all file names on disc contain embedded control characters. Those with a clean system master are prevented from Loading and Listing, having Catalogued. Nothing within this technique will stop a user armed with a catalogue analyser program from finding out the full file names and thereby reading the security code employed, but otherwise you can assume that the programs are unloadable to the user.

The only access point is Hello, which runs with the Reset key redirected to reboot DOS. It is set in line 15 and unset in 177. Multi-level password files are read into page three. You can have as many as there are desired levels,

(continued on next page)

Security listing 1—Hello.

```
10  REM HELLO
15  POKE 1010,166: POKE 1011,250:
      CALL  - 1169
20  HOME : PRINT "R.KING   MASTER
      DISC          DOS 3.3"
30  PRINT "VOL.2  11/2/83"
50 D$ =  CHR$ (4): REM  CONTROL-D

60  PRINT D$;"BLOAD PSSWD"
65  PRINT D$;"BLOAD PSSWD"
70  VTAB 10: PRINT "USE OF THIS D
     ISC BY PASSWORD ONLY"
80  PRINT : PRINT "ENTER PASSWORD
      ";
90  FOR N = 1 TO 5: GET A$: PRINT
      "*";
100 PWD$ = PWD$ + A$
110  NEXT
120  REM ---GET PASSWORDS---
130  FOR N = 1 TO 5
140 B$ =  CHR$ ( PEEK (767 + N)):
     OWN$ = OWN$ + B$
150 C$ =  CHR$ ( PEEK (772 + N)):
     NOWN$ = NOWN$ + C$
160  NEXT
165  REM ---DESTROY PASSWORDS---
170  FOR N = 1 TO 10: POKE 767 +
     N,0: NEXT
175  REM ---OWNER OR NON-OWNER?--
     -
177  POKE 1010,191: POKE 1011,157
     : CALL  - 1169
180  IF PWD$ = OWN$ THEN  POKE 77
     8,255: PRINT D$;"RUN DIR.OWN
     ER"
190  IF PWD$ = NOWN$ THEN  POKE 7
     78,0: PRINT D$;"RUN DIR.NON-
     OWNER"
200  REM ---USER DISALLOWED---
210  HOME : VTAB 8: HTAB 11: PRINT
     "INCORRECT PASSWORD"
220  VTAB 11: HTAB 14: PRINT "ACC
     ESS DENIED"
230 S =  - 16336
235  FOR N = 1 TO 40
240 CLICK =  PEEK (S) -  PEEK (S)
     -  PEEK (S) +  PEEK (S) +  PEEK
     (S) -  PEEK (S)
250  NEXT
260  VTAB 20: HTAB 8: PRINT "RE-T
     RY BY ENTERING <PR£6>"
270  NEW
```

Listing 2—Dir. Owner.

```
10  REM   DIR.OWNER
20  HOME
30  PRINT "OK, YOU HAVE ACCESS AS
      **OWNER**"
40  VTAB 3: PRINT "FILE DIRECTORY
     "
50  VTAB 5: PRINT  TAB( 10);"1...
     ..CHANGE PASSWORD"
60  PRINT  TAB( 10);"2.....MUSIC
     COMPOSER"
70  PRINT  TAB( 10);"3.....SNOOPE
     R"
80  PRINT  TAB( 10);"5.....PASSAC
     AGLIA"
100  PRINT  TAB( 10);"6.....QUIT"

150  VTAB 22: PRINT  TAB( 10);"MA
     KE SELECTION(1-6) ";: GET A$

160  IF  VAL (A$) < 1 OR  VAL (A$
     ) > 6 THEN  PRINT  CHR$ (7):
     GOTO 150
165 D$ =  CHR$ (4): REM  CONTROL-
     D
166  PRINT
170  ON  VAL (A$) GOTO 1010,1020,
     1030,1040,1050,1060
1010  PRINT D$;"RUN SECURE"
1020  PRINT D$;"RUN RK"
1030  PRINT D$;"RUN SNOOPER"
1040  PRINT D$;"RUN SPACER"
1050  PRINT D$;"RUN BACH"
1060  HOME : VTAB 22: NEW
```

Listing 3—sample.

```
10  REM ---SAMPLE---
20 PWD =  PEEK (778)
30  REM ----------------
40  REM
50  REM PROGRAM WHICH USES
60  REM PAGE 3 FOR MACHINE
70  REM CODE ROUTINES
80  REM
90  REM ----------------
95  POKE 778,PWD
100  IF PWD = 255 THEN  PRINT  CHR$
     (4);"RUN DIR.OWNER"
110  PRINT  CHR$ (4);"RUN DIR.NON
     -OWNER"
```

Listing 4—secure.

```
10  REM ---SECURE---
20  HOME
22  VTAB 4: PRINT "  CHANGE OWNER
      OR NON-OWNER (N/O) ";: GET
      B$: PRINT
23  IF B$ = "O" THEN 30
24  IF B$ = "^" THEN 100
25  PRINT  CHR$ (7): GOTO 22
30  VTAB 10: PRINT "ENTER OWNER P
     ASSWORD (5 CHARS"
```

(listing continued on page 154)

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(listing continued from page 152)

in this case too. The names of the PSSWD files differ in their embedded control characters and are not, as first appears, the same file twice.

Lines 90 to 110 accept the password from the user without echoing on the screen. Lines 130 to 160 compare the input with all the passwords within the system to find the access level to provide.

Location 778 is set up with a code defining the access level; in this instance owner is 255, non-owner is 0. It remains in force throughout the time in which the disc is in use and instructs the code at the end of every subsequent program which directory selector to Run. One directory selector is shown, Dir.Owner; another should exist for each security level implemented.

If any of the utility programs use page three locations themselves it is a requirement of the protocol that they save location 778 as a variable at the beginning of the program. It is then reinstated before exiting, as shown in the sample listing.

The only remaining function is the password maintenance utility Secure. It is available through the Owner directory program selector only. The technique is skeletal but sound, and would benefit from polishing. There is no reason, for example, why the directory selector should be hard-coded. By itself, being a catalogue analyser and adopting a convention within some section of the file naming, the security level of each program could be made implicit, though the level of description within the selector screen might suffer.

Overlays

D J Bullar of South Chailey, Sussex offers a technique which allows overlaying of program modules without disturbing either the current variables or the high-resolution pages. The Applesoft Chain facility corrupts the high-resolution areas where the Basic program exceeds about 6K, and setting Lomem beforehand has no effect.

Three example program modules show the technique adopted. Line 9 of each module is a subroutine which stores away the pointers to variables in a few bytes just before the second high-resolution screen. Use it just before leaving the current module.

(continued on page 157)

(listing continued from page 152)

```
40  PRINT
50  FOR N = 1 TO 5
60  GET A$: PRINT A$;"  "; ASC (A
     $): POKE 767 + N, ASC (A$)
70  NEXT
80  PRINT  CHR$ (4);"BSAVE PSSWD,
     A768,L5"
90  PRINT  CHR$ (4);"RUN DIR:OWNE
     R"
100  VTAB 10: PRINT "ENTER NON-OW
     NER PASSWORD (5 CHARS)"
110  FOR N = 1 TO 5
120  GET A$: PRINT A$;"  "; ASC (
     A$): POKE 772 + N, ASC (A$)
130  NEXT
140  PRINT  CHR$ (4);"BSAVE PSSWD
     ,A773,L5"
150  PRINT  CHR$ (4);"RUN DIR.NON
     -OWNER"
```

Overlays 1.

```
4  LOMEM: 24584
5  GOTO 10
9 PP = 24576: FOR J = 0 TO 7: POKE
     PP + J, PEEK (105 + J): NEXT
     : PRINT : PRINT D$;"RUN ";NS
     $
10  REM  ****MAIN PROGRAM SECTION
     1 ****
20  PRINT "SECTION 1"
22 D$ =  CHR$ (4)
30  PRINT : INPUT "PLEASE ENTER A
     NUMBER";N1
40  INPUT "AND ANOTHER";N2
50  INPUT "NOW PLEASE ENTER A NAM
     E";A$
60  HGR : VTAB 24
70  PRINT "I WILL NOW PAINT THE H
     GR SCREEN WHITE":HC = 7
80  HCOLOR= HC: FOR H = 0 TO 191:
     HPLOT 0,H TO 279,H: NEXT
90  PRINT "NOW BACK TO TEXT"
100  FOR H = 0 TO 1000: NEXT
110  TEXT
120 NS$ = "SECT2": GOTO 9
```

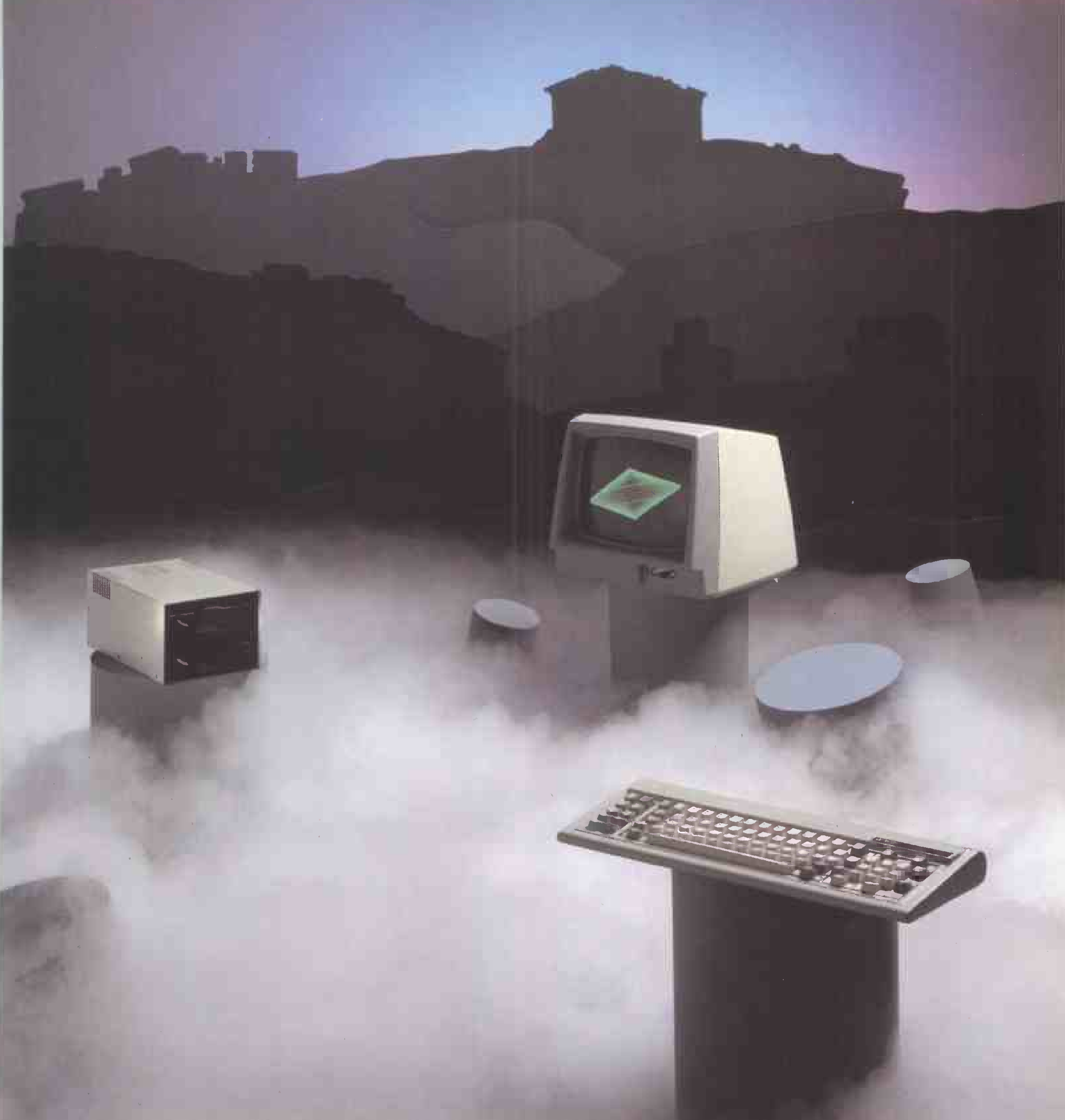
Overlays 2.

```
4  FOR J = 7 TO 2 STEP  - 1: POKE
     105 + J, PEEK (24576 + J): NEXT
     : POKE 106, PEEK (24577): POKE
     (105), PEEK (24576)
5  GOTO 10
9 PP = 24576: FOR J = 0 TO 7: POKE
     PP + J, PEEK (105 + J): NEXT
     : PRINT : PRINT D$;"RUN";NS$

10  REM  SECTION 2
20  PRINT : PRINT "HELLO THIS IS
     SECTION 2"
30  PRINT "THE TWO NUMBERS YOU GA
     VE ME WERE ";N1;" AND ";N2
40  PRINT : PRINT "THEIR PRODUCT
     IS ";N1 * N2
50  PRINT : PRINT "SEE IF HGR IS
     STILL O.K."
60  FOR H = 0 TO 3000: NEXT
70  POKE  - 16304,0
80  VTAB 23: PRINT "IS IT O.K.?"
90  PRINT "NOW BACK TO TEXT"
100  FOR H = 0 TO 3000: NEXT : TEXT

110  FOR H = 0 TO 10: READ X(H),Y
     (H): NEXT
120  PRINT "NOW I WILL CALL SECTI
     ON 3"
130  FOR G = 0 TO 3000: NEXT
140 NS$ = "SECT3": GOTO 9
150  DATA  150,0,150,159,80,0,220
     ,          0,150,159,0,100
     ,279,100,150,            159
     ,279,100,279,30,0,30,0,10
          0
```

Overlays 3.

```
4  FOR J = 7 TO 2 STEP  - 1: POKE
     105 + J, PEEK (24576 + J): NEXT
     : POKE 106, PEEK (24577): POKE
     (105), PEEK (24576)
5  GOTO 10
9 PP = 24576: FOR J = 0 TO 7: POKE
     PP + J, PEEK (105 + J): NEXT
     : PRINT : PRINT D$;"RUN";NS$

10  REM  SECTION 3
20  PRINT : PRINT "HELLO THIS IS
     SECTION **3**"
30  PRINT "THE NAME YOU GAVE ME W
     AS ";A$
40  PRINT "I PICKED UP SOME OTHER
      DATA FROM SECTION 2": PRINT
     "I WILL NOW DRAW WITH IT "
50  PRINT "SO HERE GOES"
60  FOR H = 0 TO 3000: NEXT
70  POKE  - 16304,0:HC = HC + 1: IF
```

(listing continued on page 157)



(continued from page 154)

Line 4 of all modules other than the first picks up these values and applies them ready for the new module to use. This line must be the first thing the new module does, because any variables met before it will be lost, as indeed J is.

Line 4 of the first module should set an appropriate Lomem; it is set in the examples to avoid both high-resolution screens, but if screen 2 is not in use Lomem: 16392 should be used instead of 24584, and the value of 24576 should be used in subsequent line 4s and all line 9s.

The limitations imposed by the technique are that data is stored in absolute locations. Programs written this way for a 48K Apple will not run on a 32K machine and will not make use of the extra memory on a 64K model. Literal strings declared in one program are not carried to the next and will need to be redefined in each module.

Graphing trig functions

An educational graph-plotting program has been sent by Michael Hambly of County Mayo. It is intended as an aid to learning about periodic functions.

The program will plot up to four equations on a single pair of axes in the domain -2π to 2π and range -2 to 2. It is especially useful for illustrating the effect of changing the values of A, B and C in equations of the form

Y = A * <function>(B * X + C).

As set up it shows the effect of changing A by plotting sin(X) with values of .5, 1, 2 and 4. The program can also handle composite functions as when plotting

Y = 2 * SIN(X)/4
Y = 3 * COS(2 * X)/4
Y = 2 * SIN(X) = 3 * COS(2 * X)/4.

(listing continued from page 154)

```
     HC > 7 THEN HC = 0
80   HCOLOR= HC: FOR G = 1 TO 10: HPLOT

     X(G - 1),Y(G - 1) TO X(G),Y(
     G): NEXT
90   FOR H = 0 TO 3000: NEXT
100  POKE  - 16303,0
120  PRINT "NOW WHICH SECTION DO
     YOUWANT"
130  INPUT "1,2 OR 3 ";SC
140  IF SC = 1 THEN NS$ = "SECT1"
     : GOTO 9
150  IF SC = 2 THEN NS$ = "SECT2"
     : GOTO 9
160  IF SC = 3 THEN NS$ = "SECT3"
     : GOTO 9
170  END
```

Graphing trig functions.

```
10 :
20  REM  COPYRIGHT (C) MICHAEL HA
    MBLY
60 :
97 :
98  REM  *** INSTRUCTIONS FOR MAI
    N PROGRAM ***
99 :
100  TEXT : HOME : SPEED= 100
110  PRINT "PROGRAM TO GRAPH TRIG
     ONOMETRIC FUNCTIONS E.G. SIN
     (X), COS(X^3), TAN(X),
        SIN(X)+COS(X)  ETC."
120  PRINT : PRINT
130  PRINT "YOU ENTER THE FUNCTIO
     NS REQUIRED IN     LINES 300
     0, 4000, 5000 AND 6000
        (YOU DON'T HAVE TO USE TH
     EM ALL)"
140  PRINT
150  PRINT "E.G. TO PLOT THE FUNC
     TION Y = SIN(X)

160  PRINT "TYPE  3000 Y = SIN(X)
      (PRESS <RETURN>)"
170  PRINT : PRINT
180  PRINT "ENTER EQUATIONS, TYPE
      'RUN 500' AND
               PRESS <RETURN>"
190  FOR I = 1 TO 2000: NEXT
200  PRINT : PRINT "N.B. SOME EXA
     MPLES ARE ALREADY ENTERED  I
     F YOU WISH TO SEE THEM JUST
     TYPE       'RUN 500' AND PRE
     SS <RETURN>"
210  SPEED= 255
220  END
470 :
480  REM  *** START MAIN PROGRAM
     ***
490 :
500  GOSUB 10000: REM  ** DRAW AN
     D LABEL AXES **
1990 :
2000  DIM X1(162),S1(162)
2010  POKE 34,20: HOME
2020 T = 162:I = 81:M = 40.5
2030 PI = 4 *  ATN (1): REM
        PI
2050  PRINT : PRINT
2060  PRINT "CALCULATION IN PROGR
     ESS PLOT WILL BEGIN IN A MOM
     ENT"
2070 :
2080  FOR J =  - I TO I - 1
2090 K = I + J
2100 S1(K) = J / M * PI
2120 :
2130 X1(K) = 140 / I * J + 140
2140  NEXT J
2150 N = 1
2160  IF N = 1 THEN  LIST 3000
2170  IF N = 2 THEN  LIST 4000
2180  IF N = 3 THEN  LIST 5000
2190  IF N = 4 THEN  LIST 6000
2200  VTAB (22): PRINT "     ": PRINT

2210  FOR J = 0 TO T - 1
2220 X = S1(J)
2230  ON N GOSUB 3000,4000,5000,6
     000
2240 Y =  - 40 * Y + 80
2250  IF Y < 0 OR Y > 159 THEN 22
     70
2260  HPLOT X1(J),Y
2270  NEXT J
2280  PRINT "PRESS ANY KEY TO CON
     TINUE";
2290  GET K$: IF K$ = "" THEN 229
     0
2300  PRINT
2510 N = N + 1
2520  IF N < 5 THEN 2160
2570  PRINT : PRINT : PRINT "PROG
     RAM COMPLETE"
2580  END
2970 :
2980  REM  ** SUBROUTINES TO BE P
     LOTTED **
2990 :
3000 Y =  SIN (X)
3100  RETURN
4000 Y = .5 *  SIN (X)
4100  RETURN
5000 Y = 2 *  SIN (X)
5100  RETURN
6000 Y = 4 *  SIN (X)
6100  RETURN
9950 :
9960  REM   ** DRAWING AND LABELL
     ING X AND Y AXES **
9990 :
10000  HGR : HCOLOR= 7
10010  HPLOT 0,80 TO 279,80: REM
```

(listing continued on next page)

Fast integer array retrieval

These two routines greatly speed up the saving and loading of integer arrays of data to and from disc or cassette. The data can be raw data from an eight-bit or 12-bit analogue-digital port, such as a temperature fluctuating against time, or any analogue values held in two-byte integer form.

Integer variables are represented within Applesoft Basic as five-byte fields, though only two of these are significant. The remaining three are wasted space filled with zeros. Integer arrays are held in two-byte format per element, which is useful where memory is at a premium.

The writing and reading of integers to and from disc via Print and Input statements is slower than the equivalent BSave and BLoad of the same data held on a single array by a factor of up to 10. The technique adopted here is based on the presence in page zero at 131-132 decimal of the address of the last variable referenced within the Basic interpreter. In the case of a string, it is the address of a pointer to the location of the text in memory which is important. Thus

ARRAY(0) = PEEK(131) + 256 * PEEK(132)

will move the address of Array%(0) into itself. It can then be used as the value of the ,A(address) parameter to BSave and BLoad for the entire array in question.

Applesoft lays out variables in memory from Lomem in the order simple variables, then arrays and string pointers, with strings themselves depending from Himem. As a result only the introduction of more simple variables after the Peeks and before the BSave/BLoad can change the address of the array and invalidate the approach.

(listing continued from previous page)

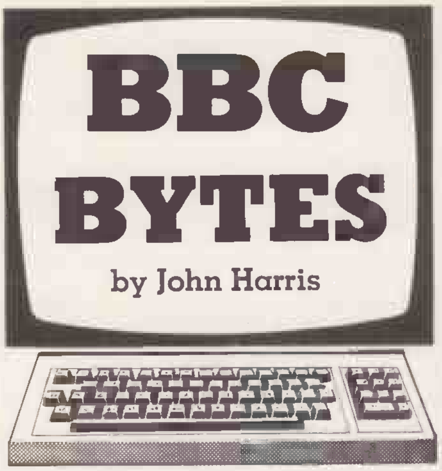
```
          X AXIS
10020  HPLOT 140,0 TO 140,160: REM
          Y AXIS
10030  FOR K = 0 TO 245 STEP 35: REM
          DIVIDING UP X AXIS
10040  HPLOT K,79 TO K,81: NEXT K
10050  FOR L = 0 TO 140 STEP 40: REM
          DIVIDING UP Y AXIS
10060  HPLOT 139,L TO 141,L: NEXT
     L
10090 :
10100  REM  ** MINUS SIGNS **
10110 P = 1:Q = 84: GOSUB 10300
10120 P = 71:Q = 84: GOSUB 10300
10130 P = 141:Q = 119: GOSUB 1030
     0
10140 P = 141:Q = 158: GOSUB 1030
     0
10150 P = 145:Q = 154: GOSUB 1030
     0
10155 :
10160  REM  ** 2'S **
10170 P = 7:Q = 84: GOSUB 10330
10180 P = 266:Q = 84: GOSUB 10330
10190 P = 147:Q = 4: GOSUB 10330
10200 P = 150:Q = 153: GOSUB 1033
     0
10205 :
10210  REM  ** PI'S **
10220 P = 15:Q = 84: GOSUB 10370
10230 P = 76:Q = 84: GOSUB 10370
10240 P = 213:Q = 84: GOSUB 10370
10250 P = 276:Q = 84: GOSUB 10370
10260  RETURN
10270 :
10280  REM  ** PLOTTING SUBROUTIN
     ES FOR '-', '2' AND 'PI' **
10290 :
10300  HPLOT P - 1,Q TO P + 1,Q
10310  RETURN
10320 :
10330  HPLOT P - 2,Q - 1 TO P - 1
     ,Q - 2 TO P + 1,Q - 2 TO P +
     2,Q - 1
10340  HPLOT P + 2,Q TO P - 2,Q +
     4 TO P + 2,Q + 4
10350  RETURN
10360 :
10370  HPLOT P - 3,Q - 2 TO P + 3
     ,Q - 2: REM     P1
10380  HPLOT P - 2,Q - 2 TO P - 2
     ,Q + 3
10390  HPLOT P + 2,Q - 2 TO P + 2
     ,Q + 3
10400  RETURN
```

Integer Load routine.

```
5  REM *PROGRAM FAST-ARRAY-LOAD
10  REM *LOAD INTEGER ARRAY FROM
     DISC
20  REM *VARPNT IN 131,132 HOLDS
     ADDRESS
30  REM *OF LAST REFERENCED VARIA
     BLE
40  REM *I.E.FIRST CHARACTER OF A
     RRAY NAME
50  REM *STRING POINTERS STORED I
     N ARRAY TABLE
60  REM *BUT SIMPLE VARIABLES WIL
     L AFFECT ADDRESS OF ARRAY
70  REM *SO DON'T CREATE NEW ONES
      IN PROGRAM
80  REM *BETWEEN LINE 140 AND BLO
     AD
100  HOME
105 D$ =  CHR$ (13) +  CHR$ (4)
110 M = 10000: DIM N%(M)
120  INPUT "NAME ";F$
140 N%(0) =  PEEK (132) * 256 +  PEEK
     (131)
150 X$ = ",A" +  STR$ (N%(0))
155 N%(0) = 1
160  PRINT D$;"BLOAD ";F$;X$
170  PRINT
180  PRINT N%(0),N%(1),N%(M)
```

Integer Save routine.

```
10  REM *SAVE INTEGER ARRAY TO DI
     SC
20  REM *VARPNT IN 131,132 HOLDS
     ADDRESS
30  REM *OF LAST REFERENCED VARIA
     BLE
40  REM *I.E.FIRST CHARACTER OF A
     RRAY NAME
50  REM *STRING POINTERS STORED I
     N ARRAY TABLE
60  REM *BUT SIMPLE VARIABLES WIL
     L AFFECT ADDRESS OF ARRAY
70  REM *SO DON'T CREATE NEW ONES
      IN PROGRAM
80  REM *BETWEEN LINE 140 AND BSA
     VE.
100  HOME
105 D$ =  CHR$ (13) +  CHR$ (4)
110 M = 10000: DIM N%(M)
115 N%(1) = 1:N%(M) = M
120  INPUT "NAME ";F$
140 N%(0) =  PEEK (132) * 256 +  PEEK
     (131)
150 X$ = ",A" +  STR$ (N%(0)) + "
     ,L" +  STR$ ((M + 1) * 2 + 7
     )
155 N%(0) = 1
160  PRINT D$;"BSAVE ";F$;X$
```



Sound experimenter

A LOT of testbeds exist to try out the BBC sound facilities. A well-designed version from J Wallace of Redcar has the advantage of having very simple keyboard operation. One-handed operation with eyes permanently on the screen is easy with this program and aids concentration. The usual alternative of numeric parameter input makes changing and comparing very much more difficult and time-consuming.

The Up and Down Cursor keys effect selection of the parameter to be amended; Left and Right Cursor keys decrease and increase its value in units of one, or 10 if the shift key is simultaneously depressed. Pressing the space bar gives the sound displayed, which, if repetitive or long, may be cancelled by pressing Escape.

Sound experimenter.

```
  100REM ** SOUND EXPERIMENTER by J>
Wallace **
  120MODE7
  130VDU23;8202;0;0;0;
  140*FX4,1
  150DIM V%(23)
  160PROCscreen
  170Y%=3
  180IF INKEY(-58) PROCup
  190IF INKEY(-42) PROCdown
  200IF INKEY(-26) PROCdecrease
  210IF INKEY(-122)PROCincrease
  220IF INKEY(-99) PROCsound
  230PRINTTAB(0,Y%);CHR$134;"]"
  240K$=INKEY$(400)
  250GOTO180
  270DEF PROCscreen
  280PRINT
  290PRINTCHR$131;"  SOUND"
  300PRINT
  310PRINT"  Channel number.........
..0 - 3"
  320PRINT"  Amplitude.............
-15 - 4"
  330PRINT"  Pitch.................
..0 - 255"
  340PRINT"  Duration..............
..1 - 255"
  350PRINT
  360PRINTCHR$131;"  ENVELOPE"
  370PRINT
  380PRINT"  Envelope number........
..1 - 4"
  390PRINT"  Length of each step....
..0 - 255"
  400PRINT"  Pitch change S1.......-
128 - 127"
  410PRINT"  Pitch change S2.......-
128 - 127"
  420PRINT"  Pitch change S3.......-
128 - 127"
  430PRINT"  No of steps  S1........
..0 - 255"
  440PRINT"  No of steps  S2........
..0 - 255"
  450PRINT"  No of steps  S3........
..0 - 255"
  460PRINT"  Amp change attack.....-
127 - 127"
  470PRINT"  Amp change decay......-
127 - 127"
  480PRINT"  Amp change sustain....-
127 - 0"
  490PRINT"  Amp change release....-
127 - 0"
  500PRINT"  Target lvl attack......
..0 - 126"
  510PRINT"  Target lvl decay.......
..0 - 126"
  520FOR I%=10 TO 23
  530PRINTTAB(36,I%);V%(I%)
  540NEXT
  550FOR I%=10 TO 23
  560PRINTTAB(36,I%);V%(I%)
  570NEXT
  580ENDPROC
  600DEF PROCdown
  610PRINTTAB(0,Y%);CHR$135;SPC(1)
  620Y%=Y%+1
  630IFY%=7 Y%=10
  640IF Y%=24 Y%=3
  650ENDPROC
  670DEF PROCup
  680PRINTTAB(0,Y%);CHR$135;SPC(1)
  690Y%=Y%-1
  700IFY%=9 Y%=6
  710IF Y%=2 Y%=23
  720ENDPROC
  740DEF PROCsound
  750*FX15,0
  760ENVELOPEV%(10),V%(11),V%(12),V%
(13),V%(14),V%(15),V%(16),V%(17),V%(
18),V%(19),V%(20),V%(21),V%(22),V%(2
3)
  770SOUND V%(3),V%(4),V%(5),V%(6)
  780ENDPROC
  800DEFPROCincrease
  810IFINKEY(-1) S%=10 ELSE S%=1
  820V%(Y%)=V%(Y%)+S%
  830IFV%(Y%)>255 V%(Y%)=255
  840PRINTTAB(36,Y%);SPC(4);
  850PRINTTAB(36,Y%);V%(Y%);
  860ENDPROC
  880DEF PROCdecrease
  890IFINKEY(-1) S%=10 ELSE S%=1
  900V%(Y%)=V%(Y%)-S%
  910IFV%(Y%)<-128 V%(Y%)=-128
  920PRINTTAB(36,Y%);SPC(4);
  930PRINTTAB(36,Y%);V%(Y%);
  940ENDPROC
```

Memory contest

It is pleasant to find a utility in the post which lists 128-byte blocks of memory in hex and character format, plus forward, backward, direct addressing and editing features is rather pleasant. To find two is a shock. To find that the authors share the same surname leads me to suspect that they know each other.

The shorter version, by A K A Kerr, starts by prompting for a start address. After the data block is displayed F moves forward, R reverse, E exits, and I allows insertion of hex bytes from a specified memory location, terminated by a naked Return. Mr Kerr says modestly that his program is suitable for improvement, but apart from leaving the last block visible on entering insert mode, it is thoroughly competent — certainly it meets its specification.

Ian D Kerr's program does the same thing in colour. A start address of zero is assumed. Up and Down Cursor keys page forwards and backwards, B amends the block location, and E enters edit mode during which an Editing warning appears at the bottom of the screen. Full cursor control exists over the displayed block, and any hex byte can be amended: Return reverts to display mode, and should the last byte of the block be amended the next is automatically paged, still in edit mode. Failed edits — into ROM or the exact spot in screen memory being typed — are rewarded with a short beep. The program is exited by Escape.

Either program may run alone or may co-reside with another Basic or machine-code program. To examine another program in core, type

'PAGE = (INT((TOP—3)/256) + 1) * 256:
CHAIN"× × ×"'

where × × × is the utility.

Voting is open to all readers not surnamed Kerr and closes on March 31. Votes with reasons score one, votes without score one-half. The result will be announced as soon as practical thereafter.

Memory contest — A K A Kerr.

```
   10 REM DISPLAY PROGRAM
   20 CLS:INPUT"BASE ADDRESS (HEX) "
ADD$:PROCHEX(ADD$)
   25 CLS
   30 FOR Q%=1 TO 16
   40 PRINT;~ADD%" ";:W$=""
   50 FOR U%=1 TO 8
   60 ADD%=ADD%+1:Z%=?(ADD%)
   70 IF Z%<32 OR Z%>126 THEN W$=W$+
" " ELSE W$=W$+CHR$Z%
   80 IF Z%<&10THENPRINT;" ";~Z%;" "
;:GOTO100
   90 PRINT;~Z%;" ";
  100 NEXTU%
  110 PRINTTAB(30);W$
  120 NEXTQ%
  130 N$=GET$:PRINT:IFN$="F"THEN25 E
LSE IFN$="R"THENADD%=ADD%-256:GOTO25
  140 IFN$="I"THEN160 ELSEIFN$="E"TH
EN END
  150 GOTO130
  160 INPUT"BASE ADDRESS "ADD$:CLS
  170 PROCHEX(ADD$):F%=ADD%
  180 PRINT;~F%;TAB(6);?(ADD%);TAB(1
2);
  190 INPUTN$:IFN$=""THENSTOP
  200 PROCHEX(N$):N%=ADD%:?(F%)=N%:F
%=F%+1
  210 GOTO180
  220 DEFPROCHEX(ADD$):IFADD$=""THEN
STOP
  230 ADD%=0:L%=LEN(ADD$):FORC%=L%TO
1 STEP-1
  240 P$=MID$(ADD$,C%,1):W%=ASC(P$)-
48:IFW%>9THENW%=W%-7
  250 ADD%=ADD%+W%*16^(L%-C%)
  260 NEXTC%:ENDPROC
```

Memory contest — I D Kerr.

```
  100 ON ERROR GOTO 210
  105 REM BDUMP : VER 2
  110 REM Updated 15/11/82
  115 REM
  120 *FX4,1
  125 MODE7
  130 PRINTTAB(14);CHR$141;"BDUMP":PRI
NTTAB(14);CHR$141;"BDUMP"
  135 PRINTCHR$132;"ADDR";CHR$131;TAB(
15);"DATA";CHR$(129);TAB(32);"ALPHA"
  140 VDU28,0,24,39,5
  145 M%=0
  150 PROCdmp
  160 REM ***    MAIN PROGRAM LOOP   *
**
  165 REPEAT
  170 K=ASC(GET$)
  175 IF K=139 THEN M%=M%-128:PROCdmp
```

(continued on next page)

(continued from previous page)

```
  180 IF K=138 THEN M%=M%+128:PROCdmp
  185 IF K=&42 THEN PROCnewbl:PROCdmp
  190 IF K=&45 THEN PROCmemed:PROCdmp
  195 UNTIL 0
  200 REM ***     ****************     *
**
  205 REM Error routine and exit
  210 IF ERR<>17 THEN REPORT:PRINTERL
  215 VDU28,0,24,39,0
  220 *FX4,0
  225 PRINT"...Bye":END
  230 DEF            PROCnewbl
  235 INPUT "Block address :"NB$:IF NB
$=""THEN235
  240 M%=EVAL("&"+NB$)
  245 ENDPROC
  250 DEF            PROCmemed:CLS:PROCdm
p:VDU7:PRINTTAB(12,18);
  255 IF (M%>(PAGE-127)) THEN IF (M%<T
OP) THEN VDU136
  260 PRINT"EDITING";:MEM%=M%:VDU31,6,
0
  265 K$=GET$:K=ASC(K$):IF K=139 THEN
IF VPOS>0 THEN VDU11:MEM%=MEM%-8
  270 IF K=138 THEN IF VPOS<15 THEN VD
U10:MEM%=MEM%+8
  275 IF K=136 THEN IF POS>6 THEN VDU8
,8,8:MEM%=MEM%-1
  280 IF K=137 THEN IF POS<25 THEN VDU
9,9,9:MEM%=MEM%+1
  285 IF(K<&30) OR (K>&46) OR ((K>&39)
AND(K<&41)) THEN 330
  290 PRINTK$;:REM ........first data
character
  295 N$=GET$:N=ASC(N$):IF(N<&30) OR (
N>&46) OR ((N>&39)AND(N<&41)) THEN 295
  300 PRINTN$;:REM ........second data
 character
  305 NV%=EVAL("&"+K$+N$)
  310 ?MEM%=NV%:MEM%=MEM%+1:VDU9:IF ?(
MEM%-1)<>NV% THEN VDU7
  315 IF POS>28 THEN FORI=1 TO 24:VDU8
:NEXT:VDU10
  320 IF VPOS>15 THEN M%=MEM%:PROCmeme
d:GOTO 330
  325 GOTO265
  330 IFK<>13 THEN 265
  335 CLS:ENDPROC
  340 DEF            PROCdmp:IF M%<0 THEN
M%=0
  345 FOR X%=0 TO 127 STEP 8
  350 AD=M%+X%: IF AD>&FFFF THEN AD=AD
-&10000
  355 ALFA$="":PRINTCHR$132;~AD;TAB(5)
;
  360 VDU131:FOR NX%=0 TO 7:HVAL=?(AD+
NX%):HEX$=CHR$HVAL
  365 IF(HEX$<" ") OR (HEX$>"~") THEN
HEX$="."
  370 ALFA$=ALFA$+HEX$:W$=STR$~HVAL
  375 IFLEN(W$)<2THENW$="0"+W$
  380 PRINTW$;" ";
  385 NEXT:PRINTCHR$129;ALFA$
  390 NEXT:PRINT
  395 *FX15,1
  400 ENDPROC
```

Crack code

Freda Perrow of Middlesborough has submitted a listing which she calls Crack Code. It is similar to what was once known as The Post Office Game and has since been marketed by Invicta Plastics in various forms as Mastermind.

This version is intended to be portable, with minor syntax changes, to other micros and consequently uses a subset of BBC Basic. While portability may be a concern within the body of *Practical Computing* it would be a pity within this column not to employ the BBC Micro's full facilities where appropriate, especially in the use of parameter-driven procedures to handle such details as the mode 7 screen characteristics.

The Post Office Game, as I played it, allowed five numbers with or without duplicates; this version allows four, without. While you are keying the program you might consider the changes necessary to convert this implementation to the alternative, and reflect on the virtues of separating control structure from essential detail.

Crack code.

```
   10 REM CRACK-CODE BY FREDA PERROW
   20 REM TERRYCOMB SOFTWARE (C) DEC
 1982
   30 DIM FIG$(4),GUESS$(4)
   40 MODE7
   50 PROCBEGIN
   60 PROCSELECT
   70 TIME=0:L=2:TRY=0
   80 ON ERROR CLS:GOTO 180
   90 REPEAT
  100 TRY=TRY+1
  110 SOUND 1.-10,177,12
  120 PROCTRY
  130 PROCCHECK
  140 L=L+1
  150 IF 15-TRY<1 THEN PROCFAIL:W=IN
KEY(250):VDU7:PROCagain:GOTO190
  160 UNTIL GOOD=4
  170 PROCDONE
  180 PROCagain
  190 IF answer$="Y" OR answer$="y"
THEN 40
  200 FOR A=1 TO 12 STEP 2:PRINTTAB(
A+2,A+3)"TOODLE-PIP..THEN";NEXT:END
  210 DEFPROCBEGIN
  220 PRINTTAB(12)CHR$130;CHR$141"CR
ACK-CODE"'TAB(12)CHR$130;CHR$141"CRA
CK-CODE"'TAB(13)CHR$131"----------"
  230 PRINTTAB(17)CHR$132"ALL NUMBER
S DIFFERENT"'TAB(18)"==============
======="
  240 PRINTTAB(19)CHR$131"* = Right
number -"TAB(23)CHR$131"right place"
''TAB(19)CHR$133;"! = Right number -
"TAB(23)CHR$133;"wrong place"''TAB(1
9)CHR$135;": = Wrong number -"TAB(23
)CHR$135;"wrong place"
  250 VDU23;8202;0;0;0;
  260 ENDPROC
  270 DEFPROCSELECT
  280 R=999+RND(9000)
  290 N$=STR$(R)
  300 FOR X=1TO4
  310 FIG$(X)=MID$(N$,X,1)
  320 NEXTX
  330 SHUFFLE=0
  340 FOR X=1TO4:FOR Y=1TO4
  350 IF X=Y THEN 370
  360 IF FIG$(X)=FIG$(Y) THEN SHUFFL
E=1
  370 NEXT Y:NEXT X
  380 IF SHUFFLE=1 THEN GOTO 280
  390 DELAY=INKEY(100)
  400 ENDPROC
  410 DEFPROCTRY
  420
  430 PRINTTAB(0,4)CHR$136;"-Guess n
ow-";CHR$137
  440 PRINTTAB(X-4,L+4)SPC(4)
  450 VDU 31,X-4,L+4
  460 FOR X=1TO4
  470 *FX15,1
  480 guess$=GET$:PRINTTAB(X,L+4);gu
ess$
  490 GUESS$(X)=guess$
  500 NEXT X
  510 SHUFFLE = 0
  520 FOR X=1TO4:FOR Y=1TO4
  530 IF X=Y THEN 550
  540 IF GUESS$(X)=GUESS$(Y) OR GUES
S$(X)<"0" OR GUESS$(X)>"9" THEN SHUF
FLE = 1
  550 NEXT Y:NEXT X
  560 IF SHUFFLE = 1 THEN SOUND1,-15
,77,12:PRINTTAB(0,4)SPC(12):PRINTTAB
(0,4)CHR$136;"--TRY AGAIN--";CHR$137
:GOTO440
  570 ENDPROC
  580 DEFPROCCHECK
  590 PRINTTAB(19,18)SPC(20)
  600 PRINTTAB(0,4)CHR$134;"please w
ait  "
  610 VDU23;8020;0;0;0;
  620 W=INKEY(150)
  630 PRINTTAB(0,4)CHR$136;"-Guess n
ow-";CHR$137
  640 GOOD=0:BAD=0
  650 FOR P=1TO4
  660 FOR Q=1TO4
  670 IF GUESS$(Q)<>FIG$(P) THEN 690
  680 IFP=Q THEN GOOD=GOOD+1 ELSE BA
D=BAD+1
  690 NEXT Q
  700 NEXT P
  710 PRINTTAB(20,20)SPC(17)
  720 PRINTTAB(20,20)CHR$134;"TRIES
LEFT = ";15-TRY
  730 REM ENTER THE NEXT LINE FOR DE
BUGGING ONLY
  740 REM PRINTTAB(20,21)CHR$134;"NO
 =";R
  750 PRINTTAB(8,L+4)"::::"
  760 VDU31,8,L+4
  770 IF GOOD = 1 THEN PRINTTAB(8,L+
4)"*";:GOTO 810
  780 IF GOOD = 2 THEN PRINTTAB(8,L+
4)"**";:GOTO 810
  790 IF GOOD = 3 THEN PRINTTAB(8,L+
4)"***";:GOTO 810
  800 IF GOOD = 4 THEN PRINTTAB(8,L+
4)"****";:GOTO 810
  810 IF BAD = 1 THEN PRINT"!";
  820 IF BAD = 2 THEN PRINT"!!";
  830 IF BAD = 3 THEN PRINT"!!!";
  840 IF BAD = 4 THEN PRINT"!!!!";
  850 ENDPROC
  860 DEFPROCDONE
  870
  880 PROCFIN
  890 IF TRY = 1 THEN G$ = " go" ELS
E G$ = " goes"
  900 PROCFIN
  910 PRINTTAB(20,22)CHR$131;"It too
k ";INT(TIME/100);" secs":PRINTTAB(2
0,23)CHR$131;" and "TRY;G$
  920 W=INKEY(500)
  930 ENDPROC
  940 DEFPROCagain
  950 *FX15,1
  960 PRINTTAB(19,20)CHR$136;CHR$131
;"Would you like    "
  970 PRINTTAB(19,21)CHR$136;CHR$131
;"another go? (Y/N)"
  980 PRINTTAB(19,22)SPC(18):PRINTTA
B(19,23)SPC(18)
  990 answer$=GET$
 1000 CLS
 1010 IF answer$<>"Y" AND answer$<>"
N" AND answer$<>"y" AND answer$<>"n"
 THEN 990
 1020 T=TIME:REPEAT UNTIL TIME-T>150
 1030 ENDPROC
 1040 DEFPROCFAIL
 1050 PRINTTAB(20,20)"Sorry too many
 tries"'TAB(20)"number was ";R
 1060 ENDPROC
 1070 DEFPROCFIN
 1080 PRINTTAB(0,4)CHR$129;"CODECRAC
KED"
 1090 ENVELOPE2,3,-4,-1,2,6,6,28,81,
-4,-5,-1,126,63
 1100 SOUND 1,2,77,5:W=INKEY(55):SOU
ND 1,2,120,5
 1110 IF TRY<2 PRINTTAB(20,20)CHR$13
4;" UNBELIEVABLE!    ":ENDPROC
 1120 IF TRY<4 PRINTTAB(20,20)CHR$13
4;" NOT BAD AT ALL   ":ENDPROC
 1130 IF TRY<6 PRINTTAB(20,20)CHR$13
4;" GOOD GAME!       ":ENDPROC
 1140 IF TRY<10 PRINTTAB(20.20)CHR$1
34;" JUST FAIR!!       ":ENDPROC
 1150 PRINTTAB(20,20)CHR$134;" YOU T
OOK YOUR TIME":ENDPROC
```

The Ultimate

At last there is a truly professional micro available in the UK at a personal price. The Z100 surpasses anything else you may have considered — mainly because Zenith Data Systems has concentrated all its resources into producing the ultimate micro. Unlike some manufacturers who are primarily involved in mainframes and minis, Zenith's technology is based on the screen approach.

Designed to carry out routine business applications including word processing, the Z100 also offers exceptional business and engineering graphics in full colour as standard.

The Z100 is superbly engineered, its reliability has been proved in thousands of installations, making Zenith the number four best-seller in the United States.*

Combined unit.

Prices from £2,072, excluding VAT. Quantity discounts available. Price includes CP/M, ZDOS (= MS-DOS), ZBASIC and colour graphics on low profile unit as standard.

* Source: Dataquest Desktops Survey.

Hardly surprising when you consider that the Z100 gives you:

- Intel 8085 8-bit and 8088 16-bit processing
- 224K to 960K RAM memory, including video RAM
- Five S100 expansion slots
- high quality colour graphics
- CP/M(TM) and MS-DOS(TM) operating systems
- 10MB (formatted) 5¼" integral Winchester disk drive
- communications facilities via 1 parallel and 2 serial RS232 ports.

The Z100 is available both as a combined screen/disk/keyboard unit or in low profile with a moveable screen.

CP/M(TM) and MS-DOS(TM) enable the user to take full advantage of the wide range of current and planned software.

The Z100 is available through our dealer network and of course is backed by nationwide field service.

When looking for a micro you may begin with "A" but ultimately you'll reach the Zenith.

For the name of your nearest dealer or systems house, or for a detailed discussion, please contact:

Zenith Data Systems Limited,
Bristol Road, Gloucester GL2 6EE.
Telephone: 0452 29451.

ZENITH | data systems

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● Circle No. 191

Fruit machine

Mode 7 Teletext graphics is capable of quite flexible displays. Richard Hooper of Gerrards Cross supplied a listing demonstrating this — a fruit machine program which behaves very much like the real thing. Press the space bar to start, a random hold may show as a flashing H, then keys 1, 2, 3, and 4 will hold their respective reels and any other key will continue.

The four reels rotate, or pictures of four reels give a very good simulation, and stop in turn at random intervals. Winning combinations on the centre line allow a single gamble G or collect — space bar — the gamble giving an even chance of doubling the payout. A £10 stake is provided to start with, and while temporary gains may be made the program inexorably rakes it in. There is sadly no provision to make off with any cash remaining at the end of play — Escape.

The main attraction of the program is the graphics themselves, which are the best Mode 7 designs I have seen. It might wean addicts from the fruit machine proper without their losing real money in the process.

Fruit machine.

```
   10 REM ON ERROR MODE 7:END
   20 ENVELOPE1,0,0,0,0,0,0,0,126,-4
,-2,-2,126,63
   30 @%=&00020200
   40 MODE7:DIM F$(7,4),R(3,1):M=10
   50 FORI=0TO7:FORJ=0TO4:FORK=0TO6:
READ A:F$(I,J)=F$(I,J)+CHR$A:NEXT K,
J,I
   60 FORI=0TO2:R(I,0)=RND(4)-1:NEXT
   70 A$=CHR$156+CHR$135:FORI=0TO15:
PRINTTAB(8,I+6)A$;TAB(18,I+6)A$;TAB(
28,I+6)A$;TAB(38,I+6)CHR$156:NEXT
   80 REPEATPRINTTAB(0,2)SPC(80)
   90 M=M-0.1
  100 N=0:REPEAT
  110 FORI=0TO3:IF R(I,1)=1 GOTO170
  120 R(I,0)=(R(I,0)+1)MOD8
  130 VDU28,10*I,21,7+10*I,6
  140 FORJ=0TO4
  150 PRINTTAB(0,15)CHR$157;F$((R(I,
0)+1)MOD8,J);
  160 NEXT
  170 NEXT
  180 IF RND(5)=1 R(N,1)=1:N=N+1:SOU
ND&11,1,100,20
  190 UNTILN=4
  200 VDU26
  210 FORI=0TO3:R(I,1)=0:NEXT
  220 PRINTTAB(0,22)SPC(80);
  230 IF R(0,0)=R(1,0) AND R(1,0)=R(
2,0) AND R(2,0)=R(3,0) PROCWIN(5*(R(
0,0)+1))
  240 IF (R(0,0)=0 AND R(1,0)=0 AND
R(2,0)=0) OR (R(3,0)=0 AND R(2,0)=0
AND R(1,0)=0) PROCWIN(4) ELSE IF (R(
0,0)=0 AND R(1,0)=0) OR (R(3,0)=0 AN
D R(2,0)=0) PROCWIN(3) ELSE IF R(0,0
)=0 OR R(3,0)=0 PROCWIN(2)
  270 FORI=0TO1:PRINTTAB(0,2+I)CHR$1
41;"YOU HAVE `";M:NEXT
  273 *FX15,1
  280 REPEAT UNTIL GET$=" "
  290 IF RND(3)=1 PROCHOLD
  300 UNTIL FALSE
  310 DEFPROCHOLD
  320 FORI=0TO1:PRINTTAB(35,2+I)CHR$
141;CHR$136;"H":NEXT
  323 *FX15,1
  330 G=GET
  340 IF G>48 AND G<53 R(G-49,1)=1:F
ORI=0TO1:PRINTTAB(10 * (G-49),22+I)C
HR$141;"HOLD";:NEXT:GOTO330
  350 ENDPROC
  360 DEFPROCWIN(P)
  363 *FX15,1
  370 G$=GET$
  380 IF G$="G" AND RND(2)=1 P=P*2 E
LSE IF G$="G" ENDPROC
  390 M=M+P/10
  400 FORI=1TOP:SOUND2,1,50,2:NEXT
  410 ENDPROC
  420  DATA 146,32,32,95,32,32,32,14
6,32,95,38,52,32,32,146,32,53,32,101
,32,32,145,126,255,52,126,255,52,145
,43,47,33,43,47,33
  430 DATA 147,32,32,112,120,124,32,
147,95,126,255,255,255,32,147,106,25
5,255,255,255,32,147,106,255,255,255
,39,32,147,42,47,96,33,32,32
  440 DATA 146,32,32,32,32,56,32,149
,32,114,118,118,116,32,149,32,118,11
0,119,61,32,149,98,126,255,63,32,32,
149,42,163,32,32,32,32
  450 DATA 148,32,32,32,95,36,32,146
,32,120,103,124,116,32,146,106,117,2
55,255,255,32,146,255,255,255,255,55
,32,146,96,255,63,39,32,32
  460 DATA 147,32,32,112,32,32,32,14
7,32,120,255,116,32,32,147,106,255,2
55,255,53,32,147,122,255,255,255,117
,32,147,32,96,47,96,32,32
  470 DATA 32,32,32,32,32,32,32,32,3
2,32,32,32,32,32,150,255,255,255,255
,255,32,32,32,32,32,32,32,32,32,32,3
2,32,32,32.32
  480 DATA 32,32,32,32,32,32,32,150,
255,255,255,255,255,32,32,32,32,32,3
2,32,32,150,255,255,255,255,255,32,3
2,32,32,32,32,32,32
  490 DATA 32,32,32,32,32,32,32,150,
47,47,47,47,47,32,150,47,47,47,47,47
,32,150,47,47,47,47,47,32,32,32,32,3
2.32,32,32
```

Winning combinations.

4 triple bars	£4.00
4 double bars	£3.50
4 bars	£3.00
4 bells	£2.50
4 plums	£2.00
4 grapes	£1.50
4 lemons	£1.00
4 cherries	£0.50
3 cherries	£0.40
2 cherries	£0.30
1 cherry	£0.20

Note that cherry combinations must be contiguous from either end reel.

Least squares

A program has been submitted by Paul Mapstone of London NW1, which will allow a least squares straight-line fitting analysis to be performed on a series of input co-ordinates. The data can be entered, edited, listed and plotted. Options include fit to x and fit to y.

The printer options are all tailored to the NEC-8023 printer but are localised to a single routine ProcCopy, which can be amended for another printer if required. If the graphics options are not used the program will run on a Model A machine, and on a Model B over 1,000 points can be handled.

Least squares.

```
   10 REM*********** LINFIT ***
   20 CLS
   30 VDU15
   40 PROCindata
   50 ON ERROR GOTO 60
   60 PROCsums(N%)
   70 MODE7:A$=FNoption
   80 IF A$="L" PROCdatalist:GOTO70
   90 IF A$="D" PROCdataprint:GOTO70
  100 IF A$="E" PROCedit:GOTO60
  110 IF A$="Y" CLS:PROClinfit(SUMX,
SUMY,SUMXSQ,SUMYSQ,SUMXY,N%-bad_data
):PROCres_y:GOTO70
  120 IF A$="X" CLS:PROClinfit(SUMY,
SUMX,SUMYSQ,SUMXSQ,SUMXY,N%-bad_data
):PROCres_x:GOTO70
  130 IF A$="P" MODE4:PROCplot:MODE7
:GOTO70
  140 IF A$="R" RUN
  150 IF A$="Q" PRINT''"IF YOU WISH
TO RE-ENTER THE PROGRAM THENTYPE GOT
O 50":@%=10:END
  160 GOTO70
  170 DEF FNoption
  180 VDU3
  190 PRINT'"OPTIONS
      PRESS KEY"
  200 PRINT"_________________________
_____________"
  210 PRINT'"LIST DATA TO SCREEN";TA
B(36);"L"
  220 PRINT'"LIST DATA TO PRINTER";T
AB(36);"D"
  230 PRINT'"EDIT X & Y VALUES";TAB(
36);"E"
  240 PRINT'"CALCULATE m,c FOR y=m*x
+c";TAB(36);"Y"
  250 PRINT'"CALCULATE m,c FOR x=m*y
+c";TAB(36);"X"
  260 PRINT'"PLOT OF POINTS & FITTED
 LINE";TAB(36);"P"
  270 PRINT'"RUN THE PROGRAM AGAIN";
TAB(36);"R"
  280 PRINT'"QUIT THE PROGRAM";;TAB(
36);"Q"
  290 =GET$
  300 DEF PROCedit CLS
  310 @%=&0001060A
  320 PRINT''"THE POINTS WILL BE LIS
TED ONE AT A TIME.IF YOU WISH TO CHA
NGE THEM,TYPE BOTH    THE NEW X & Y
VALUES (OR EXPRESSIONS).  TO STOP ED
ITING,PRESS S. IF YOU DO NOT  WISH A
 POINT TO BE INCLUDED IN THE"
  325 PRINT"ANALYSIS SET X=9999 FOR
THAT POINT."
  330 PRINT:PRINT
  340 L%=1
  350 PRINT"POINT        X VALUE
Y VALUE"
  360 PRINT"_________________________
___________"
  370 PRINTTAB(2);STR$L%;TAB(10);X(L
%);TAB(23);Y(L%)
  380 INPUT"X="X$,
  390 IF X$="S" THEN L%=N%:GOTO440
  400 IF X$<>"" THEN X(L%)=EVALX$
  410 INPUT"Y="Y$
  420 IF Y$="S" THEN L%=N%:GOTO440
  430 IF Y$<>"" THEN Y(L%)=EVALY$
  440 IF L%=N% THEN @%=10:ENDPROC EL
SE L%=L%+1:PRINT:GOTO370
  450 DEF PROCindata
  460 INPUT "NUMBER OF POINTS:"N%
  470 IF N%<2 PRINT:PRINT"THE NUMBER
 OF POINTS MUST BE >=2"':GOTO460
  480 PRINT:PRINT:PRINT
  490 DIM X(N%),Y(N%)
  500 PRINT"POINT        X VALUE
Y VALUE"
  510 PRINT"_________________________
___________"
  520 FOR L%=1 TO N%
  530    PRINTTAB(2);L%;SPC(7);:INPUT
X$,Y$
  540    X(L%)=EVALX$:Y(L%)=EVALY$
```

(continued on next page)

(continued from previous page)

```
  550    NEXT
  560 ENDPROC
  570 DEF PROCsums(N%)
  580 SUMX=0:SUMY=0:SUMXSQ=0:SUMYSQ=
0:SUMXY=0:xmin=X(1):xmax=X(1):ymin=Y
(1):ymax=Y(1):bad_data=0
  590 FOR L%=1 TO N%
  600    IF X(L%)=9999 THEN bad_data=
bad_data+1:GOTO700
  610    IF xmin>X(L%) OR xmin=9999 T
HEN xmin=X(L%)
  620    IF xmax<X(L%) ORxmax=9999 TH
EN xmax=X(L%)
  630    IF ymin>Y(L%) THEN ymin=Y(L%
)
  640    IF ymax<Y(L%) THEN ymax=Y(L%
)
  650    SUMX=SUMX+X(L%)
  660    SUMY=SUMY+Y(L%)
  670    SUMXSQ=SUMXSQ+X(L%)^2
  680    SUMYSQ=SUMYSQ+Y(L%)^2
  690    SUMXY=SUMXY+X(L%)*Y(L%)
  700    NEXT
  710 ENDPROC
  720 DEF PROClinfit(SUMX,SUMY,SUMXS
Q,SUMYSQ,SUMXY,N%)
  730 IF N%>2 GOTO780
  740 SLOPE=(Y(2)-Y(1))/(X(2)-X(1))
  750 intcp=Y(1)-SLOPE*X(1)
  760 DELTAM=0:DELTAC=0
  770 ENDPROC
  780 DELTA=N%*SUMXSQ-SUMX*SUMX
  790 IF DELTA=0 THEN SLOPE=1E37:int
cp=1E37:DELTAM=0:DELTAC=0:ENDPROC
  800 SLOPE=(N%*SUMXY-SUMX*SUMY)/DEL
TA
  810 intcp=(SUMXSQ*SUMY-SUMX*SUMXY)
/DELTA
  820 SD=SQR(ABS((SUMYSQ+SLOPE^2*SUM
XSQ+N%*intcp^2+2*(-SLOPE*SUMXY-intcp
*SUMY+SLOPE*intcp*SUMX))/(N%-2)))
  830 DELTAM=SD*SQR(N%/DELTA)
  840 DELTAC=SD*SQR(SUMXSQ/DELTA)
  850 ENDPROC
  860 DEF PROCres
  870 PRINT'
  880 @%=&0001080A
  890 PRINT "GRADIENT =",SLOPE;
  900 @%=&0001030A
  910 PRINTTAB(25);"+/-";DELTAM
  920 PRINT
  930 @%=&0001080A
  940 PRINT "INTERCEPT=",intcp;
  950 @%=&0001030A
  960 PRINT;TAB(25);"+/-";DELTAC''
  970 @%=10
  980 ENDPROC
  990 DEF PROCdataprint CLS
 1000 @%=&1080C
 1010 VDU2
 1020 PRINT"POINT                  X V
ALUE           Y VALUE"
 1030 PRINT"__________________________
________________________"
 1040 FOR L%=1 TO N%
 1050    PRINTTAB(2);STR$L%;TAB(17);
 1060    IF X(L%)<0 PRINTX(L%);TAB(33
); ELSE PRINT" ";X(L%);TAB(33);
 1070    IF Y(L%)<0 PRINTY(L%)ELSE PR
INT" ";Y(L%)
 1080    NEXT
 1090 @%=10
 1100 VDU 13,13,13,3
 1110 ENDPROC
 1120 DEF PROCdatalist CLS
 1130 VDU14
 1140 @%=&1060A
 1150 PRINT"POINT       X VALUE
Y VALUE"
 1160 PRINT"__________________________
___________"
 1170 FOR L%=1 TO N%
 1180    PRINTTAB(2);STR$L%;TAB(10);X
(L%);TAB(23);Y(L%)
 1190    NEXT
 1200 @%=10
 1210 VDU15
 1220 A$=GET$
 1230 ENDPROC
 1240 DEF PROCres_y
 1250 PRINT''"LEAST SQUARES FIT TO T
HE Y-VALUES":PRINT"  (y=m*x+c) GIVES
:"
 1260 PROCres
 1270 VDU3
 1280 PRINT"RESULTS TO PRINTER ?";
 1290 IF GET$="Y" VDU2:PROCres_y
 1300 ENDPROC
 1310 DEF PROCres_x
 1320 PRINT''"LEAST SQUARES FIT TO T
HE X-VALUES":PRINT"  (x=m*y+c) GIVES
:"
 1330 PROCres
 1340 VDU3
 1350 PRINT"RESULTS TO PRINTER ?";
 1360 IF GET$="Y" VDU2:PROCres_x
 1370 ENDPROC
 1380 DEFPROCplot
 1390 LOCAL xscale,yscale,Q$,numbers
 1400 xscale=1200/(xmax-xmin)
 1410 yscale=880/(ymax-ymin)
 1420 MOVE0,36:DRAW1276,36:DRAW1276,
1020:DRAW0,1020:DRAW0,36:REM DRAW FR
AME
 1430 VDU 28,0,31,39,31,24,0;43;1279
;1023;29,-xmin*xscale+20;-ymin*yscal
e+76;:REM SET TEXT & GRAPHICS WINDOW
S & POSITION OF ORIGIN
 1440 MOVE0,ymin*yscale:DRAW0,ymax*y
scale:MOVExmin*xscale,0:DRAWxmax*xsc
ale,0:REM DRAW AXES
 1450 PROCplot_data
 1460 Q$="DO YOU WANT "
 1470 PRINT'Q$;"THE Y-FIT LINE PLOTT
ED ?";
 1480 IF GET$="Y" PROClinfit(SUMX,SU
MY,SUMXSQ,SUMYSQ,SUMXY,N%-bad_data):
GCOL4,1:MOVE xmin*xscale,(SLOPE*xmin
+intcp)*yscale:DRAW xmax*xscale,(SLO
PE*xmax+intcp)*yscale:GCOL0,1:REM DR
AWS Y-FIT LINE
 1490 PRINT'Q$;"THE X-FIT LINE PLOTT
ED ?";
 1500 IF GET$="Y" PROClinfit(SUMY,SU
MX,SUMYSQ,SUMXSQ,SUMXY,N%-bad_data):
GCOL4,1:MOVE (SLOPE*ymin+intcp)*xsca
le,ymin*yscale:DRAW (SLOPE*ymax+intc
p)*xscale,ymax*yscale:GCOL0,1:REM DR
AWS x-FIT LINE
 1510 PRINT'Q$;"THE POINTS NUMBERED
?";
 1520 IF GET$="Y" THEN numbers=TRUE:
PROCplot_data
 1530 FRINT'Q$;"A PRINTING OF THE AB
OVE ?";
 1540 IF GET$="Y" PRINT:PROCcopy
 1550 ENDPROC
 1560 DEF PROCplot_data VDU5
 1570 FOR I%=1 TO N%
 1580    IF X(I%)=9999 GOTO1600
 1590    IF numbers MOVE X(I%)*xscale
-8,Y(I%)*yscale-8:PRINT STR$I% ELSE
PLOT 69,X(I%)*xscale,Y(I%)*yscale
 1600    NEXT:VDU4:ENDPROC
 1610 DEF PROCcopy LOCAL YMAX%,YMIN%
,X%,DY%,B%
 1620 YMAX%=992:YMIN%=0
 1630 VDU 26,2,1,27,1,84,1,&31,1,&36
 1640 FOR Y%=YMAX% TO YMIN% STEP -32
 1650    B%=0
 1660    VDU 1,27,1,83,1,&30,1,&33,1,
&32,1,&30
 1670    FOR X%=0 TO 1276 STEP 4
 1680       FOR DY%=0 TO 28 STEP 4
 1690          B%=B%+B%+POINT(X%,Y%+DY%
)
 1700          NEXT
 1710       VDU 1,B%
 1720       NEXT
 1730    VDU1,13,1,27,1,&72,1,13,1,27
,1,&66,1,13
 1740    NEXT
 1750 VDU1,27,1,&41,3
 1760 ENDPROC
```

Lightcycle

In the February issue there was a program from Mark Callaway called Tangle. A similar though markedly more sophisticated version has been written by Adrian Roe of Ilkley, which he has based on the game played by Flynn in the film *Tron*.

Players riding lightcycles attempt to force opponents to crash into jet trails produced by the cycles, or into the playing area boundary. The implementation can be played by one or two players. But the tactical play shown by the program in the one player game is not really up to what one might expect from a thoroughly vicious Master Control Program.

Still, playing the two-player game is quite capable of bringing out the worst in people's characters. The graphics and sounds combine to create a very effective and fast-moving game.

Lightcycle.

```
   10 REM*********************
   20 REM*****LIGHT CYCLE*****
   30 REM*****VERSION 0.5*****
   40 REM******BY A. ROE******
   50 REM******C. FEB'83******
   60 REM*********************
   70 REM*CREATIVE CONSULTANT*
   80 REM****S. WESTERMAN*****
   90 REM*********************
  100 MODE1
  110 VDU23;8202;0;0;0;
  120 PROCTITLE
  130 PROCRULES
  140 PROCQUES
  150 REPEAT
  160   PROCINIT
  170   PROCSTART
  180   REPEAT
  190     PROCMAIN
  200     UNTIL HALT%=1
  210   *FX15,1
  220   UNTIL TURN1%=0 OR TURN2%=0
  230 CLS
  240 IFPLAYNO%=2THEN260
  250 PRINTTAB(1,13);:IFTURN1%=0THEN
PRINT"THE M.C.P. HAS DE-REZED ANOTHE
R USER !":GOTO280 ELSE PRINT"I WILL
APPROPRIATE YOU NEXT TIME !!":GOTO28
0
  260 PRINTTAB(6,13)"CONGRATULATIONS
 ";
  270 IFTURN1%=0THENPRINT;"USER TWO"
 ELSE PRINT;"USER ONE"
  280 PRINTTAB(10,16)"ANOTHER GAME ?
":AN$=GET$
  290 IFAN$="Y"THEN140ELSEMODE1:END
  300 DEFPROCMAIN
  310 IFPLAYNO%=1THEN440
  320 FORFLAG%=1TO2
  330   A%=0
  340   REPEAT
  350     A%=A%+1
  360     PROCKEYPRESSEDYN(KEYNO%(A%
,FLAG%))
  370     UNTIL A%=4
  380   IFPRESSTF%=TRUE AND FLAG%=1
THEN DIR1%=DIR%:PROCMOVE(LS1X%,LS1Y%
,DIR1%):PROCSOUND1
  390   IFPRESSTF%=TRUE AND FLAG%=2
THEN DIR2%=DIR%:PROCMOVE(LS2X%,LS2Y%
,DIR2%):PROCSOUND2
  400   NEXT FLAG%
  410 STR%=STR%+1:IFSTR%<5THEN430
  420 IFDIR1%=0 OR DIR2%=0 PROCCRASH
:HALT%=1 ELSE DIR1%=0:DIR2%=0:STR%=0
  430 ENDPROC
  440 FLAG%=2
  450 IFDIR2%<3 PROCUDCOM(LS2X%,LS2Y
%,S%) ELSE PROCLRCOM(LS2X%,LS2Y%,S%)
  460 IFCHANGE%=1 PROCNSEW:CHANGE%=0
:TIME=0:GOTO450 ELSE IFTIME>500 DIR2
%=DIR%
  470 PROCSOUND2
  480 FLAG%=1:A%=0
  490 REPEAT
  500   A%=A%+1
  510   PROCKEYPRESSEDYN(KEYNO%(A%,F
LAG%+2))
  520   UNTIL A%=4
  530 IFPRESSTF%=TRUE DIR1%=DIR%:PRO
CMOVE(LS1X%,LS1Y%,DIR1%):PROCSOUND1
  540 STR%=STR%+1:IFSTR%<5THENT%=0:G
OTO560
  550 IFDIR1%=0 PROCCRASH:HALT%=1 EL
SE DIR1%=0:STR%=0:T%=0
  560 ENDPROC
```

```
570 DEFPROCKEYPRESSEDYN(K%)
580 IFINKEY(K%) DIR%=A%:A%=4:PRESSTF%=TRUE:ENDPROC
590 PRESSTF%=FALSE
600 ENDPROC
610 DEFPROCMOVE(X%,Y%,D%)
620 GCOL0,FLAG%:MOVEX%,Y%
630 ON D% GOTO 640,650,660,670
640 Y%=Y%+S%:IFY%>988THEN690ELSE680
650 Y%=Y%-S%:IFY%<96THEN690ELSE680
660 X%=X%-S%:IFX%<94THEN690ELSE680
670 X%=X%+S%:IFX%>1180THEN690
680 PROCXY:PROCPOINT:DRAWX%,Y%:ENDPROC
690 DIR1%=1:DIR2%=1:PROCCRASH:HALT%=1:ENDPROC
700 DEFPROCXY
710 IFFLAG%=1 LS1X%=X%:LS1Y%=Y% ELSE LS2X%=X%:LS2Y%=Y%
720 ENDPROC
730 DEFPROCPOINT
740 IFPOINT(X%,Y%)=1 OR POINT(X%,Y%)=2 DIR1%=1:DIR2%=1:PROCCRASH:HALT%=1
750 ENDPROC
760 DEFPROCUDCOM(X%,Y%,Z%)
770 PROCT:GCOL0,2
780 IFDIR2%=1THENZ%=S%:BUD%=988 ELSE Z%=-S%:BUD%=96
790 MOVEX%,Y%:J%=Y%+Z%
800 PROCCOMPOINT(X%,J%,J%,BUD%):IF CHANGE%=1 ENDPROC
810 Y%=Y%+Z%:DRAWX%,Y%:PROCXY
820 ENDPROC
830 DEFPROCLRCOM(X%,Y%,Z%)
840 PROCT:GCOL0,2
850 IFDIR2%=4THENZ%=S%:BLR%=1180 ELSE Z%=-S%:BLR%=94
860 MOVEX%,Y%:J%=X%+Z%
870 PROCCOMPOINT(J%,Y%,J%,BLR%):IF CHANGE%=1 ENDPROC
880 X%=X%+Z%:DRAWX%,Y%:PROCXY
890 ENDPROC
900 DEFPROCCOMPOINT(P1%,P2%,P3%,P4%)
910 IFPOINT(P1%,P2%)=1ORPOINT(P1%,P2%)=2THEN930
920 IF(P4%>100 AND P3%<P4%)OR(P4%<100 AND P3%>P4%)THENCHANGE%=0:ENDPROC
930 CHANGE%=1
940 ENDPROC
950 DEFPROCNSEW
960 IFDIR2%>2THENDIR2%=RND(2) ELSE DIR2%=RND(2)+2
970 ENDPROC
980 DEFPROCT
990 T%=T%+1:IFT%=10 DIR1%=1:DIR2%=1:FLAG%=2:PROCCRASH:DIR1%=1:HALT%=1
1000 ENDPROC
1010 DEFPROCSTART
1020 CLS:VDU19,1,7,0,0,0,19,2,0,0,0,0:GCOL0,3
1030 PROCGRID(1200):PROCGRID(990)
1040 COLOUR1:FORI%=1TOTURN1%:PRINTTAB(I%*2,30);BIKE$:NEXT
1050 PRINTTAB(9,30);:IFPLAYNO%=1 PRINT"  USER" ELSE PRINT"USER 1"
1060 COLOUR2:FORI%=1TOTURN2%:PRINTTAB(38-I%*2,30);BIKE$:NEXT
1070 PRINTTAB(25,30);:IFPLAYNO%=1 PRINT"M.C.P." ELSE PRINT"USER 2"
1080 GCOL0,1:PLOT69,LS1X%,LS1Y%:GCOL0,2:PLOT69,LS2X%,LS2Y%
1090 PROCDELAY(50)
1100 COLOUR3
1110 FORI%=11TO9STEP-1:PRINTTAB(19,30);:IFI%=9 PRINT"01" ELSE PRINT;I%
1120     SOUND3,3,20,20:PROCDELAY(100):NEXT
1130 PRINTTAB(17,30)" GO!!":SOUND3,3,60,20
1140 A$=INKEY$(100)
1150 TIME=500:DIR2%=RND(4)
1160 ENDPROC
1170 DEFPROCGRID(A)
1180 PROCDELAY(10)
1190 FORI=90 TO A STEP100
1200     SOUND0,-10,0,1
1210     IFA=1200 MOVEI,90:DRAWI,990 ELSE MOVE90,I:DRAW1190,I
1220     PROCDELAY(10):NEXT
1230 ENDPROC
1240 DEFPROCDELAY(DELAY%)
1250 TIME=0:REPEAT UNTIL TIME>DELAY%
1260 ENDPROC
1270 DEFPROCSOUND1
1280 IFHALT%=1THENENDPROC
1290 IFA1%<>DIR1% THEN PITCH1%=0
1300 PITCH1%=PITCH1%+1
1310 SOUND&0011,-15,PITCH1%,255
1320 A1%=DIR1%
1330 ENDPROC
1340 DEFPROCSOUND2
1350 IFHALT%=1THENENDPROC
1360 IFA2%<>DIR2% THEN PITCH2%=0
1370 PITCH2%=PITCH2%+1
1380 SOUND&0012,-15,PITCH2%,255
1390 A2%=DIR2%
1400 ENDPROC
1410 DEFPROCCRASH
1420 PRINTTAB(17,30)"DE-REZ"
1430 SOUND&0011,0,0,0:SOUND&0012,0,0,0
1440 SOUND0,1,4,4:SOUND1,2,200,50:SOUND2,2,100,50:SOUND3,2,75,50
1450 IFDIR1%=0ORFLAG%=1 FLAG%=1:TURN1%=TURN1%-1:PROCSTOP(LS1X%,LS1Y%):ENDPROC
1460 FLAG%=2:TURN2%=TURN2%-1:PROCSTOP(LS2X%,LS2Y%):ENDPROC
1470 DEFPROCSTOP(X%,Y%)
1480 VDU19,FLAG%,8,0,0,0:GCOL0,FLAG%
1490 PROCEXP(X%,Y%)
1500 *FX9,5
1510 *FX10,5
1520 PROCDELAY(400)
1530 CLG
1540 ENDPROC
1550 DEFPROCEXP(X%,Y%)
1560 POOFC%=FLAG%
1570 FORJ%=32TO16STEP-16
1580   GCOL0,POOFC%
1590   FORI%=J% TO -J% STEP(-J%*2)
1600       MOVEX%,Y%+I%:MOVEX%-I%,Y%-I%:PLOT85,X%+I%,Y%-I%
1610       NEXTI%:POOFC%=3:NEXTJ%
1620 ENDPROC
1630 DEFPROCTITLE
1640 ENVELOPE1,2,0,0,0,0,0,0,127,-1,-1,-1,126,30
1650 ENVELOPE2,1,-10,-10,-10,5,5,5,126,0,-1,-1,126,30
1660 ENVELOPE3,1,1,1,1,5,5,5,127,-1,-1,-1,126,90
1670 VDU23,230,0,0,120,124,126,124,120,0,23,231,0,0,31,63,127,63,31,0
1680 VDU23,240,7,15,31,63,71,59,60,56,23,241,248,252,194,189,127,255,126,60
1690 BIKE$=CHR$240+CHR$241
1700 DIMP%(5),N%(9),KEYNO%(4,3)
1710 RESTORE1760
1720 *FX9,5
1730 *FX10,5
1740 VDU19,3,0,0,0,0:VDU19,1,0,0,0,0
1750 FORI=1TO8:READN%(I):NEXT
1760 DATA1,2,3,2,1,4,3,4
1770 FORT%=1TO3:FORI%=1TO4:READKEYNO%(I%,T%):NEXT,
1780     DATA-66,-98,-67,-83,-74,-90,-104,-105,-66,-98,-90,-106
1790     READP%(1):IFP%(1)=0THEN1890
1800     FORI%=2TO4:READP%(I%):NEXT
1810     FORI%=1TO3STEP2:MOVEP%(N%(I%)),P%(N%(I%+1)):NEXT
1820     FORI%=5TO7STEP2:GCOL0,I%-4:PLOT85,P%(N%(I%)),P%(N%(I%+1)):NEXT
1830     GOTO1790
1840     DATA100,900,160,600,160,600,280,660,300,840,480,900,360,660,420,840,300,600,480,660,500,840,680,900
1850     DATA500,840,560,660,500,600,660,660,600,660,660,700,580,700,680,740,700,600,760,900,760,740,820,800,820,600,880,900,900,840,1100,900
1860     DATA960,600,1020,840,100,340,280,400,100,160,160,340,100,100,280,160,300,260,360,400,360,100,420,300,420
1870     DATA260,480,400,500,340,680,400,500,160,560,340,500,100,680,160,700,100,760,400,760,100,880,160
1880     DATA900,100,960,400,960,340,1080,400,960,220,1080,280,960,100,1080,160,0,0
1890     VDU5:FORI%=1TO30:SOUND1,-15,I%,1:SOUND2,-15,I%,1:SOUND3,-15,I%,1
1900     GCOL0,2:SHIFT%=SHIFT%+16:MOVE100+SHIFT%,512:PRINT;CHR$230:MOVE1060-SHIFT%,512:PRINT;CHR$231:NEXT:VDU4
1910     *FX15,0
1920     SOUND0,1,4,10:SOUND1,2,200,80:SOUND2,2,100,80:SOUND3,2,75,80
1930     FLAG%=1:PROCEXP(600,496)
1940     FORI=9TO13:VDU19,3,I,0,0,0:VDU19,1,I+1,0,0,0:PROCDELAY(100):NEXT
1950     VDU19,3,7,0,0,0
1960     CLG
1970     ENDPROC
1980     DEFPROCINIT
1990     LS1X%=608:LS1Y%=512:LS2X%=640:LS2Y%=512:A1%=0:A2%=0:DIR1%=1:DIR2%=1:DIR%=1:STR%=1:T%=0:HALT%=0:CHANGE%=0
2000     ENDPROC
2010     DEFPROCQUES
2020     VDU19,0,4,0,0,0,19,3,6,0,0,0,19,2,0,0,0,0,19,1,7,0,0,0
2030     COLOUR3
2040     PRINTTAB(10,16)"1 OR 2 USERS ?":PLAYNO$=GET$:PLAYNO%=VAL(PLAYNO$):IFPLAYNO%<1ORPLAYNO%>2THEN2040
2050     PROCKEYS:COLOUR3
2060     PRINTTAB(8,16)"SPEED LEVEL (1TO4) ?":S$=GET$:S%=VAL(S$):IFS%<1ORS%>4THEN2060 ELSE S%=2^(S%+1)
2070     TURN1%=3:TURN2%=3
2080     ENDPROC
2090     DEFPROCKEYS
2100     CLS
2110     IFPLAYNO%=2THEN2150
2120     COLOUR1:PRINTTAB(13,2)"USER CONTROLS";TAB(13,3)"_____________";TAB(13,6)"'A' = UP"
2130     PRINTTAB(13,8)"'Z' = DOWN";TAB(13,10)"'DELETE' = LEFT";TAB(13,12)"'COPY' = RIGHT"
2140     ENDPROC
2150     COLOUR1:PRINTTAB(13,2)"USER ONE";TAB(13,3)"________";TAB(13,6)"'A' = UP"
2160     PRINTTAB(13,8)"'Z' = DOWN";TAB(13,10)"'X' = LEFT";TAB(13,12)"'C' = RIGHT"
2170     COLOUR2:PRINTTAB(13,20)"USER TWO";TAB(13,21)"________";TAB(13,24)"'RETURN' = UP"
2180     PRINTTAB(13,26)"'DELETE' = DOWN";TAB(13,28)"'.' = LEFT";TAB(13,30)"'/' = RIGHT"
2190     ENDPROC
2200     DEFPROCRULES
2210     VDU19,0,4,0,0,0:VDU19,1,0,0,0,0
2220     CLS:PRINTTAB(10,1)"LIGHT CYCLE"
2230     PRINT'" This program is based on a game"'"played by Flynn in the film 'TRON'."''" Each player rides his own LIGHT CYCLE"
2240     PRINT'"which emits a jet trail from it's"'"exhaust. At the start of the game the"'"two users ( USER  1 = white,"
2250     COLOUR1:PRINT'" USER  2 = black ),";:COLOUR3:PRINT" are in the centre"'"of the playing grid. When the pitch"'"of the count down tone is raised,"'"users must start moving within 2"'"seconds, or be DE-REZED !"
2260     PRINTTAB(4,28)"PRESS SPACE TO CONTINUE":ANY$=GET$:CLS
2270     PRINT''" The object of the game is for you"'"to force your opponent to :"'"  1 : Crash into your tail"'"  2 : Crash into his own tail"'"  3 : Crash into the grid boundry"
2280     PRINT'" Each user is given three lives."
2290     PRINTTAB(5,20)"GOOD CYCLING...."
2300     PRINTTAB(4,28)"PRESS SPACE TO CONTINUE":ANY$=GET$:CLS
2310     ENDPROC
```

● Circle No. 192

● Circle No. 193

ACORN ATOM

Function keys

UNLIKE its successor the BBC Micro, the Acorn Atom is not fitted with definable function keys, writes Chris Cytera of Bristol. However, with the aid of a short program, it is a simple matter to reprogram existing keys to execute Basic statements.

The program is written in machine code and allows the definition of eight keys when used in conjunction with Ctrl D, E, P, Q, R, S, T, U. These keys have been chosen because they are control codes unused by the Atom, but there is no reason why any of the keys corresponding to an ASCII value should not be redefined.

Type in the assembler listing in the usual way. Enter Run and a printout of the hexadecimal addresses where the strings defining the keys are stored should result. To define a key, simply enter a Basic string at the appropriate address; for example:

$#8C00 = "LIST"

This will produce a program listing whenever Ctrl-D is pressed. A second example is:

$#8C40 = "PRINT" "HELLO" ";END"

The End is necessary in this case, or else an error message results.

A total of 64 characters are allowed for each string, so a general formula to calculate the address of the string corresponding to key number F is:

A = S + F * 64

where S is the address of the first string, #8C00. The key numbers are assigned at line 930 onwards. For example,

!K = #11100504

assigns ASCII codes 4, 5, 16 and 17 as key numbers 0, 1, 2 and 3.

Save the program by

*SAVE "FUNCTION KEYS" 28B5 2900

The functions themselves can be saved too, if desired. The source code need only be saved if you wish to modify the program at a later date. Use *Run to reload and execute the code. Floating-point arrays from %SS to %ZZ will corrupt the code.

The initialisation routine installs the address corresponding to LL1 in #20A and #20B, so that OSRDCH is redirected to LL1. The address previously present is saved in #21C and #21D, so that the program does not interfere with other utilities which redirect OSRDCH.

Routine LL1 calls the normal OSRDCH routine, and then checks the ASCII code obtained to see if a function key has been pressed. If not, an exit occurs. Otherwise, the address of the string to be executed is calculated and placed in locations 5 and 6.

In order to multiply by 64, the number of characters per string, I have carried out two 16-bit shifts to the right. They are followed by a transposition of the two bytes. The alternative would be six 16-bit shifts left. Finally, the program jumps to #C2F2 in the Basic ROM, which interprets and executes the line whose address is held in locations 5 and 6.

Atom function keys

```
  10 N=8
  20 DIM LL4
  30 F.Z=0 TO 4;LLZ=-1;N.
  40 S=#8C00
  90 P.$21
 100 F.Q=1 TO 2
 110 P=#28B5
 120[
 130:LL0 \ INIT.
 140 LDA #20A
 150 STA #21C
 160 LDA #20B
 170 STA #21D
 180 LDA @LL1&#FF
 190 STA #20A
 200 LDA @(LL1/256)&#FF
 210 STA #20B
 220 RTS
 230:LL1 \ GET KEY
 240 JSR LL4
 250 PHP
 260 LDX @N-1
 270:LL2 CMP K,X
 280 BEQ LL3
 290 DEX
 300 BPL LL2
 310 LDX #E4
 320 PLP
 330 RTS
 340:LL3 \ FUNCTION
 350 LDA @0
 360 STX #90
 370\ MULT BY 64
 380 LSR #90; ROR A
 390 LSR #90; ROR A
 430 ADC @S&#FF
 450 STA 5
 460 LDA @(S/256)&#FF
 470 ADC #90
 480 STA 6
 490 JMP #C2F2
 600:LL4 JMP (#21C)
 900]
 910 K=P
 920 N.Q
 930 !K=#11100504
 940 K!4=#16141312
1000 P.$6
1010 F.X=0 TO N-1
1020 P."F("$K?X+#40")
     ="&S+X*64'
1030 N.X
1040 LI.#28B5
1050 E.
```

JUPITER ACE

Game demo

THE LISTING by S D Collier of Llangollen, Clwyd is for a simple game in which the player has nine chances to guess where the computer is "hiding". The computer responds with clues to guide the player to one of 100 rooms.

The program will run easily within the Ace's 3K of memory and is fully documented to help newcomers understand Forth.

Ace game.

```
Words used:          GAME INST CHOOSE AGAIN EQ TL TH INPUT RND SEEDON
Variables used:      SEED RPOS

0 VARIABLE SEED

0 VARIABLE RPOS

: SEEDON  ( Part of Random No. Generator.)  SEED @ 75 U* 75 0 D+
  OVER OVER U( - - 1- DUP SEED ! ;

: RND ( Random Generator.)  SEEDON U* SWAP DROP ;

: INPUT ( As basic.) QUERY LINE ;

: TH ( Guess too high?) DUP RPOS @ ) IF ." Too high !" CR THEN ;

: TL ( Guess too Low?)  DUP RPOS @ ( IF ." Too low !!" CR THEN ;

: EQ ( Guess correct?)  DUP RPOS @ = IF ."Correct!!" CR AGAIN THEN ;

: AGAIN CR CR ." To play again type GAME" DROP CR QUIT ;

: CHOOSE ( Select RND No. for variable RPOS ) 100 RND 1+ RPOS ! ;

: INST (Instructions) CLS ." I will hide in a building of 100"

  CR ." floors. I will give you 9 goes to "

  CR ." Guess where I am." CR CR ;

: GAME ( Put it all together !) INVIS INST CHOOSE 0 10 1 DO
  DROP ." Guess " I . INPUT DUP . TH TL EQ LOOP
  ." It was room " . CR AGAIN ;

To play just type GAME.
```

For the best hardware, the best software.

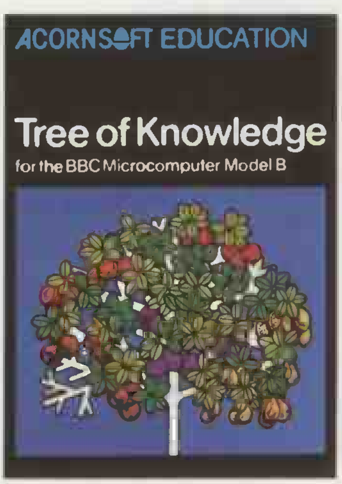
The BBC Microcomputer system is generally regarded to be the best micro in its price range you can lay your hands on. So, if you're thinking of buying one or already own one, you'll want to know about the software that's been specially designed for it.

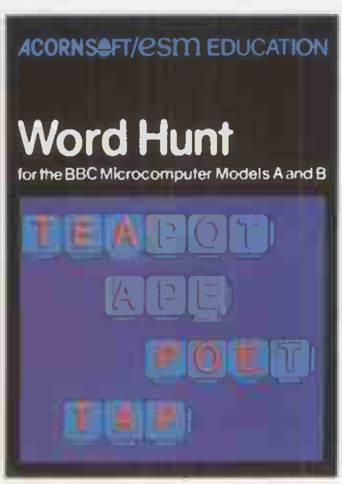
Not surprisingly, it's made by Acornsoft, the software division of Acorn Computers Ltd., who designed and built the BBC Microcomputer. So naturally you can expect the highest quality software with the built-in ingenuity to fully exploit the BBC Micro's potential.

<u>Further education for everyone.</u>

Tree of Knowledge (£9.95) is an interactive program for children of all ages teaching categorisation. It illustrates some of the more practical aspects of computing in that the pupil first educates the computer, building up a database by answering the computer's questions, and the database is then used to play games of deduction and logic.

Word Hunt (£11.90) is a set of four programs, each containing a list of nine words. The object of the exercise is to select one word and then try to create as many smaller words as possible from the selected word.





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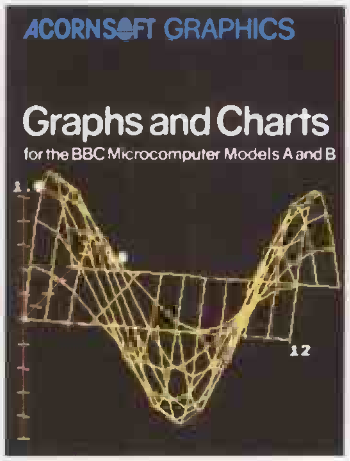
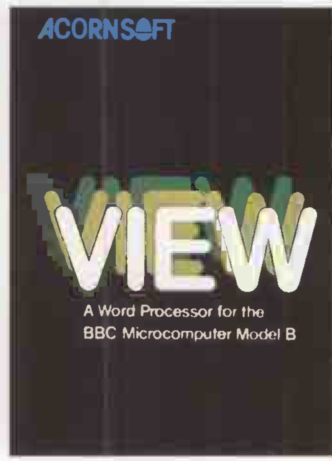
Graphs and Charts (price £17.45) which includes the book 'Graphs and Charts on the BBC Microcomputer' contains a set of programs





to present data graphically in a wide range of applications. The graphs include automatic scaling, labelling of axes and use of colours.

And VIEW (price £59.80) a program that enables your machine, together with a printer, to operate as a fully operational word processor. For convenience the program is in ROM so that it can become a permanent feature of your machine. (It can easily be fitted by your local dealer). You'll find out more by going to your dealer or by sending for the free catalogue.

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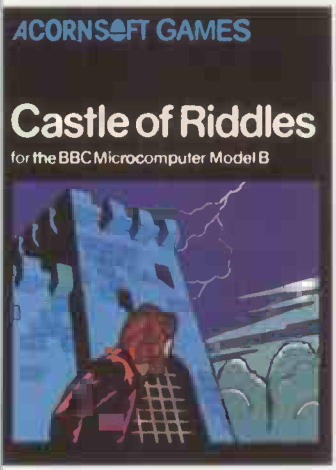

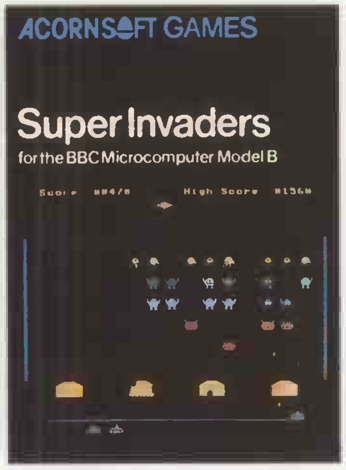

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If you're a credit card holder and would like to buy cassettes of the programs shown in this advertisement, or if you would like to know the address of your nearest stockist, just phone 01-200 0200.

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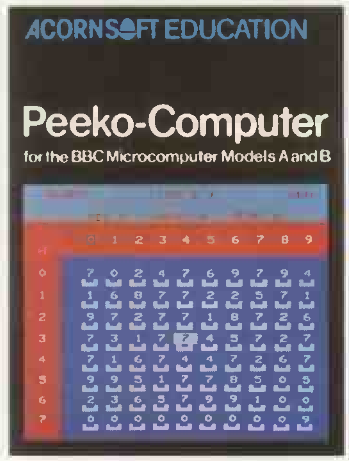

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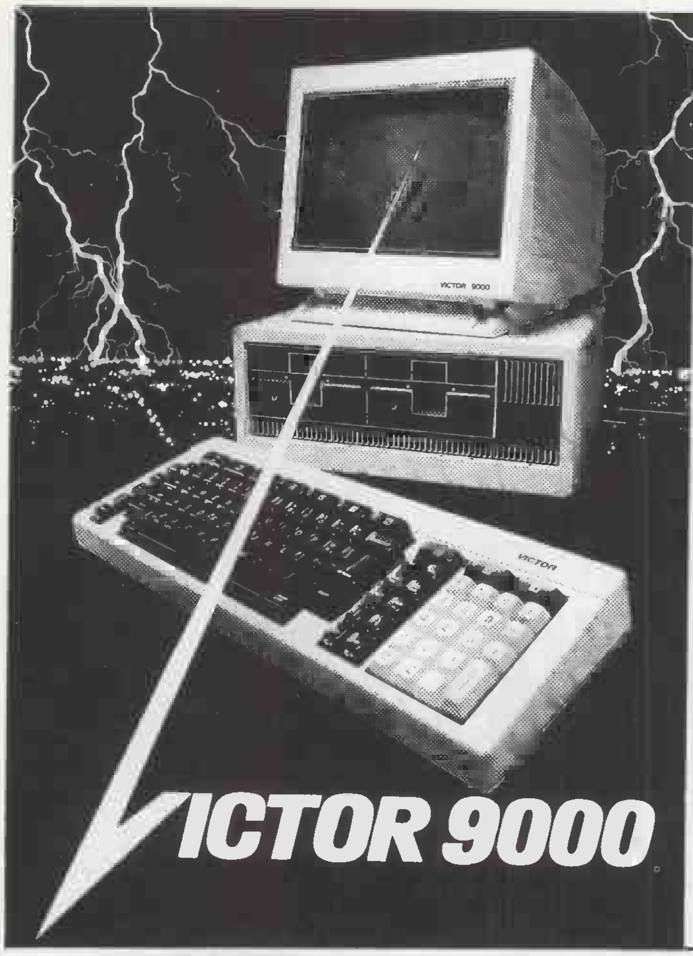

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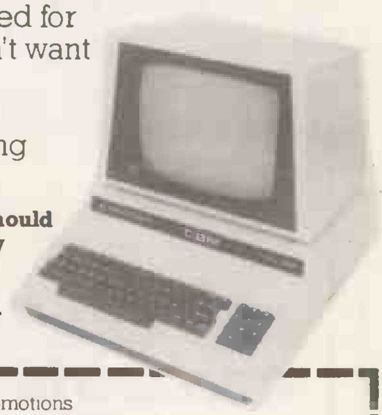

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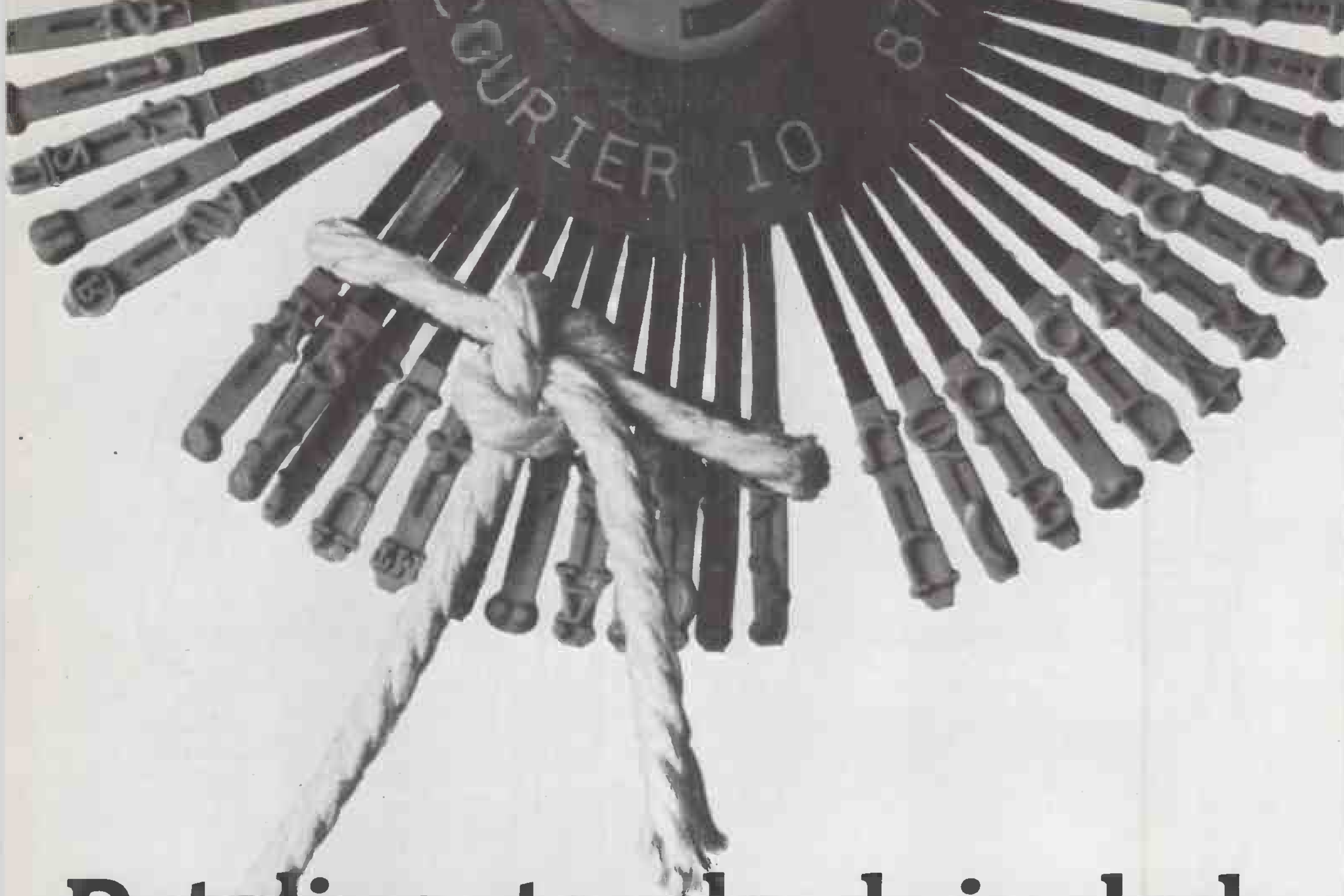

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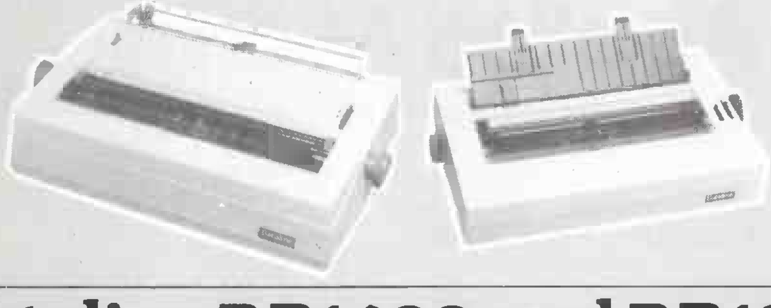

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Explaining ATARI

Jack Schofield makes his choice from the literature on the popular American micros.

WHEN THE ATARI microcomputers came out way back in 1979, the documentation was above the average level for the time. Mind you, the average was appalling. Since then, while newer micros have not surpassed the Atari technically, documentation has improved greatly, and the *Atari Manual* and *Atari Basic* self-teaching course now look very inferior. Independent books have thus arrived to fill the gap.

Atari Basic is supplied with the 800 and 400 programmer's kit. It seems to be the rewrite of similar books for other micros such as the TRS-80, which are far less complicated. The coverage of Atari sound and graphics and I/O is perfunctory, and you can examine the index in vain for words like Peek and Poke, for joystick and paddle commands, and for any mention of disc operations.

Atari has always aimed to appeal to the uninitiated, and even the manual does not mention player-missle graphics, so it is no surprise that the authors of *Atari Basic* seem to be completely ignorant of it. However, the result is, for a 340-page book, pretty feeble and well worth throwing away.

Fortunately there is now a book which every Atari owner should buy as a replacement, *Your Atari Computer.* It dates from 1982 not 1979, is better printed on better paper, and includes far more useful tables and illustrations. It starts with pictures and simple setting up, before moving on to Basic programming. It includes cassette and disc tutorials, joystick controls and all the rest.

The chapter on advanced graphics even includes display lists and animated character graphics. The final chapter of nearly 70 pages contains an excellent compendium of Basic statements and functions. Finally there are nine appendices of useful information including conversions, trig functions, useful Poke locations, etc. There is a thorough index. With 464 pages for £10.95, *Your Atari Computer* is extremely good value and highly recommended.

The alternative is *Atari Sound and Graphics: A self-teaching guide,* which is a follow-up to *Atari Basic.* The new book makes good many of the omissions of the earlier volume — many, but by no means all. The two books together move at a slower pace than *Your Atari Computer,* but they do not start as well and they do not go as far. They leave you ignorant of joysticks, disc use, the display list, player-missile graphics among others. Though they might suit a beginner, they would be hopeless for the enthusiast.

Inside Atari Basic is a slim volume by Bill Cairns, Training Director with the Home Computer Division of Atari. It is a useful, practical book full of drawings and short demo routines. Most subjects are allowed only a couple of pages each, and are tackled in not much depth. However, it is the kind of book you can dip into anywhere and find something interesting. It is probably the best book for younger Atari owners, the eight to 14 range.

Atari Games and Recreations also seems to be written for a youngish audience as it is full of cartoons and adopts a slightly patronising tone. The strengths of the book are that it is well organised and contains many excellent little programs.

Some of the programs have been supplied by Atari people, some are taken from magazines and many more are written by the authors. All of them are well explained. The fact that they are "games and recreations" means they are on average longer than the usual demo programs, but that gives the reader a stronger incentive for keying them in.

Atari Games and Recreations is a substantial book suitable for beginners, especially teenagers, but can be enjoyed by anyone who can take the chatty American style. An American friend describes it as "very entertaining".

Another two entertaining books come from Winfried Hofacker's company in Germany. *Atari Basic — Learning by Using* came out in 1981, and was one of the first Atari books available in the U.K. This gave it a special relevance, as information was hard to come by at the time. It provides a lot of short and generally amusing demo routines you can learn from. It does not offer any type of methodical instruction. Many of its "lucky dips" have been superseded by later offerings, but the book remains an entertaining intro to some aspects of the Atari.

The second Hofacker book is *Games for the Atari* by S Roberts. It gets you on to player-missle graphics from page 2, and machine-language player movements by page 9. However, there are only 18 pages of explanation. Most of the book is filled with games listings which you can type in, and which you can learn from, but which are not explicated in an educational way. They include Backgammon, Ball, Robot Attack, Calendar, Smart and others.

The last 25 pages of appendices then cover things like the Antic microprocessor, display-list interrupts and the GTIA chip. Therefore the book is suitable for people who know Atari Basic well and have some grasp of machine language — intermediate programmers, not beginners. People who don't like typing can obtain the listings from the Hofacker books on cassettes.

Some Common Basic Programs is the Atari edition of a book also available for a few other major micros such as Pets and TRS-80s. The 76 short programs include useful financial, mathematical and statistical routines. Examples are Salvage Value and Mortgage Amortisation, Plot of Polar Equation and Simultaneous Equations, Poisson Distribution and Multiple Linear Regression. The few

(continued on next page)

Explaining ATARI

(continued from previous page)

lightweight programs include American tax calculations, recipe cost — example: Strawberry Shortcake — and Alphabetize. No games. This is certainly a useful book, but not particularly Atarified. The programs have been translated from Microsoft Basic, and the screen handling shows no imagination at all. The programming is purely functional.

The main book for more advanced Atari programmers is *De Re Atari,* written mainly by Chris Crawford of Eastern Front fame together with other Atari programmers. At £17 it is rather expensive for a book that has been serialised in *Byte* magazine. It does not even have a cover, consisting of a bag of three-hole punched loose pages. On the other hand it is cheap for the brilliance of what it contains — thorough explanations of the special Atari techniques using the Antic, CTIA/GTIA and Pokey chips. They are unique to the Atari micros, which is why you can't just adapt stuff from Apple books. It thus bridges the gap between the manual and the incredibly complicated and massive Hardware Manual and O/S Guide.

De Re Atari has 10 chapters, five appendices and a glossary. Subjects include sound and graphics techniques including scrolling, the operating system and disc-operating system, and a useful Atari Basic overview. The examples given often refer you to Atari's range of remarkable games. While it is not really intended for beginners, this book is clearly written and any beginner would learn useful things from it. It must therefore — even at the price — be recommended. For the intermediate to advanced programmer it could be considered essential.

Note that in all the books referred to so far, Basic means Atari Basic. However, there are three Basics available: Atari Basic, which uses long strings like Dec Basic and others; Basic A +, which is an extended Atari Basic; and Microsoft Basic, which uses string arrays instead. Coverage of the last two is almost non-existent, but there is a little in *Compute!*'s two books.

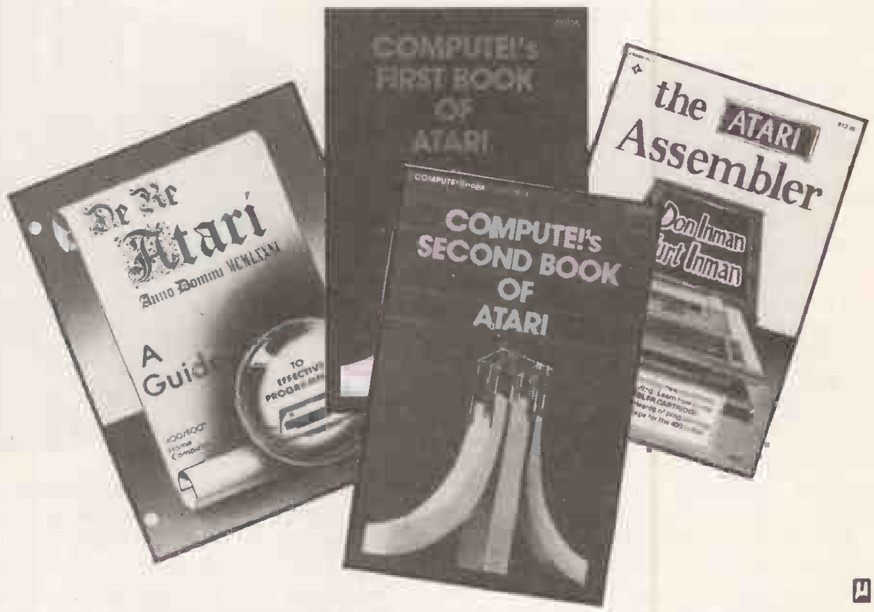
Compute!'s First Book of Atari contains many short articles selected from the American *Compute!* magazine. Some of the early chapters are misleading if not actually wrong. Again it is one of the books we were grateful for when it came out, but cannot recommend very strongly now. Most of the contents, including Chris Crawford's article on player-missle graphics, have been superseded.

Compute!'s Second Book of Atari is newer, thicker and better. It is the same style as the first book, but none of the material has been previously published in *Compute!* This does not mean all the material is wholly new, as many ideas have appeared in other places. Nonetheless it contains enough new and useful things to be worth having.

Among the useful program routines are a 49-second screen dump, a player-missile graphics editor, scrolling and page-flipping techniques, and some good stuff on machine language and DOS. Again, this is a worthwhile book for intermediate to advanced programmers, though it does contain something for everyone.

Sadly, *Compute!* doesn't seem to have collected together the excellent series written by Bill Wilkinson of Optimized Systems Software. Bill's company wrote Atari Basic and Basic A +, plus alternative operating systems and disc-operating systems. He probably knows more about the Atari than anyone outside Atari, and his articles in *Compute!* are well worth having. *Compute!* has published his book *Inside Atari DOS,* but it was not possible to obtain a copy for review.

The Atari Assembler is a book that is designed as a beginner's companion to the Assembler ROM. It is an extremely slow and steady book which takes you step by step — almost keypress by keypress — through entering and using simple machine-code routines. For anyone who wants to start assembler programming I cannot think of a better way of doing it.



Atari Basic: A self-teaching guide by Albrecht, Finkel and Brown. Published by John Wiley, 336 pages, £8.25. ISBN 0 471 06496 3.

Atari Sound and Graphics: A self-teaching guide by Moore, Lower and Albrecht. Published by John Wiley, 238 pages. £7.50. ISBN 0 471 09593 1.

Your Atari Computer by Lon Poole with Martin McNiff and Steven Cook. Published by Osborne/McGraw-Hill, 460 pages, £10.95. ISBN 0 931988 65 9.

Inside Atari Basic by Bill Carris. Published by Reston, Prentice-Hall, 184 pages, £10.35. ISBN 0 8359 3082 3.

Atari Games and Recreations by Kohl, Kahn and Lindsay. Published by Reston, Prentice-Hall, 346 pages, £11.95. ISBN 0 8359 0242 0.

Atari Basic: Learning By Using by Thomas E Rowley. Published by Hofacker, 74 pages, £4.95. ISBN 3 92 1682 86 X.

Games for the Atari by S Roberts. Published by Hofacker, 116 pages, £4.95. ISBN 3 91 1682 84 3.

Some Common Basic Programs: Atari Edition by Poole, Borchers and Cook. Published by Osborne/McGraw-Hill, 200 pages. £11.10. ISBN 0 931988 53 5.

De Re Atari: A guide to Effective Programming. Published by Atari Inc, £17. Catalogue number APX-90008.

Compute!'s First Book of Atari. Published by Compute! Books, 186 pages, $12.95. ISBN 0 942386 00 0.

Compute!'s Second Book of Atari. Published by Compute! Books, 252 pages, $12.95. ISBN 0 942386 06 X.

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>HARDWARE

Two important eight-bit CP/M micros are tested in depth. The DEC Rainbow 100 also has a 16-bit 8088 processor to offer the best of both worlds. The Cromemco C-10 single-disc micro is an office model that comes with a suite of free software and is cheaper than the Osborne.

>SOFTWARE

How useful are the programs that write programs? We offer a comparative review.
How good are 16-bit payroll packages? We tell.
Is it possible to do word processing on a Spectrum? Bill Bennett investigates.

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The June issue will contain special articles on programming and practical applications, from how to handle interrupts on the BBC to using a portable micro for archeology. Plus all the usual departments including the Open File pages of programs for popular computers, new product news and your letters.

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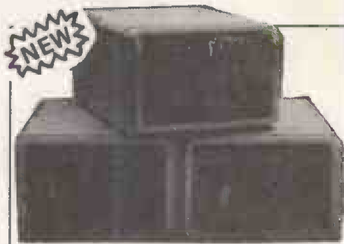

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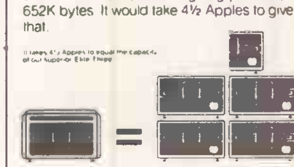

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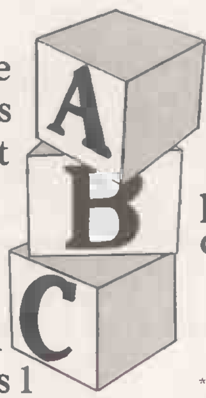

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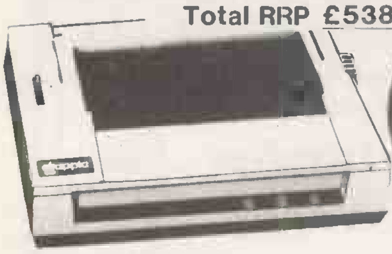

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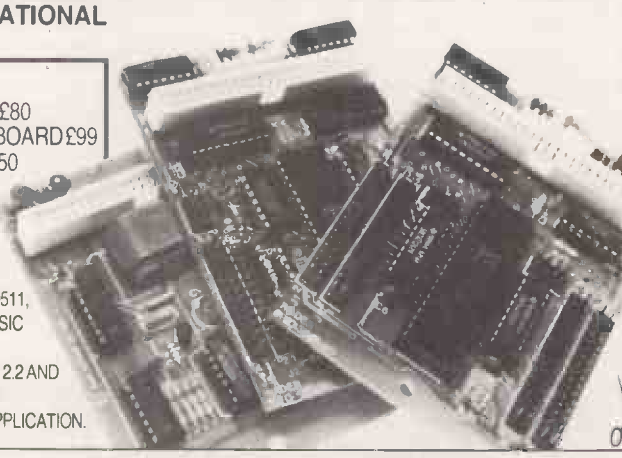

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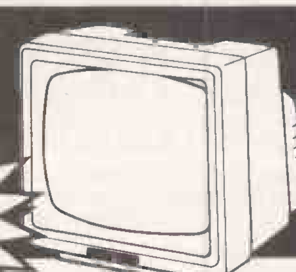

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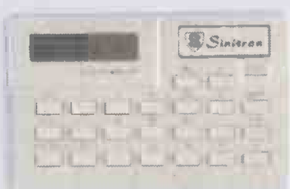

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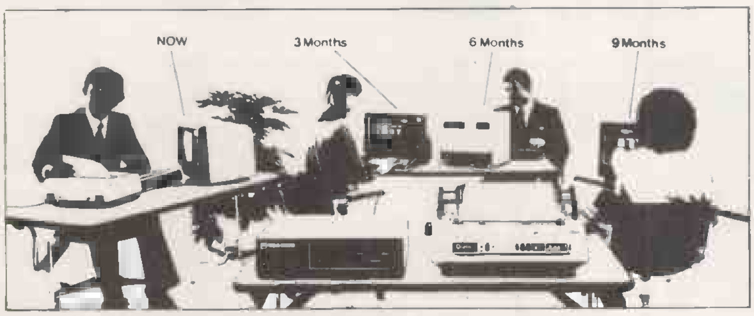

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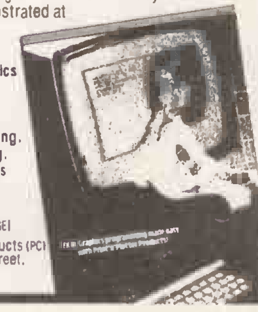

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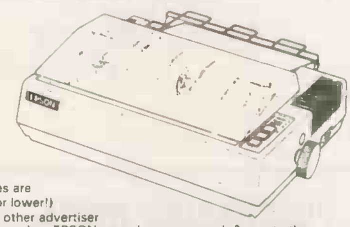

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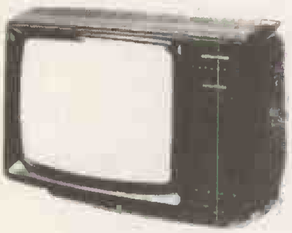

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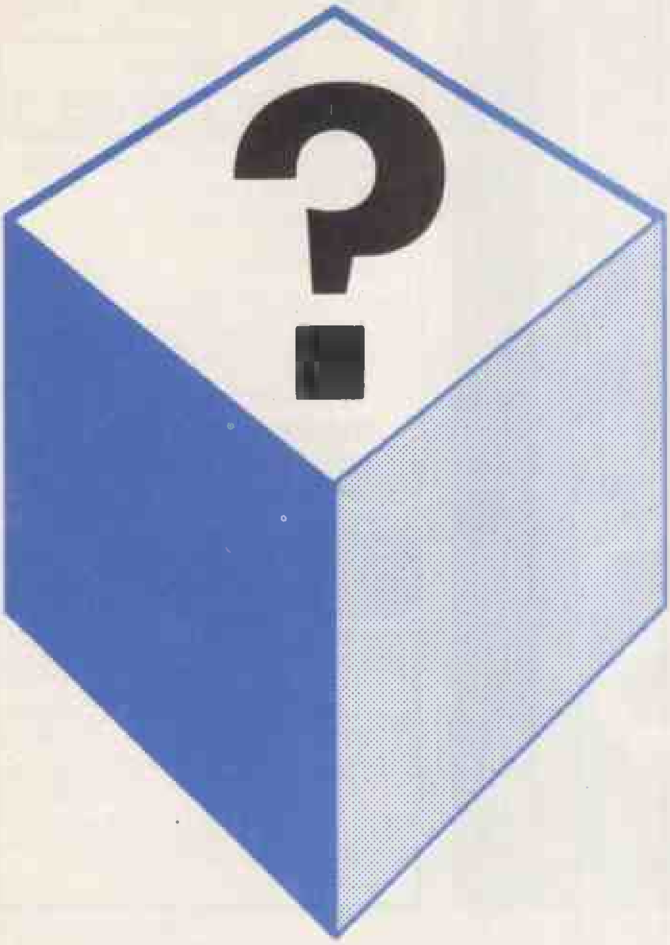

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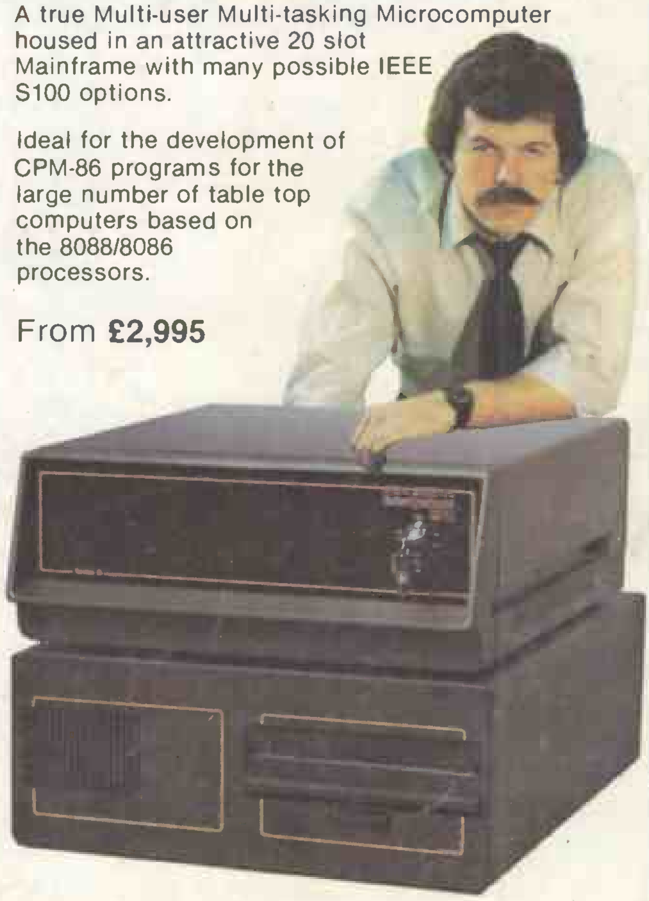

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