Practical Computing

COMPETITION
Win a DRG printer

90p November 1984
Volume 7 Issue 1

PRINTERS
Buyers guide to low-cost models

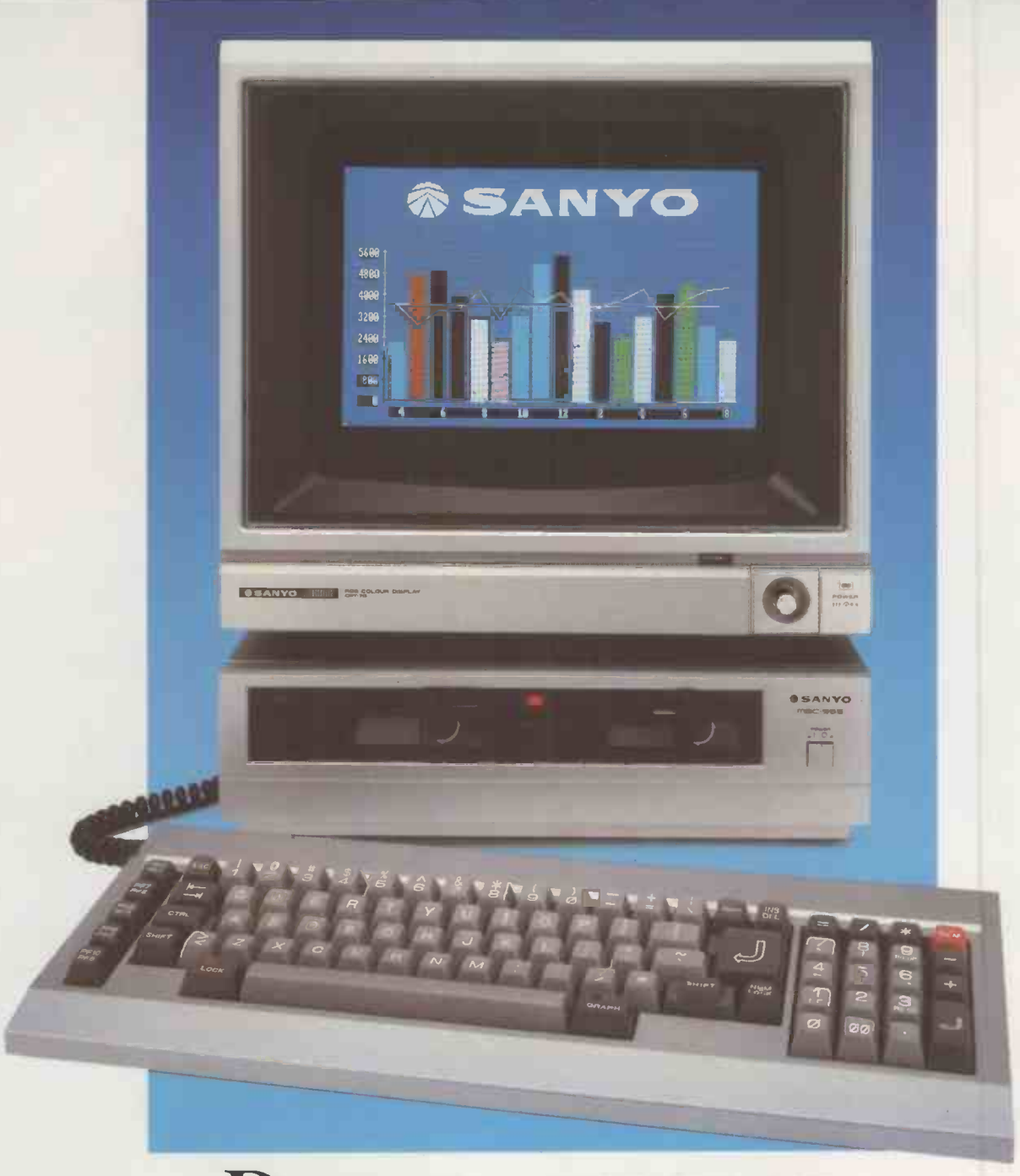
Reviewed:
Commodore 16
and Plus-4

IBM PC portables
triple test

Synth keyboards
for the BBC

How good is
dBase III?

Australia	A$3
Canada	C$4.50
Denmark	DKr35
France	Fr32.60
Germany	DM9
Greece	Dra290
Holland	DFl9
Italy	L4200
New Zealand	NZ$3.95
Singapore	M$6.35
Spain	Pts370
Switzerland	SFr7.40
USA	$3.95 (D72162)



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*EXCLUDING MONITOR.

SEE SANYO, THEN DECIDE

SANYO

2

● Circle No. 101

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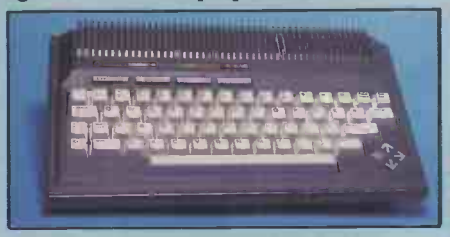

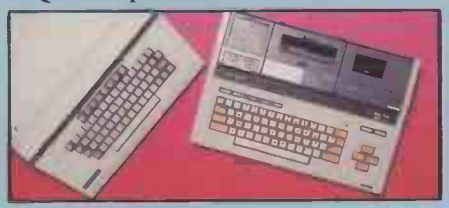

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Jack Schofield

Assistant Editors
Ian Stobie
Glyn Moody

Art Editor
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Carol Hammond

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Sue Jordan

Consultants
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Advertisement Secretary
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Northern office
Geoff Aikin 061-872 8861

Classified
Lucy O'Sullivan 01-661 8163

Group Advertisement Manager
Shobhan Gajjar 01-661 8441

PUBLISHING DIRECTOR
Chris Hipwell

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Would-be authors are welcome to send articles to the Editor but *PC* cannot undertake to return them. Payment is at £35 per published page. Submissions should be typed or computer-printed and should include a tape or disc of any program.
Every effort is made to check articles and listings but *PC* cannot guarantee that programs will run and can accept no responsibility for any errors.

Survival

BRITISH microcomputer manufacturers have been given a year to make it. Otherwise there will be an irreversible loss of independence to foreign companies. This is the startling conclusion of the report by the government-funded Economic Development Committee for the information technology industry, presented to the National Economic Development Office, NEDO.

The committee is chaired by Professor John Ashworth, who is also chairman of the National Computing Centre, Vice-Chancellor of Salford University, and former Chief Scientist in the Cabinet Office.

Particular alarm is raised by three facts. First, imports now take 54 percent of the British information technology market, and we have a balance of trade deficit of almost £1 billion. Second, Britain's share of the world IT market has declined from nine percent in 1970 to only five percent today. This puts us behind both France and Germany. Third, there has been a 30,000 decrease in the number of people employed in information technology over the last 10 years.

Professor Ashworth puts it bluntly. "The U.K. information industry now faces a crisis of survival. It's no longer a question of whether we can adopt the technology and stay ahead, but whether we can adopt it and stay in the race."

Undoubtedly successive governments have made ludicrous mistakes over the last decade, particularly with regard to public procurement and training in IT. Public procurement is the system by which governmental agencies, which make up about half the IT market, buy recommended products. In the U.K. this has resulted in a shambles. We have ended up with neither standardisation, nor efficiency, nor a strong local industry.

An earlier NEDO report in 1976 highlighted existing shortages of skilled people, and warned this would get worse unless something was done. Eight years later our IT training policies have left us with an even worse shortage of skilled people in the IT Industry, along with over three million unemployed.

Our record on research investment hardly bears thinking about. For example, the Alvey programme, about which so much fuss had been made in the IT industry, is costing the government £200 million. That is less than the annual cost of keeping open the few uneconomic pits that the National Coal Board is trying to close.

Nevertheless it is pointless for the IT industry, of which we are all part, simply to blame the government. Many British micro manufacturers have created most of their own problems through being late to recognise the importance of the micro, through bad product design, and through unreliability of both performance and delivery.

At Practical Computing we have been forcibly reminded of the incompetence of many suppliers by our experiences while preparing the annual "British Micro" supplement. We mailed every relevant company with a two-page form to fill in with latest company details. We also asked for information and photographs of their latest products.

At the time of writing we are two weeks past the "final deadline" for material for the supplement, and still have not had a response from 23 of the 90-odd manufacturers we contacted. By this time they have all received three phone calls from us, most have had two sets of forms sent, and some three.

And yet we are still being told by senior company officials that they have never heard of the Supplement, that they have not received the forms — believe that, and the postal system must have virtually ceased over a large part of the country — that they have no photographs of their products, or that the only person who can reply is in a meeting or, more often, on holiday. Only one company, just bought out from receivership, had the honesty to admit the truth: the managing director "just couldn't be bothered".

According to the NEDO report, the British micro industry is fighting for its life. The truth is, a quarter of the British micro industry lacks either the interest or the competence to ensure it gets the best possible free publicity in the micro magazine which is keenest to encourage and support it.

5 Years ago...

Over the last year there has been talk about a wonderful new language called Pascal. It is said, by those who favour it, that it is much better than Basic in every way; that everyone should immediately learn it; and that when they have done so, a new era of light and harmony will settle on the microcomputing world.

It is further suggested that *Practical Computing* should publish a course of Pascal, as was done for Basic, and that listings in that language should be published exclusively.

Basic has many faults. It is slow, badly adapted to building hierarchies of program. One can, no doubt, use five lines of Pascal for what it takes 50 lines of Basic to accomplish, and the result will run in one-tenth the time. The supporters of Pascal say that it is elegant, compact, quick, and so designed that it forces habits of clear thought on to the user.

That comparison ignores the best thing about Basic, that almost everyone in microcomputing understands it. It is the *lingua franca* of microcomputing — a most powerful and welcome unifying force.

PC Volume 2 Issue 11

SPOT THE DIFFERENCE

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

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- ☐ at least 10 open files*
- ☐ 9 indices per file*
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- ☐ Record locking

*16 bit systems

- ☐ On-line interactive file maintenance, file update and data entry
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- ☐ Multi-user, multi-file applications
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● Circle No. 103

The ideal home micro

I WAS MOST interested to read the article in the July issue of *PC* entitled "Revaluation". The editor has again brought a responsible voice to bear, this time upon the "what is the best home micro" debate.

It has seemed to me generally, as new machines have come on to the market, that the tremendous importance to a programmer of program-usable memory has been pretty much ignored. The practice of quoting maximum RAM as absolute RAM is reprehensible, especially when a machine thought of as 48K has only 13.5K available for programming. As the home-based programmer knows to his cost, any program containing a lot of text will soon eat that. Even worse is the 128K Sanyo MBC-555 that provides a meagre 41K for programming.

The question of price is interesting. Clearly it is important when two machines offering much the same facilities are differentially priced — the cheaper will always score. But most machines have differing features, and are not therefore directly comparable.

The colour question is simple — the more the better. But despite its 256 the Atari will not make the headway it might have because of its weird Basic. Any computer needs to be an integrated system with a balance of sophistication, ease of use, and economy of memory. On the last point the BBC Micro is a disaster, except for mode 7. What this machine needs is dedicated video RAM. I should love to be able to write more than the most trivial programs in mode 1!

Also of immeasurable importance is the quality of the Basic. Even had Camputers not folded, the Lynx machine was never likely to be more than a fringe machine about the home market. Its language is pitifully inadequate, with no multi-statement lines, the need to add variables to Next, and the archaic Let. Camputers could certainly never have heard of memory economy since it is very possible to use 40 percent of what is available in line number, space and unnecessary variable addition overheads. Seeing all that valuable memory which could be used to broaden the scope of my program disappearing like water down a storm drain evinces an almost pathological hate reaction.

The philosophy behind the Amstrad CPC-64 is right, as may be that of the forthcoming Enterprise. Certainly the Enterprise's specification is impressive, but if the 84 by 56 text is to be readable one may well have to pay over £1,000 for a monitor capable of displaying it properly.

I await its appearance with bated breath.

P A S Craddock,
Walsall,
West Midlands.

Smalltalk PC

IN YOUR REFERENCE to Smalltalk on page 86 of the June issue there is an implication, which has been noted by Xerox Corporation, that Asolv Ltd is distributing a Xerox product. I must draw your attention to this since Asolv does not and has not at any time sold or purported to sell Xerox Smalltalk.

I would appreciate an acknowledgement to your readers that Smalltalk PC is a wholly separate product from Xerox Smalltalk.

Any reference to our product should be clearly marked as Smalltalk PC, which is a registered trademark both in the U.K. and Europe, having copyright to C J Macie Software Systems with exclusive distribution in the U.K. by ourselves.

J M Ash,
Asolv Ltd,
Basingstoke,
Hampshire.

Reader survey

PRIZES to readers who filled in our annual Reader Survey form have now been sent out. First prize of £150 went to Julian Smith of Newport, Shropshire. Runner-up prizes of £75 went to L W Eaton of Malvern Link and J N Picton of Kelverdon. We would like to thank all the readers who took part.

Correction

BOURNE EDUCATIONAL SOFTWARE'S programs for the Amstrad, which we reviewed favourably in our October issue, are priced at £8.95 including VAT, not £18.95 as stated. Other programs are now available, including Map Rally which helps 7- to 13-year-olds understand the concept of co-ordinates and map directions. The Bourne range is also available for the BBC and Electron. Telephone: (0794) 523301.

dBase Department

THE INCLUSION of a regular dBase department in the magazine is to be welcomed. However, the proposed method shown in September's issue of validating an input value against a pre-defined list was not only a little clumsy but also profligately wasteful of variables, a scarce resource in dBase II.

A short modification to the first, rejected, method can easily overcome the problem of validating codes even of the wrong length or containing the delimiter used in the list of good codes:

```
STORE "LDN MAN GLA BHM
  YRK EDN "TO OKCODES
IF (TEST CODE + "
  "$OKCODES). AND.
  LEN(TESTCODE) = 3
  ok
ELSE
  error
ENDIF
```

Phil Bird,
London W1.

APART from his admission that the solution given is "still a little clumsy", might I offer Mike Lewis the following piece of dBase code

```
STORE !(my:var) + chr(32) TO
  qs
STORE "LDN MAN GLA BHM
  YRK EDN" TO test
STORE @(qs,test) TO option
IF option > 0
  *O'k
ELSE
  *Not O'k
ENDIF option > 0
```

Two features Mr Lewis requires are that the data should be tested for lower case, and he has also to provide a uniqueness to the items in his list.

If we use the ! function in dBase II, this will force my:var into upper case in a throwaway variable that we will call qs. The addition of the space character, ASCII 32 to qs provides the fixed format of not three but the four characters that we should be testing.

The device of banging on a Null or Space character in formatting variables in concatenated arrays for professional software is well known, and I am surprised that it was not used by Mike Lewis. Mine is a far more elegant solution, and I have also provided a variable Option to direct further program operation.

The notion of setting up variables and then releasing them in dBase II is contrary to the limitation on variables and wasteful in operating time. In dBase II, as well as Basic, it is good discipline to have system variables for reuse. In dBase my favourites are qn for numerics, qs for strings and words like OK, Again, and Read as flags.

N E S Hall,
Nailsea,
Bristol.

Mike Lewis replies: These letters are typical of many that

(continued on next page)

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

Clean machines – safety first

KEEPING YOUR READERS must be important to you, so please publish a warning against the use of carbon tetrachloride for cleaning micros. Carbon tetrachloride is very toxic. It should never be used in the house. It is used with care even by experienced chemists.

Isopropyl alcohol, more correctly known as propan-2-ol, is a reasonably safe solvent, though it is flammable. Anyone using it should do so in a well ventilated environment away from sources of ignition — and that includes the pilot light in the central heating burner or cooker.

But never, never use carbon tetrachloride.

P J Jenks,
BDH Diagnostics,
Poole,
Dorset.

I WAS thoroughly enjoying your spoof article, "The Clean Machine", in the September issue of *PC* until I realised it was actually serious.

What concerned me most was the lack of meaningful advice on the subject of personal safety. For the untutored to tamper with recently isolated equipment without being made aware of the potential severe consequences of touching capacitors, power supplies, cathode guns and so forth, puts them in appalling danger.

Peter V Turton,
United Kingdom Association of Field Service Managers,
Hemel Hempstead,
Hertfordshire.

WE ARE a British company that has been developing, manufacturing and marketing computer cleaning products internationally for nearly 20 years. We are very concerned that readers of your magazine may be tempted to take the erroneous advice given in an article on computer cleaning.

First, operators should never themselves dismantle their computers to clean or replace parts. This procedure would nullify any manufacturer's guarantee and, in many cases, would cause permanent damage.

Secondly, the products which the author recommended are not suitable for cleaning delicate electronic equipment. Washing-up liquid leaves smears and residues, metal cleaners score and scratch, and isopropyl alcohol, although used widely by experienced computer maintenance engineers for special technical applications, is much too harsh for general cleaning of microcomputers.

Philip Kingsbury,
Automation Facilities Ltd,
Wargrave,
Berkshire.

Chris Naylor adds: There are five chemicals commonly used in computer cleaning and The Royal Society of Chemistry has provided the following information concerning them. The toxicity levels have been established by the Health and Safety Executive and refer to parts per million for both long-term exposure and short-term exposure of up to 10 minutes.

Trichlorotrifluoroethane. Non-flammable. Low toxicity, 1,000 ppm long-term, 1,250ppm short-term.

Trichloroethane. Non-flammable. 350ppm long-term, 450ppm short-term. Harmful on inhalation and swallowing. Toxic. Can affect eyes, respiration and skin. Narcotic.

Trichloroethylene. Non-flammable. 100ppm long-term, 150ppm short-term. Harmful on inhalation and swallowing. Can cause headache, dizziness and nausea.

Carbon tetrachloride. Non-flammable. 10ppm long-term, 20ppm long-term. Very toxic by inhalation and swallowing. Affects skin and eyes. On inhalation causes headache, mental confusion, fatigue, nausea, vomiting and coma. Small swallowed doses can cause liver and kidney damage and death. Has been shown experimentally to be a carcinogen.

Isopropyl alcohol. Highly flammable. 400ppm short-term, 500ppm long-term. Toxic on inhalation and swallowing. Can cause headache, dizziness, depression, nausea, vomiting, narcosis, anaesthesia and coma. Fatal dose by swallowing 100ml.

Both carbon tetrachloride and trichloroethane can form phosgene gas, used as a poison in the First World War, by applying them to strong fires or heating.

"Regrettably," says the Royal Society of Chemistry, "information doesn't always become available on hazards for a long time — so always err on the side of caution."

(continued from previous page)

have been received, all arguing in favour of the in-string function as a way of checking character strings against a pre-defined list. I agree that this is more efficient than forming dummy variable names which incorporate the valid values.

But the main purpose of the dBase department was to illuminate the difficulties caused by the lack of any decent array handling in dBase, and to suggest in general terms ways of getting round it. Perhaps I chose a bad example. There must be dozens of processes that could be carried out so much more easily in dBase, if only the language supported straightforward tables and subscripts.

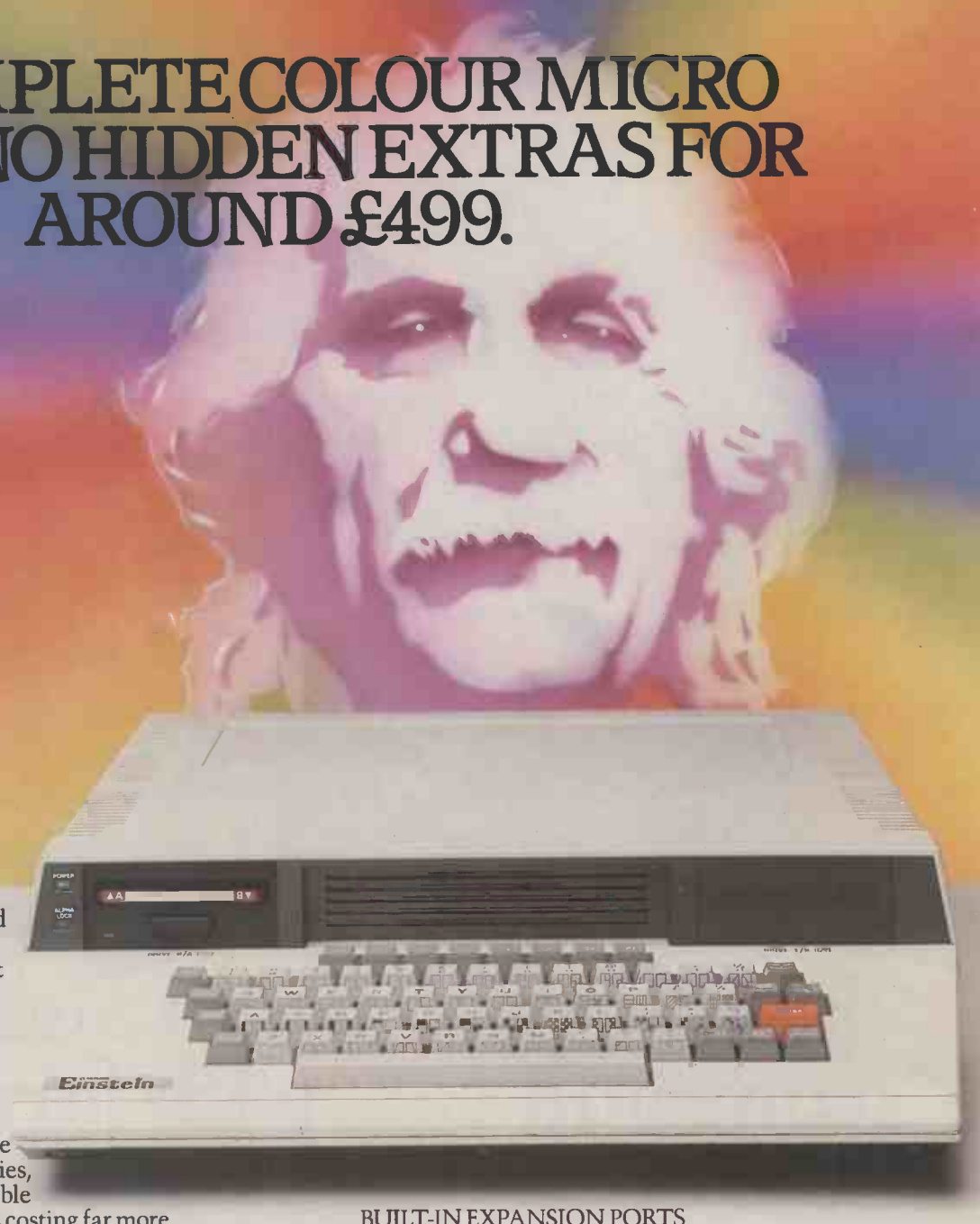
How British?

IN THE SEPTEMBER issue of *Practical Computing*, you carry an advertisement by Casu Electronics, in which they describe their Micro PX computer as "all-British" and claim "it is one of the first British designed and manufactured microcomputers".

We take exception to the inaccuracy of these statements, since this computer is based around the American-designed Slicer processor board, and undoubtedly contains a number of other non-British components such as the disc drives, controller boards, keyboard, and so on.

(continued on page 13)

A COMPLETE COLOUR MICRO WITH NO HIDDEN EXTRAS FOR AROUND £499.



The title of 'genius' is not bestowed lightly on man or machine: those extraordinary qualities and powers of intellect are rare.

Einstein had them in full measure. And so now does the new micro computer from Tatung, designed and built in Britain and appropriately named – Einstein.

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

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

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

BUILT-IN 80K MEMORY
Total memory capacity 80K RAM divided into 64K 'user' memory and 16K for colour graphics production.

BUILT-IN DISC DRIVE
500K 3" compact floppy disc drive. Potential for massive extra storage with a second 500K disc drive internally.

BUILT-IN 16 COLOUR GRAPHICS High resolution graphic animation from 32 sprites (definable shapes), 16 vivid colours.

BUILT-IN EXPANSION PORTS
Connection to both TV and optional colour monitor, most printers and other computers via RS232C interface. Also twin joystick ports, 8 bit user port, exclusive Tatung Pipe.

BUILT-IN FLEXIBILITY
Powerful Crystal BASIC. Multi-lingual plus ability to run CP/M.†

BUILT-IN VERSATILE SOUND
Sound synthesiser facility includes chromatic music with three voices. Substantial speaker with volume control. Provision for speech synthesiser.

Einstein has them all. Feature for feature, it meets the needs of the novice and the experienced operator, both at home and in the office.

Einstein, designed and built in Britain, is a complete colour micro computer with no hidden extras.

And for under £500 is sheer genius.

TATUNG
Einstein

SHEER GENIUS: AT WORK, AT HOME.

DIAL 100 AND ASK FOR FREEFONE EINSTEIN FOR YOUR NEAREST STOCKIST.

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†CP/M is a trade mark of Digital Research Inc.

For the price of ten aliens you can communicate with far friendlier

Imagine the benefits of being able to communicate with other computer users.

Of letting your computer save money on new software as well as helping improve your programming skills.

And wouldn't you be better informed if your computer kept you up to date with new developments in the computer world.

Just a few of the ways in which our Modem helps a Commodore 64, become more useful to you.

Fitted in seconds.

Our Modem is as easy to fit as it is to use. One end slots into your Commodore 64's cartridge port the other plugs into your telephone line.*

Computer Pals.

Once you've installed a Modem you can communicate with all other Commodore 64 Modem owners.

You can leave messages on bulletin boards, sell and swap programs.

You could work together on programs. Discuss recent software releases.

And even play chess.

Now you see it.

You'll be able to see page after page of information from existing systems like Prestel, Micronet† and the exciting new system called Compunet.

now eings.

Compunet, it's new and unique.

At present Compunet's exclusively for Commodore 64 Modem owners.

It's the most advanced communications system designed for home computer users. At last you can work hand-in-hand with a giant mainframe.

Because you can send and receive information.

This increased interactivity brings the capacity of large computers into your home.

Software galore.

And a lot of it's free. Free games, free education, free information.

Free from hassle too. Because you can now select software from Compunet then save it on to cassette or disk.

What's more, highly prized software from leading companies is on offer, thanks to our Modem's built in security systems.

You'll also be able to pick up useful hints and tips to improve programming skills.

Free tuition.

Now your computer can make a serious contribution to your children's education.

Already Compunet has over 50 free educational packages, with subjects ranging from elementary maths to A-level Physics. And there's up to 10 new packages every month.

Our Modem delivers the goods.

You can already shop via Compunet and make great savings by joining Comp-u-card.

Before long, you will be able to view new property lists, order groceries, organise your banking and even request insurance quotes.

All in addition to a wide range of services currently available through other systems.

Free for all.

If you order a Modem now you will receive one year's free subscription to Compunet.

Representing a saving of £30.

Add to this the reductions you can get on many purchases through Compunet and you can see the obvious values of owning a Modem.

What price the world at your fingertips?

A Modem costs much the same as 10 aliens.

Or, to be precise £99.99.

Which is money well spent, because a Modem continually revitalises your computer.

Making the Commodore 64 a home computer that should never lose its appeal.

You may find our Modem in the shops, if you're very quick.

Alternatively you can avoid disappointment and buy direct from Commodore. Simply complete the coupon, then we'll send you a Modem, plus your year's free subscription to Compunet.

commodore

Commodore Communications Modem,
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Please send me a Commodore 64 Communications Modem plus a year's free subscription to Compunet (worth £30).

I am enclosing a cheque/postal order for £99.99 (incl. VAT and P&P.) made payable to Vicsoft ☐

I would like my Visa/Access card debited. ☐

No. | | | | | | | | | | | | | | | | |

Signature _____

Or please send me further information. ☐

Name Mr/Mrs/Miss _____

Address _____

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Registration subject to Compunet's terms and conditions. Allow 28 days for delivery.

Post to: Commodore Communications Modem,
1 Hunters Road, Weldon, Corby, Northamptonshire NN17 1QX.

*A new-style B.T. socket is required.
†Prestel and Micronet require additional subscriber charges.

Prestel is a registered Trademark of British Telecommunications.
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● Circle No. 105

STOP PRESS

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

Mini's too expensive

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

Micro's too small

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

SuperStar multi-user system...

...is just right

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

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

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

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

BROMCOM

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OEM, Dealer and Overseas enquiries are welcomed.

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

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

● Circle No. 106

12

Feedback

(continued from page 8)

For the record, our own Delvex-186 board is completely designed and manufactured in the U.K.

Roger M Sinden,
Country Computers Ltd,
Redditch.

The editor adds: Anyone can complain about the accuracy of an advertisement to the Advertising Standards Authority, Brook House, Torrington Place, London WC1E 7HN.

Apple II file security

MAY I suggest a simple yet effective file security device for Apple II users who wish to keep the contents of their files away from prying eyes? The method is simply to embed a single control character, or a password made up of control characters, in the file name when saving to disc. These characters are transparent when the disc is catalogued, but must be included on loading, otherwise the file cannot be accessed. You must remember to keep a note of the control character and its location within the file name, otherwise you could find yourself locked out of your own file.

N J Goulding,
Bath,
Avon.

Spectrum password

IN YOUR March 1983 letters column you published a Spectrum security routine by W H Roberts. I have been using it since then, but have recently discovered that it contains a significant flaw: pressing Caps Shift and 6 together will break into the routine, allowing the listing to be examined and the password discovered.

To prevent this happening add the following lines to your program

```
9995 LET err = PEEK
  23613 + 256 * PEEK
  23614:POKE err,0:POKE
  err + 1,0:LET z$ = "(whatever
  password you choose)"
9996 PRINT AT
  10,8;"PASSWORD PLEASE"
9997 POKE 23606,60:POKE
  23607,83:INPUT LINE y$
9998 CLS:IF y$ = z$ THEN
  POKE 23606,0:POKE
  23607,60:POKE err,3:POKE
  err + 1,19:GO TO (whatever
  line your program starts from)
9999 New
```

Save the program in Autostart mode using

```
SAVE "name" LINE 9995
```

Line 9995 ensures the program will now crash if someone tries to break into it by pressing Caps Shift and 6. Line 9997 scrambles the character set so that the password entered will be invisible on the screen. Line 9998 returns the character set back to normal once the correct password has been entered, and also returns the break routine back to normal.

D K Davis,
London E2.

TV conversion

MY PROBLEM is that I have been unable to get my colour portable television converted to an RGB monitor to use with my BBC Micro. I've tried every television and computer repair shop I know, but to no avail. I've even tried telephoning the makers, but all they could suggest was buying a circuit diagram from them and then trying all the repair shops again. Is there anybody in the London area who can help?

Andrew Constantinou,
London N7.

Directory for handicapped users

WE ARE in the process of establishing a database of software for the handicapped. Each entry to the database will contain a description of the programs, the handicaps they are suitable for, the type of computer system required, name and address of supplier/developer and price, etc. This information will be made available through printouts in answer to specific enquiries. One major aim will be the concerted effort to promote the database — and therefore the software — abroad, as we have been doing for non-software products in the field.

As we are currently collecting and processing information, we would be pleased to hear from anyone who may wish to contribute to the database.

Peter Curran,
Handicapped Persons Research Unit,
Newcastle upon Tyne Polytechnic,
1 Coach Lane,
Newcastle upon Tyne
NE7 7TW.

Educational software

IT HAS BEEN said that computer hardware in schools is no longer a problem, thanks to the DoI pound-for-pound programme. The problem is a lack of both knowledge and software, and if these two important commodoties are lacking then, as Jon Lansdell rightly says in the May issue of *PC*, the school's expensive computer equipment lies undisturbed and unused, something which, at today's prices, cannot be allowed to happen.

As educational software publishers, we too have a problem of lack of knowledge and software. We have no knowledge of what teachers want, which means we have to take a shot in the dark with software which we think will be useful to them.

If you are a teacher, any software house would be glad to know of your ideas, wants or needs. We certainly would.

Andrew Noakes,
Kidsoft Educational Software,
Romsley,
West Midlands.

Text compression

I WAS INTERESTED to see the article by Mike Lewis on my four-bit text-compression scheme in the June issue Software Workshop. If any reader wants to take it further I can be contacted at the address below. Various coded versions of the scheme now exist, and I am interested in other applications.

Jack Pike,
Holly Cottage,
Chawston,
Bedfordshire MK44 3BH.

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TDI Pinnacle

THE TDI PINNACLE is a 12MHz 68000-based machine running under the p-system. It has 256K of RAM, a 14in. screen, a keyboard, and one Centronics and seven serial ports as standard. Other operating systems available include CP/M-68K and BOS. The Pinnacle will support up to seven users.

Prices start at £4,995 for a system with one 800K floppy and a 10Mbyte Winchester. Top of the range is a 1,536K RAM system with a 32Mbyte hard disc. The cost is £9,345. Details from TDI Pinnacle Limited. Telephone: (0272) 742796.

Hello Mr Chips

RADIO 4's micro programme *The Chip Shop* is back. It is broadcast on Saturdays at 4.15p.m. It is joined by *The Radio 1 Chip Shop,* presented by David Freeman, and going out at 7.33a.m. on Saturdays on Radio 1. Basicode software will be broadcast on Sundays at 5.55a.m., also on Radio 1, and repeated at the same time on Saturdays.

Neptune robots developed

TWO electro-hydraulically powered robots have been developed by Cybernetic Applications. Neptune 2 has seven servo-controlled axis movements, while Neptune 1 has six. Mentor is a smaller desk-top robot which is electro-mechanically powered.

Interfaces are available for BBC Micro, Spectrum and Vic-20. The robots are addressed as if they were part of the micro's memory. They are sold in kit form, with the control electronics ready built.

The Neptune 2 costs £1,725 for the kit, £475 for the electronics; Neptune 1 costs £1,250, and the electronics £295. The Mentor robot costs £345, and its associated electronics £135. All prices exclude VAT. Details from Cybernetic Applications on (0264) 50093.

New Dimension

DIMENSION 68000 is, unsurprisingly, a 68000-based machine which comes in its basic configuration with 256K RAM, two 400K floppies, and serial and Centronics ports. The Dimension can be fitted with 6512, 8086 and Z-80 emulation co-processors, which allow it to run Apple, IBM PC and CP/M software.

The system includes a keyboard with 10 function keys and numeric pad, but no monitor. Cost is £3,199. The emulation processors and software cost about £300 each. A 20Mbyte Winchester is available for an exta £3,195. All prices exclude VAT. The Dimension 68000 is distributed in the U.K. by Tashkl on 01-904 4467.

(More news on next page)

The Panasonic Portable is an IBMulator with an 8088, 256K of RAM, and one or two 360K disc drives. There is a built-in thermal printer and an integral 9in. monochrome screen. The Portable will cost about £2,000. More information from Panasonic Industrial (U.K.) Ltd. Telephone: (0753) 73181.

Hardware shorts

- The Apple Macintosh is now available with 512K RAM. The big Mac costs £2,595. More on (0442) 60244.
- Wren micros can now be upgraded from 64K RAM to 256K for £399. Double-sided double-density floppy drives are also available for £345. Details on 01-253 2277.
- The BBC Micro single disc drive now costs £199 instead of £249. However, the Z-80 second processor has already gone up by £100 to £399. More on (0933) 22895.
- Xbub is a 128K bubble memory for the Apple II+ and IIe from Xcalibur. The cost is £495. Details on (0604) 21051.
- The Amstrad's stereo sound facility is used in a speech synthesiser from DK'tronics. The cost will be about £40. More on (0799) 26350.
- Wang has reduced the price of its PC from £2,805 to £2,240, and at the same time boosted the RAM to 256K. Other PC products have been reduced by 20 percent. More from 01-560 4151.
- Speech 64 is a speech synthesiser for the Commodore 64 from Currah. Cost is £29.95. More information on (0429) 72996.
- A guide to micros for the disabled has been produced by Sunderland Polytechnic. The cost is £8. Details from R Foster on (0783) 76191 extension 120.
- The Rat is an infrared touch joystick from Cheetah from the Sinclair Spectrum. The unit costs £29.95. More on 01-833 4909.
- Texas Instruments has produced a 18.2Mbyte Winchester for its Professional computer. The unit costs £2,950. More information from (0234) 223000.
- Commodore's 8296 business micros are now bundled with over £800-worth of software, including a word processor and calc.

Acorn BBC model C arrives

PEOPLE who have been asking for a BBC model C should be satisfied with the range previewed at the *PCW* show: there were eight of them. Machines in the new range are all called ABC, for Acorn Business Computers. Technically they are a repackaging job of the trusty old BBC model B with second-processor options.

This is not to say the repackaging is dull. Technically the range looks superb, and you have a choice of 6502, Z-80, Intel 80286 and National Semiconductor 32016 processors.

All the machines look the same, and comprise an oversized monitor screen plus detached keyboard. The BBC main board and second processor are inside the monitor box, which also contains the floppy- and hard-disc drives, if fitted.

Efficiency rather than good looks characterise the range.

The ABC Terminal with 6502 processor is at the bottom of the range. It is essentially the standard model B in a new box with the addition of a green screen, Econet and a University of Sussex type of VT-100 terminal-emulation program. It is obviously intended as an Econet network or DEC terminal, and could be attractive to secondary schools and colleges.

It is the ABC Personal Assistant with 6502 processor that is the model C. It comprises, in effect, a model B with the addition of a double-density disc controller, 640K floppy-disc drive, View and Viewsheet software on ROM, Econet and a green screen. The built-in software and screen indicates it is intended to be used as a word processor.

The ABC-100 with 6502 and Z-80 processors is a model B with the Z-80 second processor built in. It has twin 720K floppy-disc drives, Econet, the green screen and CP/M. Bundled software is the high-quality Memoplan, Fileplan, Microplan and Graphplan range. This is your low-cost eight-bit business system. A souped-up version called the ABC-110 offers a 10Mbyte hard disc and a colour screen.

The ABC-200 has a 6502 and a National Semiconductor 32016. The 32016, which used to be called the 16032, is about the best chip you can get in a micro. It has a full 32-bit internal architecture and is designed for running Unix-like operating systems. Acorn claims it offers the power of a DEC Vax on a desk top. The ABC-200 is a scientific research/programmer-type computer and comes with a bundle of languages: C, Lisp, Pascal, Fortran 77, Forth and BBC Basic. There is no applications software for the 32016, so it is a good time to start writing some.

The souped-up version is the ABC-210. It has up to 1Mbyte of RAM with virtual memory management, the Xenix operating system, a 10Mbyte hard disc and colour screen.

The ABC-300 with 6502 and 80286 processors is a sophisticated true 16-bit business micro which runs Digital Research's multi-tasking Concurrent-DOS. This allows many IBM PC-DOS 1.1 and PC-DOS 2 programs to be run, as well as up to three other CP/M-86 programs. The hardware includes 256K of RAM, twin 720K floppies and a green screen.

The souped-up version of the ABC-300 is the ABC-310 which has more memory, a 10Mbyte hard disc and a colour screen.

All the machines have a good quality detached keyboard with a full numeric keypad and 10 function keys across the top. All the monitor screens are 12in.

However, several interesting queries remain to be answered. First, how different is the model B main board used in all the machines from the one we know and love? Will the model B have its board changed to match? It could easily be redesigned to use fewer chips and thus be both more reliable and cheaper to make.

Second, how IBM compatible is the Concurrent-DOS, and how well does it exploit the 80286? IBM's own PC-DOS 3.0 treats the 80286 as though it was an 8088, and the 80286 version of Concurrent-DOS could simply treat it as an 8086.

Third, there is a big jump from the Z-80 system to the 80286 version. What happened to The Graduate, which could logically have been in the middle? Fourth, will Acorn take advice and restyle the ABC range in two-tone grey and cream? Surely the machines do not have to look horrible?

Fifth and sixth, when will they be available and what will they cost? Prices will range from about £600 to £5,000, depending on the state of the market when the machines finally appear. Acorn is talking of launching the range in January 1985, but availability is anyone's guess.

This is the One

THE IDEA of an IBM PC-compatible micro with two floppies and an 80-character by 25-line screen is not particularly exciting, but Data General has managed to pack that specification into a 10lb. battery-powered portable, the One — see photo on page 3.

The full-size screen is of the LCD variety, and the 720K floppy-disc drives are 3.5in. microfloppies of the Sony type. The CPU is an 80C88, which is a CMOS version of the 8088.

The One also comes with 128K of RAM, 64K of ROM including a text editor and terminal software, clock/calendar, printer port, RS-232C port, built-in modem — at least in the American version — a.c. adaptor and MS-DOS operating system.

Data General is aware that IBM software comes on 5.25in. discs, and has two solutions to the problem. First, it offers an external 5.25in. disc which you can use to copy software across on to the 3.5in. format. Second, it is working with software houses to supply the top programs in the 3.5in. format. Launch offerings range from WordStar, dBase II, Microsoft Multiplan, Lotus 1-2-3 and Symphony to the Zork series and Sublogic's Flight Simulator II. Tamsys has already been signed up as a software distributor.

Although the One is claimed to be on sale now in the U.S. it will not appear in the U.K. until January. The price of a single-floppy One is £2,490 plus VAT.

Contact Data General, Hounslow House, 724-734 London Road, Hounslow, Middlesex TW3 1PD. Telephone: 01-572 7455.

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Symbiotic Computer Systems has been at the forefront in the development of mass storage and networking products over the past three years designing and manufacturing systems to enable the full range of Apple microcomputers to form a business facility, powerful enough to rival many mini-computers on the market.

Symbfile – Symbiotic's Winchester hard disk system can now be used with both the **Macintosh** and the **Apple*IIc*** as well as the **Apple II** range. The Symbfile is available in capacities up to 42 megabytes – enough space to store about 25 thousand pages of data! which can be accessed at extremely high speeds and contained on much larger volumes than even the highest capacity floppy disks.

Symbnet – the Symbiotic tree and branch local area network, allows up to 127 computers to access one Symbfile. Symbnet is one of the few commercially available network systems that uses fibre optic technology. Fibre optic cable is unaffected by electrical interference and can run up to 9 Km between stations with no degradation of signal and can now also be used with low cost twisted pair cables for distances up to 30 metres. This allows the user to mix both fibre optic and twisted pair cable to suit their exact requirements, providing one of the most cost effective and noise immune systems available.

Symbstore – is the answer to secure back up; it utilizes inexpensive cassettes each capable of holding 10.5 Megabytes of data, that can be used quickly and efficiently to stream a complete Symbfile image to tape. The full range of Symbiotic products are also available on the **BBC Micro.**

The Symbiotic group of Companies distribute their products through a wide network of dealers covering virtually the whole of western Europe.

For more details contact one of the following Symbiotic group companies –

Symbiotic Computer Systems Ltd	Duroma House, 32 Elmwood Road, Croydon, Surrey CR9 2TX, England. Tel: 01-683 1137 (PBX) Telex: 928202 SYMPLC
Symbiotic Computer Systems (Benelux)	Keizersgracht 26, 5611. GD. Eindhoven, Netherlands. Tel: 040 456055
Symbiotic Computer Systems France	2 Rue Henri Chevreau, 75020 Paris, France. Tel: 349 06 80
Symbiotic Computer Systems A/S	PO Box 354, O. Tryggvassons 4, 7000 Trondheim, Norway. Tel: 07 53 20 27
Symbiotic Computer Systems Inc	PO Box 1431, Fairfield CT 06430, USA. Tel: 203 374 5910

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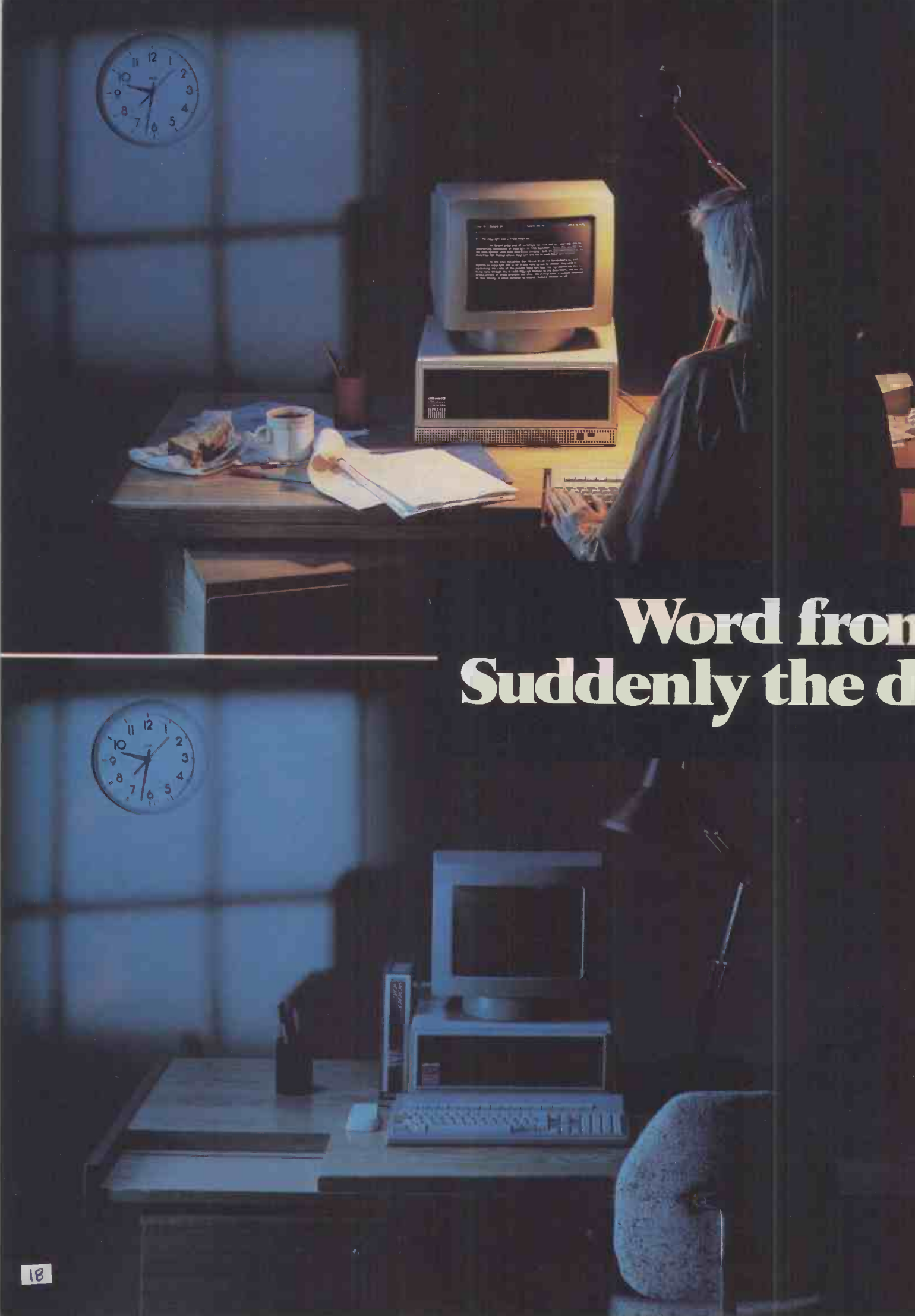

Word from
Suddenly the d

It's 9.32 in the evening.
Her date's been stood up.
Another episode of Crossroads has been missed.
And still the job isn't finished.
The poor woman has been at the document all day, and now she's beginning to droop.
Mistakes creep in.
Mistakes that need more time to correct because you haven't got the right word processing package.
Isn't it time you knew about Word from Microsoft?

Quite simply, it's the most capable word processing package in the business.

Microsoft.
y seems shorter.

Which is saying something, because you know how many there are to choose from.
Even Business Computing, not normally lavish with praise, said "It does nearly everything that other word processors do and it does it easier, faster and better."

And because it comes from Microsoft, the originators of BASIC for personal computers, it has been designed for the future.
With everything you're ever likely to need built in.

For example, take style sheets.
Complete design flexibility for all kinds of document, with an integral format reference facility.
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With Word, exactly what is shown on the screen is printed on the page.
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Particularly as Word can locate one error in a 250-page tome on command.
And built-in merge means faster, smoother mail shots, the life blood of so many businesses.
Is there any doubt that Word is the word processing program you need in your office?
It's more advanced than Multimate and has practically twice the functions of Wordstar.

Introduce it to your secretary.
And tell her not to worry about missing Crossroads.
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* Delta is available for almost any microcomputer with the MSDOS, PCDOS, CP/M, or MP/M operating systems, including IBM, DEC Rainbow, SIRIUS, XEROX, ICL, EPSON and many others.

DMS is also available for Commodore computers.

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● Circle No. 111

Logo for the BBC and others

LOGO learning packages for the BBC Micro, Commodore 64 and Apple IIe have been announced for October by Honeyfold Software, the company behind the Dr Watson series of Basic and Assembler courses. Each package consists of a full implementation of Logo on tape, together with a parent/teacher guide book explaining the language; it costs £14.50 including VAT. A pack of A4-sized work cards linked to 24 interactive computer-based lessons is available for schools, priced at £28 excluding VAT.

Honeyfold is working on Spectrum, Electron, Amstrad and MSX versions. Details from Honeyfold Software Ltd, Standfast House, Bath Place, High Street, Barnet, Hertfordshire EN5 1ED. Telephone: 01-627 0445.

Meanwhile the official BBC Logo, which is being written by the Open University, is now scheduled to go on sale early in 1985. Details from BBC Publications Software Department, 35 Marylebone High Street, London W1M 4AA.

Macintosh visual filing

FILEVISION lets you use the Apple Macintosh's graphics capabilities to create a database keyed on visual symbols. To use the program you draw a picture and then add text or numeric information linked to the picture; Filevision provides drawing tools and editing facilities to help you do so. You

can interrogate a database built up in this way by clicking the Mac mouse over your pictures as well as in more conventional ways.

Filevision costs £159 plus VAT and is available from Pete & Pam dealers. Contact P & P Micro Distributors Ltd, Todd Hall Road, Carrs Industrial Estate, Haslingden, Rossendale, Lancashire BB4 5HU. Telephone: (0706) 217744.

BBC Pascal

TURBO PASCAL is now available for the Electron, BBC and Torch. This Pascal compiler is well established on MS-DOS and CP/M systems, and the new version fully supports BBC graphics and other hardware features.

Turbo Pascal comes on disc and costs £49.95 excluding VAT. Details from Altor Ltd, Brechin House, 801 Govan Road, Govan, Glasgow. Telephone: 041-445 1015.

Soccer database

YOUR TEAM enables soccer fans to keep up-to-date records on the progress of League or amateur clubs. The menu covers results, attendance figures, players and the like. The program is available for the BBC, Electron, Commodore 64 and Spectrum. It costs £9.95 including VAT.

Contact BEC Sports, BEC House, Highlands Avenue, Northampton. Telephone: (0604) 499246.

Detective adventure

SHERLOCK is Melbourne House's follow-up game to its successful Hobbit adventure. Set in Victorian England, Sherlock can recognise natural-seeming sentences typed in from the keyboard. The program has an extensive vocabulary of over 800 words, which lets you quiz intelligent characters who have complex and well-defined personalities of their own.

Available on the 48K Spectrum now, and on the Commodore 64 from November, the program also makes use of graphics. The price is £14.95 including VAT. Details from Melbourne House on 01-940 6064.

U.S. Election game

ELECTION TRAIL for the Commodore 64 is a simulation game based on the U.S. Presidential elections. You control one of the candidates

and try to gain as many states as possible using media campaigns, movie-star endorsements and whatever other strategies your funds allow.

Election Trail costs £7.95 including VAT on cassette and £9.95 on disc from the aptly named Amplicon Group. Telephone: (0273) 608331.

Shorts

● Know Your Own Personality for the BBC, Commodore 64, Spectrum and Electron, is based on the book by Professor Hans Eysenck and Dr Glenn Wilson. The program administers a series of tests dealing with tough- and tender-mindedness, extraversion and introversion, and emotional stability. Published by Mirrorsoft, the price is £9.95 including VAT on cassette, and £12.95 on disc. Details on 01-353 0246.

● Blast allows the new Epson PX-8 battery portable computer to communicate with the IBM PC or other MS-DOS or CP/M machines. The program, price £195 plus VAT, also allows you to use the PX-8 as a terminal connected to a mainframe. Details from Transam, telephone 01-404 4554. Transam has also recently developed a version of Fortran for the PX-8.

● All cassette copies of Aural Sculpture, the new album from The Stranglers rock group, will come with a Spectrum adventure game also recorded on the tape. Scattered bursts of Stranglers music and lines from Stranglers songs provide the clues. Aural Sculpture is released on November 5.

● British Telecom is entering the home-computer games business with a range of games which will be available from High Street shops in October. The games will be sold under the Firebird brand name and will cost £2.50 each including VAT. Early titles include Viking Raiders for the Spectrum, Bird Strike for the BBC Micro and Zulu for the Commodore 64.

● Sagesoft is offering Apple II owners its integrated sales, purchase and nominal ledger software, bundled together with a Z-80 card and copy of CP/M 2.2, for £375 plus VAT. Telephone Sagesoft on (091) 2847077.

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- Supercalc 2* £165

SAGESOFT
- Sage Accounting* £325
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Most machine formats available.

SOFTWARE FOR IBM/PC

Please see CP/M listing. All product with an *will also run on MS-DOS and PC-DOS and are priced the same

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- Database Manager II £185

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- Framework £450

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(B)PC 11/84

Here comes the ATeam

LESS THAN a month after the American launch of the new 80286-based PC/AT, IBM has unveiled it in the U.K. Product details were given in last month's issue, so the real news is the pricing and availability.

The AT with 256K of RAM and one 5.25in. 1.2Mbyte floppy disc costs £2,951 plus VAT, while the price with 512K of RAM, one floppy and one 20Mbyte hard disc is £4,281 plus VAT. Neither price includes a screen or operating system.

Samples of both models will be dispatched to dealers shortly, with systems available in November. Manufacture

will begin in Greenock, Scotland, this year.

The PC Cluster networking system will be available in December. The PC Network broad-band network will be available early in 1985 along with the version 3.1 of PC-DOS required to support it.

The PC/IX single-user version of Unix will be available in November, while the multi-user PC Xenix should arrive early in 1985.

IBM is compiling a list of the programs that function to its satisfaction on the AT models. Most seem to run, but a few — such as the Microsoft Flight Simulator — do not, due to timing and interrupt differences with the PC models.

An incidental benefit of the aggressive pricing of the new AT is that IBM has taken 18 percent off the price of the PC/XT system unit, which has dropped from £3,536 to £2,828 plus VAT.

Further details are available from IBM Retail Centres and authorised dealers.

Grid Compass II

GRID has launched a new version of the stylish Compass IBM data-compatible portable, and made it far more powerful than the one reviewed in *Practical Computing* in May.

The major enhancement is that it can now take up to 512K of ROM chips under a new panel on the front. This means software no longer has to be held in RAM, and makes room for 600 percent more data.

With 512K of RAM, 512K of ROM and 384K of bubble, the total memory is 1.4Mbyte. When you remember it has a full 80-column by 25-line electroluminescent screen, the Grid packs a lot of power for a 10lb. portable.

Other new products include a file server, for networking Grid micros along with IBM PCs, and versions of the Grid integrated software to run on IBM PCs. Unfortunately there is no package deal for those who have already bought the Grid software: you have to pay full price for the IBM versions if you want to transfer data between the two.

Although — like Ferrari cars, Lear fan-jets and other executive toys — the Grid Compass remains an expensive micro.

Prices have been reduced by up to 30 percent and now start at £3,595 but the Compass is still to micros what a Ferrari is to cars — an expensive executive toy.

Contact Grid Systems, Unit House, 33 London Road, Reigate, Surrey. Telephone: Reigate 41211.

Multi-tasking Multi-Job

MULTI-JOB is a multi-tasking operating system which allows up to nine programs to be run on an IBM PC — assuming you have enough RAM. You need 128K for two jobs, and 64K to 128K extra for each further job.

In reality the jobs run one at a time, but Multi-Job's time sharing makes it seem as though they are running simultaneously. Multi-Job should be particularly useful where programs use other resources. It would make sense to combine a printing job on a word processor and a communications program with something more keyboard intensive, like a spreadsheet.

Multi-Job is available from various sources, including Pete & Pam, telephone 01-677 7631; and Impex Software, telephone 01-900 0999. Pete & Pam's price is £129 plus VAT; Impex's is £98.95 plus VAT.

Portable PC II

TELEVIDEO's portable IBM PC compatible micro, the TPC-II, is now available in the U.K. from Thorn-EMI Computeraid.

The TPC-II has 256K of RAM, a single 360K 5.25in. drive and a bundle of software. It weighs 28lb. and costs £1,895 plus VAT. Contact Thorn-EMI, Silbury Court, 372 Silbury Boulevard, Witan Gate East, Central Milton Keynes MK9 2AF. Telephone: (0908) 825151.

Software shorts

● IBM has launched a new version of Multiplan, two new versions of the Pertmaster critical-path analysis system, and 10 libraries for the Execuvision presentation graphics system. The IBM Microsoft Multiplan 1.1 now supports 512K of RAM and a maximum printed page width of 512 characters. Contact your local IBM dealer.

● The Professional Bibliographic System is a database designed for handling up to 30,000 books. Biblio-Link is a utility program that allows it to be linked to a mainframe. Both programs run on IBM PCs and compatibles. Contact Personal Bibliographic Software Inc., PO Box 4250, Ann Arbor, Mi 48106. Telephone (area code 313) 996-1580.

● Sphinx is now marketing the Xenix version of Unix for the IBM PC/XT. Contact Sphinx Ltd, 43-53 Moorbridge Road, Maidenhead, Berkshire SL6 5PL.

● Riva Terminals has announced PCPlot III, a program that enables the IBM PC to emulate a Tektronix 4010 graphics terminal. The program comes with a tutorial and costs £170. Contact Riva Terminals, 9 Woking Business Park, Woking, Surrey GU21 5JY. Telephone: (04862) 71001.

● PC Statistician is an advanced statistical analysis program that can accept DIF files from Lotus 1-2-3 and VisiCalc, as well as ASCII files from other programs. It costs $300, including free updates. Contact Human Systems Dynamics, 9010 Reseda Boulevard, Suite 222, Northridge, Ca 91324.

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COBOL Compiler	£549	£549	C Compiler		£269	£269
C Compiler		£435	PERSONAL BASIC Int		£115	
PASCAL		£249	CIS COBOL	£425	£425	
BUSINESS BASIC Comp		£469	FORMS-2	£110	£110	
MACRO ASSEMBLER	£159	£99	FILESHARE	£250	£425	
SUPERSOFT C Comp	£185	£185	SUPERSOFT BASIC Compiler		£200	£200
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MICROWARE

Amstrad's new CPC464 comes with plenty of free plugs.

CPC464 green screen VDU (GT64)

You may have noticed that the press has got very excited about our new computer system.

And rightly so.

Because the new CPC464 comes complete with its own green screen VDU or colour monitor, built-in cassette data recorder, 64K of RAM, 32K of ROM, typewriter style keyboard and a very fast extended BASIC.

When you consider that the complete computer system including green screen VDU and cassette data recorder will only set you back £249, that's plenty to get excited about.

You can use the green screen version of the CPC464 with a colour TV by connecting the optional power supply and modulator (MP-1).

"I think the Amstrad will give a lot of sleepless nights to Sinclair, Acorn and Commodore..."

POPULAR COMPUTING WEEKLY

Other micros can't get anywhere near the CPC464's memory for the price. Over 42K is available to users, thanks to the implementation of ROM overlay techniques.

Sophisticated and complex program are easily accommodated.

And the CPC464 offers you hig resolution graphics, 80 column te display, up to 8 text windows, a graphi window and a palette of 27 colours.

"The CPC464... in two boxes and one lead includes a list of features that would shame a hybrid of the major machines."

PERSONAL COMPUTER WORLD

One of the most obvious is the qualit of the on-screen graphics. Quite simpl the CPC464 beats the micro/domest TV combination out of sight.

That's because our monitor drive each colour on the screen directly fro the computer. Nothing gets in the way the best possible picture. And you won have tuning problems, either.

There's plenty of interest for mus lovers when the 3-voice, 7-octave stere output is fed through a hi-fi amplifie and speakers.

"The Amstrad is a powerful, fast machine, with plenty of memory, easy to program..."

PERSONAL COMPUTER WORLD

A fast growing range of Amso programs is already available.

The high quality software takes fu

£249
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£359
Computer complete with colour monitor (CTM640)

CPC 464 complete with monitor and datacorder

lvantage of the CPC464's high ecification and speedloading capa- ility. Which means even complex rograms can be loaded quickly.

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"The Amstrad machine provides a lot of other features for a very low price."

GUARDIAN

At Amstrad, we're constantly looking to the future. That's why the CPC464 has a built-in parallel printer interface. A low cost optional disk drive system including CP/M* (with the option to access 3000 programs) and LOGO. A joystick port. And the virtually unlimited potential of the Z80 data bus with sideways ROM support.

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ASK PC

Q Is there an easy way to buy computer parts from the U.S.?

J Moore, Leicester.

A There are several ways of paying for goods you wish to buy in America. You can get dollar bills from your bank and include them with your order. Remember to allow for the cost of carriage. But this method is dangerous, since even with registered post you have no comeback if the letter gets lost outside the U.K.

A safer way is to go to the bank and get a bank draft, which is payable through the banking system to the supplier's bank account. You then write with your order saying that the draft is on its way. Though safe, it may be very slow.

The easiest way is to write and quote your Access — known as Mastercard in the U.S. — or Visa credit-card number and its expiry date. You are charged in dollars for the goods, and this is converted to sterling by the credit-card company at the rate of exchange in force when the bill arrives here. You eventually settle up at the end of the month in the usual way.

Remember to ask for the goods to be sent by air mail or you may have a three-month delay. Goods bought abroad are subject to both import duty and VAT, which are usually collected by the Post Office on delivery.

Q Further to the review of the Advance 86 in the June 1984 edition of *Practical Computing*, please can you tell me whether the ROM Basic in the model A or the disc Basic in the model B allow numerical arrays to be written to tape? Also is the Advance 86 socketed for an 8087 co-processor? I need to perform lengthy calculations, so speed is essential.

L G Preuss, Zürich, Switzerland.

A Both the cassette Basic, which is stored in ROM, and the disc Basica support data files in which numbers or strings can be stored. The disc Basica has more advanced features for handling files than the cassette version, and is an advanced 16-bit form of the familiar eight-bit MBasic with several extra features for colour and graphics.

The 8087 is an arithmetic co-processor designed to work with the Intel family of central processors, including the 8086 in the Advance and the 8088 in IBM machines. To make one of these standard processors multiply, a subroutine must be written to perform multiplication in terms of multiple additions. The 8087 has a stack of eight 80-bit registers, each of which can hold a real number. Arithmetic is performed in these registers without having to access memory repeatedly.

The 8087 chip effectively adds 48 new instructions to the 8086, allowing it to perform operations such as addition, subtraction, multiplication, division and square roots. Trigonometric and exponential functions are usually evaluated by software in the compiler or interpreter, and a special library of routines is need to calculate these using the 8087.

The 8087 chip is expensive. The cheapest we have seen is $175 or £130 in one-off quantities for one that runs at 5MHz. The chip simply plugs into the Advance's mother-board; the difficulty arises from software, or rather the shortage of it. Unless your Basic, Fortran or whatever has been written to use the 8087 to do the arithmetic it will contain code for the appropriate mathematical routines within the compiler, and will use these rather than the 8087.

Not much software using the 8087 is around, and what exists is expensive. One source is Microware, PO Box 79, Kingston, Massachusetts 02364. For example, Fortran and Pascal cost $1,350 each, though there is a patch for the Microsoft Basic compiler for $150.

If your quest for speed is so important, it is worth considering some of the other alternatives. If the program has a lot of disc accesses, either to read or write data, then the time delay will be slashed if you add some extra memory and some software to use it, either as cache memory or as a silicon disc. Quadram memory expansion boards for the IBM PC have software for a silicon disc, and Dataflex Ltd, 238-246 King Street, London W6 has software for both cache and silicon disc.

Alternative Apple discs

Q I have an Apple II with one disc drive. I also have a spare 5.25in. Shugart SA-400 drive. I know that this is not compatible with the Apple, but can it be made to work? I am considering fitting two Pertec FD-400 8in. disc drives or a hard disc if the difficulties and cost are not too great.

G Bates, Lancaster.

A The Shugart SA-400 disc drive can be made to work on an Apple with a little care. First you need a printed-circuit board, which costs $30 from R and D Electronics, 100 East Orangethorpe, Anaheim, Ca 92801. R and D provides details of the tracks that must be cut on the SA-400 board and the jumper wires that must be soldered in. The power supply of the Apple may be inadequate if you already have several expansion cards in your system; the disc drive will draw an extra 450mA from the 5V supply. You might need to consider a separate power supply for the discs.

An Apple can be altered to use 8in. drives without too much difficulty. This has the advantage of increased storage and faster access times to the discs, but it is expensive. The 8in. drives have circuitry to perform most of the disc functions, but the Apple, unlike many other machines, carries out these functions in software.

Plainly, a new disc controller board is required to interface the two. One that we know of is the Vista A800, which costs $299 from Advanced Computer Products, 1310B East Edinger, Santa Ana, Ca 92705. This board uses high-speed DMA and so runs much faster than Apple discs usually do. It supports all the standard Apple DOS 3.3 commands except Init — and an improved version of this is provided. Eicon makes a unit with two 8in. drives and a disc controller card. It is available in the U.K., but is expensive at £1,695 plus VAT.

You might consider a hard disc to be a better buy, since it gives faster disc access than a floppy and also provides an enormous amount of storage.

In "Ask PC" our panel of experts answer questions on any area of microcomputing. If you have a nagging problem, write to us, writing ASK PC clearly on the top left-hand corner of the envelope. The most representative questions of general interest will be answered and published each month.

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

This month the replies are provided by John and Timothy Lee.

The Second Professional Personal Computer Conference

A date for your diary-the Financial Times second high level meeting on the Professional Personal Computer in London on 8 and 9 November 1984. This conference will focus on a market which is one of the most exciting in today's electronics industry but most complex and difficult to interpret.

The availability of distribution channels and retail outlets has become as critical as availability of venture capital in the success of personal computer ventures. With the advent of low cost powerful computing hardware, personal computer software assumes a new value and importance. This conference brings together leading figures from the major divisions of the industry to provide vital insights into the professional personal computer market of tomorrow.

Speakers will include:

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The Second Professional Personal Computer Conference

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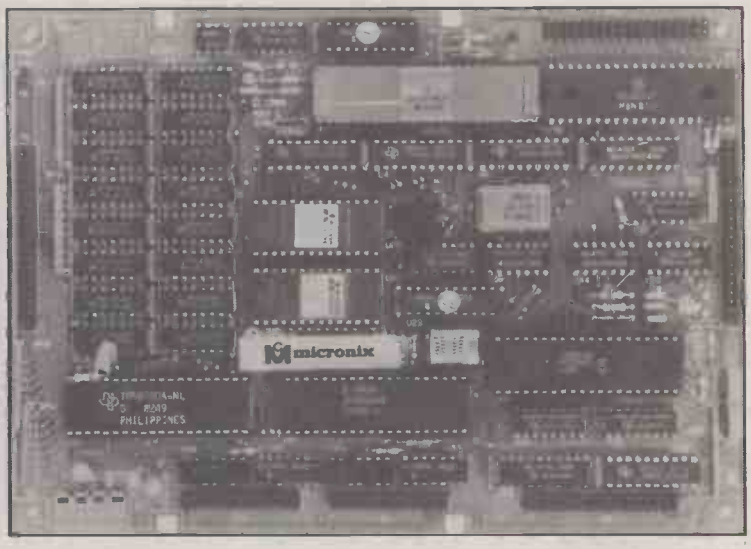

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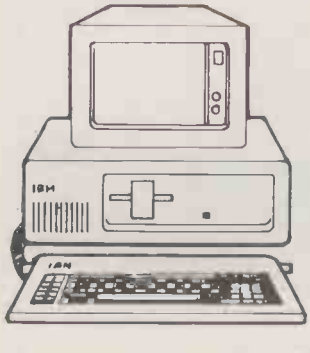

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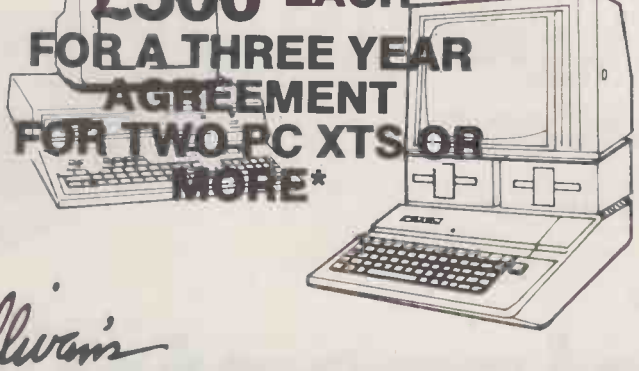

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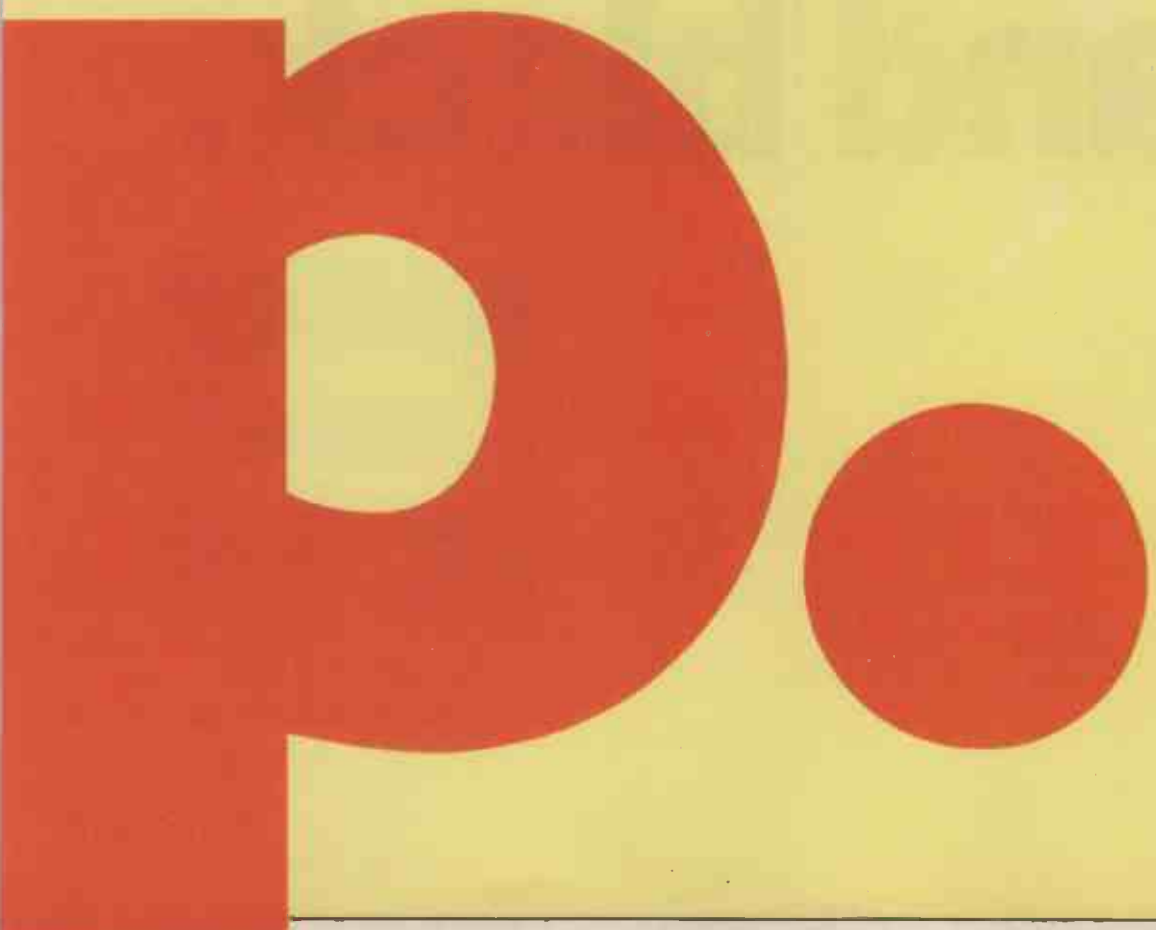

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Top mouse

John Billingsley reports on the European finals of the Micromouse contest.

THE LURE of five free trips to Japan brought 14 micromice to Copenhagen for the 1984 European finals — 15 if you include Mappy. Of these, 11 reached the centre in practice. The task of eliminating mice to set the final running order was easy.

Four teams arrived from Britain, intent on winning the championship back from the Finnish holders. Two teams came from Germany, and the Finns were out in force with three mice.

Alan Dibley brought T4, T5 and a Thezeus with revamped software. He also brought Bill Urmenyi's Gonzales, now cured of its sentry-box dithering. Dave Woodfield brought Thumper and Knownaim, plus a new mouse which was christened Enterprise during the time trials. Fullyautomatix was accompanied by David Jones and his team from Bangor-on-Dee.

From Germany came Ralf Hinkel's Speedy Gonzales and a team from Darmstadt with a mouse simply named Maus. Hannu-Matti Jarvinen's team brought Manu, Telly and Microsaurus, the Finnish champion mice for the past two years.

Gonzales and Thezeus started off with times around six minutes, while Fully-automatix at last lived up to its name with a three-minute score. Speedy Gonzales had some sensor trouble, but put up 2½ minutes all the same. Ralf Hinkel has designed a cunning guidance system which balances the reflections from the walls to place his tower-shaped mouse in the centre of passageway. Unfortunately it was developed with matt-white walls, on which the method works perfectly; the Euromouse maze had a gloss-painted walls which made Speedy shy away.

The gigantic Microsaurus with 1¼ minutes was slightly faster than T4 and Knownaim, while Manu and Telly were just behind T5, around the one minute mark. Leading by 12 seconds was the new Woodfield mouse, which was being introduced to a maze for the very first time. Enterprise is a steered tricycle, earning its name from the two stalk-mounted sensors which give it an outline resembling a certain starship.

After the maze had been reconfigured with some shorter paths and some dead-end tangles, Maus made a brief appearance. It performed very well for a beginner but retired after a few minutes. Fullyautomatix objected to the lighting: fortunately it is not expressly stated in the rules that the team may not follow the mouse around, shading it with an umbrella. The audience loved it, but Fullyautomatix was not so keen. Speedy Gonzales ran next, appearing to do very well until it came to a halt one square from the centre. With scrambled navigation it made off for home again. Surely Knownaim could show the audience how a mouse should behave? Apparently not, as time after time it slewed into a corner.

Now T4 found the centre in 1 min. 27s. and after a repair to a motor lead reduced the time to 1 min. 6s. From then on, mice marched to the centre in procession. Microsaurus reduced the leading time to 1 min. 3s., then Tellu whittled it down to 57s. Its twin, Manu shaved 16 more seconds off to leave the awesome target of 41s.

T5 blundered on an awkward corner and failed to find the shortest path. But Enterprise glided off almost soundlessly, taking up the challenge with a first run of just 47s. Tension mounted during the second and third runs, but on the fourth Enterprise dispelled all doubts by arriving in just 30s. Its lap of honour cut 2.5 more seconds off this incredible time — for a 70-square shortest path — with bursts of up to 3 metres per second.

Plans are already being laid for next year's British championships. For novices, the maze will be rearranged to form a single twisting passageway. New mice can concentrate on sensors and guidance, getting the mechanics right before turning to maze-solving. The experts will be tuning up their mice ready for Japan, while many mice might go on to compete at the Euromicro conference in Brussels at the beginning of September.

Alongside the maze, the first ping-pong playing robots should be putting in an appearance. Already several robot builders have written to say that their machines are under way, and it should be possible to have a preparatory skirmish in January.

For details of Euromouse and Robot Ping-Pong, write to John Billingsley, Department of Electrical Engineering, Portsmouth Polytechnic, Anglesea Road, Portsmouth PO1 3DJ.

How to keep the Bluggers happy

Boris Allan was at the second conference of the British Logo User Group.

FOR WELL OVER a year the question between consenting Bluggers has been: "Why is there no Logo for the BBC Model B?" At the first conference of the British Logo User Group in September 1983, there was much gnashing of teeth at the lack of a BBC Logo. But when the second Blug conference was held in September 1984 at Loughborough University everything had changed. Bluggers discovered that "shortly" there will be four versions of Logo available for the Acorn BBC computer.

Two versions are from individual companies not associated with either the BBC or Acorn: Logo Software Limited of Avon and SOLI/LCSI of Paris. The other two versions are from organisations closely connected with the BBC and Acorn. The third version is produced and marketed by Acornsoft, and the fourth version is produced by the Open University and marketed by BBC Enterprises.

Competition

Therefore, Acorn and the BBC are in open competition with a Logo for their joint product, the Acorn BBC computer. So, after waiting more than a year too long, both the BBC and Acorn have a provisional product, which is not a joint product but two separate products. Neither product is — of course — ready for release, so we will have to wait for the fight to start. It could be quite a fight, and both will probably lose to one of the independent suppliers.

It is difficult to evaluate any of the four products at this stage because all are unfinished and have problems. However, when I spoke to some teachers who use Acorn BBC computers in schools, the consensus was that the preferred version was that from SOLI/LCSI because it was the closest to versions already available on the Spectrum, Apple II and Atari. This semi-compatibility means that schools with Spectrums and Acorns would have similar Logos on both machines.

Also, in the time since the Acorn version of Logo was first announced, the Spectrum version has appeared and Research Machines has released two complete versions plus two updates. It shows a rather strange view of priorities that Acornsoft released languages such as BCPL and Lisp well before Logo, particularly as Acornsoft Lisp will be superseded by Logo for most applications.

Though there is a touch of unreality about the attitudes of Acornsoft and BBC Enterprises towards the language, the rest of the Logo community is very much in contact with the real world. The theme of the conference was Special Educational Needs and BLUG now has a Special Education Node. There were many contributions, which ranged from Marlene Kliman's programmable icons, to Mike Doyle's concept keyboard, to Allan Martin's simulation databases and to Richard Olney's Stories of Tilly the Turtle. These, plus many more, showed the richness and variety of Logo work and the way in which Logo is now being used as a development language.

For details of BLUG contact Richard Knott, BLUG, 106 Park Road, Loughborough, Leicestershire LE11 2HH.

Progress

In her lecture Sylvia Weir gave an example of how through using Logo an ineducable 17-year-old quadriplegic had progressed to become a computer science undergraduate. She dwelt at length on the effects of different sides of the brain on spatial and other perceptions and how this might be related to problems of, for example, dyslexia. Weir's work with the less able and the handicapped was impressive and showed great potential.

Logo is famed for its use of turtle graphics, a technique which has spread to many other computer languages such as UCSD Pascal. Turtle geometry is an example of what Seymour Papert, the best-known figure in Logo, terms a microworld, in that turtle graphics allow the user to explore the world of geometry on a computer and learn powerful ideas in the process. At the conference Papert said that he felt other microworlds needed developing to extend the utility of Logo, and he revealed that work was about to start on two very concrete microworlds in Logo.

The first microworld is concerned with sprites and motion; that is, the modelling of biological and physical dynamics on a computer via the mechanism of sprites. For example, relativistic dynamics could be simulated by sprites moving at various speeds, with light being represented by the fastest sprites. You could also study the locomotion of animals.

The second microworld is that of data or social studies. It allows statistics to be learnt through experience and helps the individual comprehend the use and misuse of information. The data microworld not only provides a treatment of statistics, but also of research methods and information retrieval. This was the most "real world" of his microworlds. Papert was careful to stress that this microworld went beyond Prolog and dBase II.

Seymour Papert opened his presidential address by asking why there was such a lack of black faces in his audience. Their absence worried him, and he wondered what it was about the Logo culture that encouraged this situation — one which he wanted to see changed.

Socially aware

Logo is now becoming closer to the real world in a socially aware manner, and is extending its coverage beyond that of education. There are many excellent Logos now available for use on home computers such as the Spectrum, Commodore 64 or Atari, and the promise of Logos for the IBM PC. So there is the potential for individuals to use Logo to their own advantage, away from the confines of schools and colleges.

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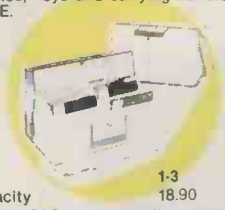

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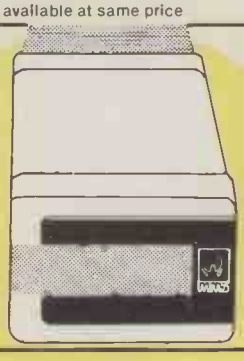

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by Ray Coles

Motorola's pin-up

Software designers the world over are longing to make the acquaintance of the youngest member of the 68000 family.

EVERYONE, it seems, regardless of which microprocessor they currently use, has a soft spot for the Motorola 68000. All the system designers I know are forever muttering: "Why didn't we use a 68000?" while they struggle with the complex intricacies of an 8086 or the limitations of some old eight-bit has-been. In a popularity poll of the world's design labs the 68000 would be the clear winner.

But when a microprocessor is chosen for a new system, many more important factors than the designers' preferences have to be taken into account. Things like device availability, unit price, and previous investment in training and capital equipment all play their part. That is why there are so many 8088/8086 systems around and so many unhappy designers.

Warty CPU

The users of a microcomputer need not concern themselves unduly about the type of CPU their system runs. They are probably writing code in Basic or Pascal, or using a turnkey package like Supercalc. Machines using the 68000 can do the job that much faster, but providing the system performs adequately most users will be content, and rightly so. All the wailing and gnashing of teeth has already been done by the hardware and software system designers. It is these poor souls who have had to mould that awful, warty old CPU into a friendly working system.

The reasons why many designers would sell their soul to the devil to get on to a design team using the 68000 are not hard to find. In a word, the 68000 is just beautiful.

When Motorola's chip designers first specified the 68000 they did not merely take some existing eight-bit device and bolt on extra bits to turn it into a 16-bit chip, as others were doing. Instead, they designed a 32-bit dream machine and then cut it down to 16 bits, so the 68000 became just a starting point for a complete new generation of compatible processors.

With 16 32-bit general-purpose registers, a 32-bit internal data bus, and a breathtakingly simple set of 56 basic instructions which could use five data types and 14 addressing modes, the 68000 became an instant success with system software designers. Hardware people loved it too, for its ability to access directly a 16Mbyte address space, its memory mapped I/O, its co-processor support, and its non-multiplexed data and address buses.

Old faithful

Not that Motorola has had everything its own way. The sheer scale of the 68000 kept yields down and prices up to begin with, and the promised peripheral device family, so essential in most systems, was late in appearing. Even now it still lacks a floating-point arithmetic unit. While posting pin-up pictures of the 68000 on their bedroom walls, most designers had to make do with the faithful old 8088/8086 from Intel.

Today, almost five years after its original launch, the 68000 has finally managed to turn the accountants' heads too. It is being specified for all the right, sensible, economic reasons in super new systems such as Apple's Lisa and Macintosh, and even the amazing now-you-see-it-now-you-don't Sinclair QL.

Meanwhile some stiff competition has sprung up from National Semiconductor with the elegant conception of the 16032. Even Intel is still managing to make the running by bolting even more goodies on to the groaning chassis of the 8086, to produce the 80186 and 80286. Attempts by love-struck designers to blow up the Intel assembly lines have so far failed.

32-bit power

Motorola, of course, has just been on tickover with the 68000, and all that 32-bit power has still to be unleashed. The first new member of the 68000 family to emerge was actually further down-market: the eight-bit bus 68008 version used in the QL. More recently the 68010 has become available, bringing with it the highly desirable feature of virtual memory support. With the 68010 Motorola is able to compete with the National 16032, which had virtual memory from the start.

The one everybody has been waiting for is the amazing 68020, which reveals for the first time the full 32-bit elegance of the original Motorola architecture. At the risk of triggering mass suicides in those design labs still stuck with the Z-80 or the 8086, I can now reveal that the waiting has not been in vain. The 68020 is now being supplied in sample quantities at only $487 each.

The 68020 has a full 32-bit address bus to reach 4Gbyte — 4,000Mbyte — of memory, a separate 32-bit data bus, and improved on-chip facilities that will make your eyes water. It is fabricated using high-speed, low-power CMOS technology. All the 68010 16-bit software will run unmodified on the new device. The slowest clock rate is 16.7MHz — faster than the fastest 68000 — and allows a performance of between two and three millions of instructions per second. At that rate it should comfortably outperform the 32-bit Vax midicomputer, currently accepted as the 32-bit standard.

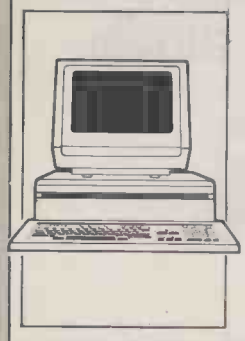
Speed increased

To further increase speed, the 68020 has a 64-level instruction cache that is kept topped up with instructions by an intelligent on-chip controller. When the next instruction is present in the cache area, instruction fetch is reduced to just two clock cycles, and simultaneous data and instruction access is possible.

Two new data types have been added: quad word of 64 bits, and bit field of one to 32 bits. There is a new basic addressing model called Program Counter Relative Indirect, which has variations to bring the total up from 14 to 20 modes. There are new instructions too. Some facilitate the new 32-bit operations while others provide new features like the eight-bit field instructions, which are useful for flag and control manipulations.

The arithmetic performance has been souped up by the incorporation of a 32-bit barrel shifter to shift data any number of places left or right in a single clock cycle. Thanks to this feature, a signed or unsigned 32- by 32-bit multiplication can be performed in only 2.64 microseconds.

There are lots of other nice features, but I don't want all those despairing designers on my conscience so I won't go on. Never mind. Only another five years before the accountants see it our way!



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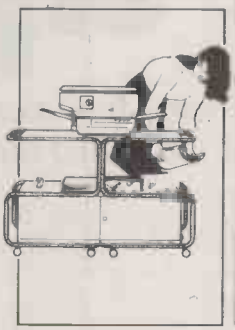

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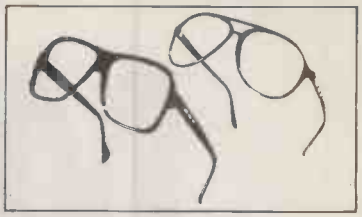

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Bolle (UK) Ltd, specialists in eye and face protection wear, introduce VDU spectacles — MICRO (Ultra lightweight) and ALPHA (modern ophthalmic frames). Fitted with IREX 90 PLUS lenses, the spectacles will substantially reduce eye strain and associated discomfort often experienced following regular or prolonged exposure to visual display systems, particularly where natural light is excluded. IREX 90 PLUS is a revolutionary organic material providing 100% protection against harmful ultra violet absorption and 90%+ protection against infra red rays. Clarity of images on screen is significantly improved and reflection is reduced leaving eyes in a relaxed condition.

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Microwriter plus Brother printer £399

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

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Zoom into new copying convenience

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

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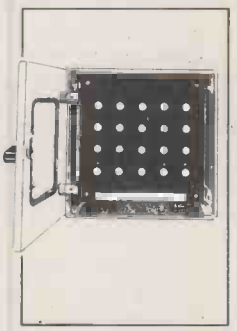
Patch panels for your computer installation

Patch Panels are an essential part of any computer installation, no matter how small. They allow you to organise your data cable network with the maximum degree of flexibility and efficiency. CCA stock a wide range of standard panels suitable for the connectors most commonly used in today's computer systems. We can also design custom-made panels to suit your particular installation. Cabinets are available with vision panels as illustrated. Our 19in racking panels are suitable for fitting to your own racks and are engraved in numerical sequence but we can incorporate your own numbering system where practicable.



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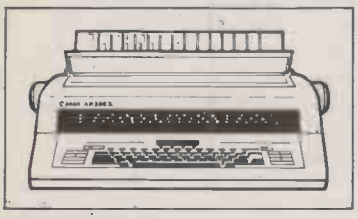

The X factor

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

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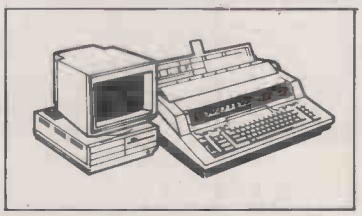

Streamline your word work

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

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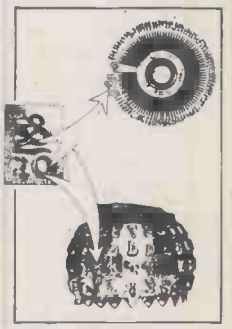
Stuck for a symbol on your typewriter?

Does your typing head meet your own individual requirements? If not, Butler & Tanner can help. They take your existing standard sphere or wheel and insert — permanently and with great care — the new characters. They can provide almost any character or symbol normally found in use around the world. If you require an unusual symbol such as a trade mark, send them a drawing as accurate as possible and they will finish it for you to reproduce exactly on your typing head. One to twenty alterations are possible and the work is guaranteed for six months.



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For years Business Aids' Scimitar Standard has been one of Britain's best selling shredders. Now the new 2205 Standard 2206 Electronic and 3104 Super offer even more refinements. All are mobile console models, available in 2mm, 4mm or 6mm shred widths, with enclosed internal waste containers. For ultra-security there is the Cross-Cut XC model. Newly designed motors make these the quietest of office shredders — the 2206 and 3104 emitting a barely audible 59 decibels. All functions are controlled electronically and an automatic anti-jam and clearing mechanism eliminates overloads at source. Contact me now, for full details.

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by Mike Lewis

Why are we waiting?

It pays to keep users informed about what their program is doing.

IF YOU ARE like me, you groan inwardly every time you see a software ad containing that much-abused phrase "user-friendly". It is abused because no software house would ever admit to the absence of this vital ingredient in its product. Yet you know and I know that most software currently on the market is downright user-hostile.

But in spite of this abuse, there are well-established standards for user-friendliness that the average programmer can easily achieve. You can make your software easy to use if you closely follow a few basic ground rules.

At the root of it all, you must know who the eventual users of your product will be. That does not mean their names and addresses, but rather their occupations, education, degree of computer knowledge and even their cultural backgrounds. After all, if you were an expert in medieval British architecture and were asked to write a book on your pet subject, you would treat it entirely differently if it was aimed at your fellow experts than if you were writing it for the casual visitor to Britain's cathedrals and castles. If you are designing an accounting package, you must know if your users will be accountants, book-keepers, data-entry operators or owners of small businesses.

The main reason for this is to get the terminology right. This applies equally to screen messages, printed output and the user manual. Above all, you must bend over backwards to avoid any hint of computer jargon. Even words that we programmers take completely for granted — such as field, file, report, input and directory — can be baffling to someone not familiar with computers. And as for such emotive terms as abort, crash, illegal and die — these are best eradicated from our vocabularies completely.

Providing a glossary of technical terms is no answer. Our job as software producers is to provide tools that will help our users in their everyday activities. If they want to be educated in computerese they will buy a book on the subject.

The same is true of the actual mechanics of operating the computer — the house-keeping functions, if you like. The user should not be distracted by such tasks as setting default drives, assigning peripherals or reorganising indexes. Even the necessary choice of making security copies should be made as automatic as possible.

Of course, all this assumes that you are writing an applications package which will be operated by non-technical people like book-keepers, wages clerks or secretaries. If you are writing a compiler or a technical programming utility your users will be programmers and there is every reason not to avoid technical terms. It's all a matter of knowing your users.

Another vital rule is to provide some form of feedback after every user action. Never leave operators in doubt about whether they have done the right thing, or even whether the key that they have just pressed has indeed registered. If you are prompting the user to check the printer and to press any key when ready, remove the prompt from the screen as soon as the key is pressed. Similarly, always erase an error message as soon as the error has been corrected.

Always try to keep your user informed about lengthy processes — operations that are likely to take more than about four

(continued on next page)

Ten tests for user-friendliness

There is no objective way of measuring user-friendliness and no infallible method of judging it. But if you can answer yes to the following questions, then there is a good chance that the designers of the software know their business and have at least given some thought to the needs of the users.

1. If you accidentally make the wrong choice from the master menu, can you change your mind before the program embarks on some time-consuming process?

2. Is there a quick and consistent method of abandoning a data-entry sequence without causing loss of data?

3. When entering a screenful of data, if you notice a typing error in the field that you have just completed, can you go back and alter it straight away, without having to wait until you have finished the entire screen?

4. If you want to change a single character in a long field, can you do so without having to retype the whole field?

5. If you accidentally hit an invalid key, will the program continue to work correctly? Try Control-C and Escape, which unless specifically trapped by the program might cause a return to the operating system.

6. Does the program erase error messages and prompts as soon as the error is corrected or the prompt is acted upon?

7. With functions that take more than, say, 30 seconds to run, is there some method of seeing how fast they are running and of reassuring yourself that the system has not hung up? A counter displayed on the screen is an obvious way of achieving this.

8. Are all error messages completely clear, informative and unambiguous?

9. Can you interrupt a long printout? You should be able to make the printing pause so that you can adjust the paper, then resume. You should also be able to abandon a printout without losing data.

10. Is the user manual designed for quick reference? Too many software publishers concentrate on tutorials and "How to get started" texts. They ignore the needs of the user who has become familiar with the package but who still needs to look up occasional points. At the very least, the manual should have a logical structure, a table of contents, and an index.

(continued from previous page)

seconds. If the program is about to embark on a time-consuming sort routine, placing the message

PLEASE WAIT

on the screen is good. But

ONE MOMENT PLEASE WHILE THE THE CUSTOMER LIST IS SORTED

would be better. Best of all, incorporate a counter with the message. If you show the counter descending to zero with each pass of the sort, the user can see how fast it is running and gets a rough idea of when it will finish.

This type of feedback is especially important for error messages. Keep your messages short, to the point and always polite. Never imply recrimination. After all, everybody presses the wrong key from time to time. Some newcomers to programming think it's very clever to respond to an invalid entry with a message like "you goofed", or even with a silly tune on the computer's speaker. It isn't.

Even a single bleep to signal an error can be intimidating to an operator working under pressure. Lately, I have taken to making all my programs completely soundless. On the other hand, an audible error signal is essential if the user is a high-volume data-entry operator who might only glance at the screen very occasionally.

The same is true of highlighting. Careful use of high-intensity or inverse-video displays can do wonders for the readibility of your screens. But don't overdo it, and try to avoid flashing. Many users even find a flashing cursor irritating.

Another highly-abused concept is the Help screen. There are few things worse than pressing a Help key, only to be confronted by a dense screenful of text taken straight from the user manual.

Some notoriously bad packages even require you to exit the current function before you call up the Help screens. Then, having presumably memorised what you have just read, you must laboriously step back to where you left off in order to use the information. A pocket-size quick-reference card would be far more user-friendly than this sort of so-called help.

In context

This does not mean that you should avoid providing Help screens in your programs. But do make them context-sensitive. If the user calls for help while an error condition is in force, it is reasonable to assume that what is wanted is more details of the field that is in error. And after the text has been displayed, return to the precise state of the program at the point where it left off.

Still on the subject of Help screens, be sure to keep the text short. A VDU screen is not the most readable of media, and few people feel comfortable trying to absorb a full 24 lines of 80 columns. One paragraph per screen is plenty for most people to read at a time.

In fact, it's worth giving very important screen messages, like

NOW MAKE SECURITY COPIES

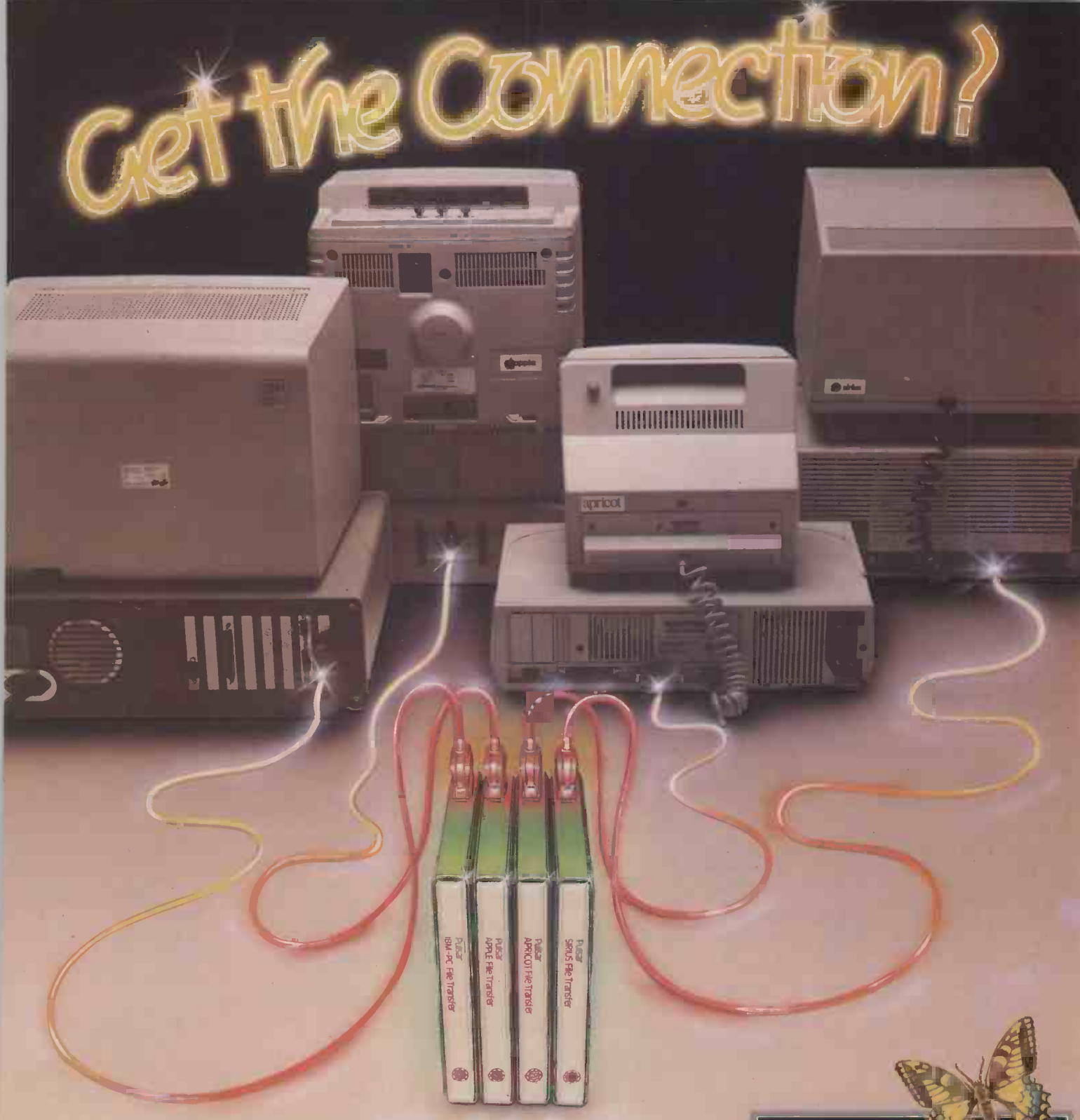
a screen to themselves. Remember that the eye tends to go to the middle of the screen first, so a message in this position on an otherwise blank screen will have the maximum impact.

The final rule is to be consistent. Decide at the outset which parts of the screen you are going to use for error messages, status lines, operating instructions and so on. Then stick to it as far as possible.

Be consistent too in the terminology you use for menus and Help screens, the way you handle operator errors, and your use of highlighting and audible feedback. Your aim should be to make the software as predictable as possible to the user, which in turn will make the user feel relaxed about using it.

This is especially true in the use of function keys and in the replies that the program expects from prompts. Imagine how you would feel if the key that you were accustomed to using to call the master menu was transformed, in just one part of the system, into the key for deleting a record. Seemingly minor inconsistencies like this can destroy a user's confidence in the system literally at a stroke.

Worse, a lack of user-friendliness can rob users at large of their confidence in the entire micro scene. So I make no apology for devoting this month's "Software Workshop" to this vital topic.



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Compound Interest – payments, present value, capital appreciation, savings
Depreciation – straight line, reducing balance, lifetime estimate, depreciation charge schedule, book value schedule

SCIENCE

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

UTILITY

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MATHEMATICS

Bessel – functions
Polynomials – solutions of equations
Matrices – solution of matrix equations, Eigenvalues
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IBM computing on the move

Jack Schofield looks at the IBM Portable Personal Computer and its transportable competitors from Compaq and Olivetti.

IT MAY HAVE BEEN the Osborne 1 that pioneered the market, but its success did not prove people wanted portability. It did prove there was a market for a cheap business micro with bundled software, but that is not quite the same thing.

The Compaq, however, offered only a marginal cost saving over the IBM PC and no bundled free software. Buying a Compaq really did mean buying portability, and they sold $111 million-worth in their first year. In response to Compaq's success, IBM has recently launched its own portable version of the PC, the Portable PC or PPC.

Financial links

The third major company involved is Olivetti, whose IBM-compatible micros are sold in the U.S. by the massive AT&T corporation with which it is linked financially. Olivetti too has felt it worthwhile to introduce a portable version of its M-24 micro.

Although many other companies make similar micros, these three brands are likely to account for the majority of IBM PC compatible portables sold over the next year or so. We therefore decided to see how they compare.

In fact, the major differences are not in the software the three machines will run but in styling. The IBM PPC is elegant, the Compaq is workmanlike and the Olivetti is stylish.

The only one that stands out technically is the Olivetti M-21, which runs much faster as it uses a full 16-bit Intel 8086-2, instead of the more common pseudo 16-bit 8088. Further, it has the most legible screen, the best graphics and the quietest disc drives. It has the fullest specification,

and yet is the smallest of the three. As it is also by far the cheapest, the Olivetti M-21 clearly emerges as the best buy, assuming production machines perform to the same level as the prototype tested.

However, from the point of view of functionality, all three machines perform to about the same level. If you are in the market for an IBM-compatible portable, all three will perform well.

Benchmarks

The standard Basic benchmarks were run, with the following times being in seconds:

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Av.
IBM PPC } Compaq }	1.3	4.8	11.8	12.2	13.4	23.6	37.6	36.9	17.7
Olivetti M-21	0.5	2.0	4.6	4.7	5.2	9.4	14.8	16.1	7.2

IBM PORTABLE

IBM's Portable Personal Computer, the PPC, was launched in the U.K. at the end of July, some months after the U.S. launch. It is a self-contained unit with an Intel 8088 chip, 256K of RAM, a 9in. amber display with contrast and brightness controls, colour-graphics adaptor, and one or two half-height 360K 5.25in. floppy-disc drives sited horizontally. The screen is monochrome, of course, and driven by a composite-video signal, so a separate colour monitor is required to take full advantage of the graphics.

The tiltable keyboard has the same excellent touch as the desk-top version, and the same layout, but the two are not interchangeable. The PPC keyboard is smaller, and its connecting lead is terminated by a telephone-type jack instead of a DIN plug. The keyboard also has a trough to hold the coiled connecting cable, and spring-loaded projections at the corners. These engage with holes around the front panel. The keyboard can thus be used hinged under the front panel, or detached completely. When packed away, the keyboard forms the base of the PPC, though the weight is borne by projecting flanges at the ends of the casing.

The main board layout is the same as the PC/XT. All the ports are sited on the back, along with the power and voltage switches which allow the PPC to be run from either 110V or 230V supplies. A flimsy hinged panel folds over this area for protection. Unfortunately there is no room inside for a mains power cable; it has to be carried in a separate pocket in the blue canvas carrying bag supplied.

The PPC keyboard has the same layout as the desk-top version but is smaller.

Easy to move

The PPC also has a superb built-in carrying handle which runs the full length of the back. It allows for a two-handed grip and makes the machine very easy to move around. Overall the PPC has a very sturdy construction, but it remains elegant. The keyboard and its system of attachment are better than those on either of the other machines.

The interior layout is crowded partly because of the need to shield the main board from the power cable and the disc drives from the monitor. This has been done well, and the display stays stable when the drives are in use, as is also the case with the Compaq and Olivetti.

The board has seven expansion slots, two of which are occupied by the graphics card and disc controller. That leaves only one full-size expansion slot empty, plus four short slots. A printer driver is not installed as standard.

IBM says the PPC can be expanded to 512K of RAM rather than 640K, and indeed it is hard to see where the other 128K would fit. Certainly any non-IBM expansion cards should be purchased with extreme care.

The PPC weighs 30lb., which makes it just about transportable. It is very easy to set up and use almost everywhere, though you need a separate bag to carry discs and you can forget about carrying the manuals.

The screen display is acceptable. It is, in fact, the standard colour display, which is not as easy to read as the monochrome one, but the reduction in size to fit a 9in. monitor sharpens it up a bit. However, it is not as good a display as either the Compaq or the Olivetti give, and it would not be as comfortable to use for long periods. It has an annoying flicker when scrolling text.

The disc drives worked perfectly during the review period, in spite of the machine being moved about. However, they were noisy. The PPC had no difficulty running Lotus 1-2-3 and all our other PC-DOS software, except the DOS 2 Diagnostics disc. DOS 2.1 is specified by IBM, but the PPC also ran our DOS 1.1 software, including the Microsoft Flight Simulator. This raises the question: Why 2.1? The answer presumably lies in the access times of the new half-height floppies, since all the other parts are simply IBM units as used in other versions of the PC. However, in general only UCSD-p programs seem

(continued on next page)

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to be particularly sensitive to these differences.

One final point: the PPC is essentially a repackaged XT with a colour-graphics card instead of a monochrome screen/printer driver, but without a hard disc. So there ought to be a hard disc version....

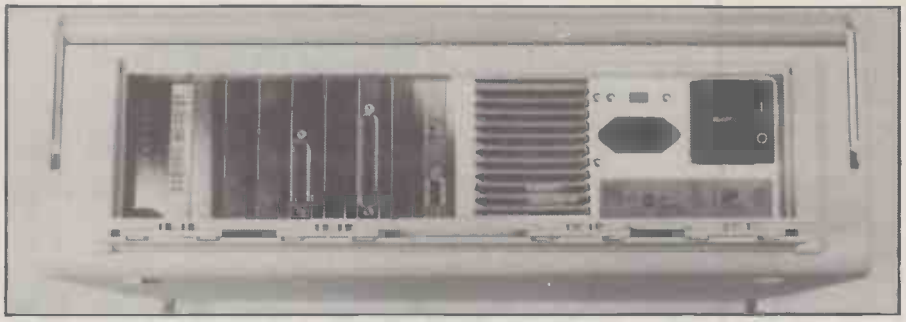
Conclusions

● The IBM Portable Personal is an IBM PC/XT repackaged in a transportable case. The effort has gone into the packaging which is excellent. The computer itself, however, shows no new advances.

● The screen resolution is not quite as good as it could be. A flicker-free combined monochrome/colour-graphics adaptor with 640- by 400- instead of 640- by 200-pixel resolution would be an improvement.

● At £1,889 plus VAT for a single-disc version the Portable PC is reasonably competitive. However, bear in mind the price includes no I/O facilities and most users will want at least a printer card.

● The IBM PPC will be made in Greenock, Scotland. It is supplied through authorised dealers. Telephone 01-200 0200 or contact IBM at 01-578 4399.



The IBM PPC can be run on both 110V and 230V supplies.

COMPAQ

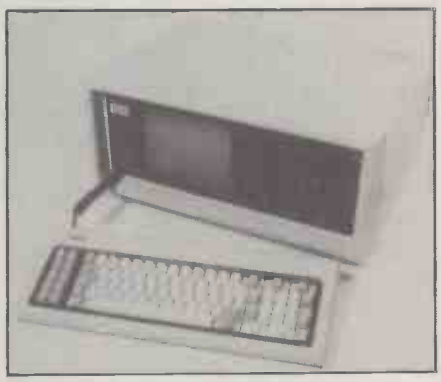
THE COMPAQ PORTABLE COMPUTER is designed and built in the U.S. by the Compaq Corporation, a company which was formed for that purpose less than two years ago. Being on the market a year before IBM's own PPC and offering excellent compatibility with the desk-top IBM PC, it has achieved great success.

It is a self-contained unit with an Intel 8088 chip, 128K of RAM, a 9in. green screen with dual text and graphics display, and one or two 320K 5.25in. floppy-disc drives placed vertically. It has 128K less RAM than the IBM PPC but includes a parallel printer adaptor. Again, colour can be displayed on a separate colour monitor.

The tiltable keyboard has an identical layout to that of the PPC. It is detachable, and joined to the system by a coiled cable which retracts into a hole next to the monitor. The keyboard is so light it is hard to use at some angles, as the cable tension is enough to pull it across a desk top. The actual keypress is shallower and less positive than on the IBM PC; touch is a matter of personal preference, but I prefer the IBM. Again, the keyboard slots over the face of the machine so that during transportation it forms the base. The clip attachment does not have the finesse of the IBM PPC, but it works adequately.

The motherboard follows a different design to the IBM's. With the machine stood on end, the expansion slots run from side to side underneath the handle, instead of up/down on the PPC. This means the ports are on the sides, hidden behind sliding panels, instead of on the back. On the power-supply side there is a large recess into which you can get just about jam a mains cable. The power supply is rated for the U.K. and is not switchable.

The Compaq has a suitcase handle, which calls for one-handed carrying. However, a padded brown carry bag is also available, and this provides the option of a shoulder strap, as does the PPC's case. Overall the Compaq is more solidly and robustly constructed than the IBM PPC.



The keyboard layout is like the PPC's.

Getting inside the Compaq is a real challenge which requires as much puzzle-solving ability as the Rubik cube as well as some strength. Inside it is built like a tank. The tough aluminium frame has been drilled full of holes, presumably to lighten it and to provide some ventilation.

The main board has sockets for 256K of RAM, and five expansion slots of which three are free. This allows memory expansion to the 640K maximum allowed by PC-DOS.

The Compaq is as easy to carry around and use as the IBM PPC. The PPC has a better handle, but the Compaq is easier to get into its carry case — it's that close.

From the point of view of booting and running software, both seem equally good. We found nothing that would run on the PPC but not on the Compaq — except, obviously, the IBM Basica, since most of that is inside the IBM ROM. In fact the Compaq had the edge, if anything: it ran through half the IBM Diagnostics disc.

As for the screen and keyboard, honours are again about even. The Compaq screen provides a more legible text than the PPC, though it has only a brightness and no contrast control. However, the IBM keyboard is far superior. It has a positive instead of a mushy feel, and it stays put when you place it on a desk top.

The disc drives are full size rather than half-height, and again performed impeccably. However, they were not much quieter than the IBM drives. It would seem to be possible to add a hard disc to the Compaq, along with a suitable disc controller. However, Compaq has recently launched the Compaq Plus 10Mbyte hard-disc model which has a special shock-absorbent mounting for the Winchester disc. It's a far better bet than upgrading the standard model.

Finally, Compaq has recently launched the Deskpro range of non-portable machines. These use the full 16-bit 8086, and it might be that Compaq will eventually change the portable to use it too, instead of the 8088.

Conclusions

● The Compaq Portable is functionally almost identical to the IBM PC and seems to be as effective as the IBM Portable PC.

● The Compaq has a superior screen display and an inferior keyboard. It is ruggedly made and workmanlike, but lacks something of the elegance of the PPC. It has 128K less RAM but a printer card instead. In the end, there is not much to choose between the two.

● At £1,795 plus VAT it is less than £100 cheaper than the IBM PC, so it is not trying to sell on price. For people who like what the Compaq offers, however, it is a viable choice.

● The Compaq Portable is distributed by Compaq Computer Ltd, Ambassador House, Paradise Road, Richmond, Surrey TW9 1SQ. Telephone: 01-940 8860.

OLIVETTI M-21

OLIVETTI announced its two new IBM PC-compatibles, the M-24 and M-21, earlier this year. Desk-top models have been on sale for some weeks and are upgraded from the prototype reviewed in our April issue. The M-21, reviewed here, is another prototype. However, the main boards of the two machines seem to be the same, so presumably this is a fair guide to the final product.

The M-21 is a self-contained unit with an Intel 8086-2 chip, 128K of RAM, a 9in. amber screen with brightness and contrast controls, colour-graphics adaptor, printer adaptor, asynch serial RS-232C port and one or two lockable half-height 360K 5.25in. floppy-disc drives. The video port is on the back under a screwed-down cover. You could disconnect the built-in screen and use the port to drive a colour monitor, but the cable was too tight for me to try this.

The keyboard follows the IBM PC layout, except for the positioning of the function keys across the top instead of down the left-hand side. It is a superior arrangement in itself, but it is not standard. The M-21 has the narrowest keyboard of the three machines, hard-wired by a cable to the front of the box. As usual it clips over the screen for transportation. Here the M-21 is different in that the fold-away handle is on the side, so it is carried with the screen facing the front, while the ports are at the back.

The main board is upside down at the bottom of the case, and a bus converter has to be added to the 16-bit 8MHz slot to provide three expansion slots. But most people will not need to add any cards, unless for RAM from 256K to 640K. Other details include a hole in the back, next to the oversized fan, into which you can cram a power cable. There is a folding flap — constructed too weakly on the prototype — to give the system an upward tilt.

Like Fort Knox

It is not possible to pronounce on the final construction but the overall appearance is stylish. It looks smaller than the IBM PPC and much smaller than the Compaq. Unlike the M-24, the M-21 proved harder to get into than Fort Knox: not wishing to damage anything, we desisted. However, the prototype's interior appeared to be very strongly constructed, and there should be no qualms on this score.

Although the M-21 was the smallest of the transportables it was also the heaviest — a couple of pounds over the IBM PPC — but Olivetti says the final version will be the lightest of the three. No carrying bag was supplied — in fact, no manuals and no discs were supplied either — but there were no problems in transporting and using it with M-24 system discs.

The oddly-shaped M-21 has its function keys across the top of the keyboard.

It is in use that the M-21's real qualities emerge. The 9in. screen is flicker-free and has brightness and contrast controls. It is outstanding for its clarity, being rather better than an Apricot and not far off a desk-top green-screen IBM PC. In fact, it was hard to believe it was only a 9in. screen. Because the M-21's front is smaller it looks bigger. The M-21 also provides an excellent grey scale, plus an enhanced 640-by 400-pixel mode, which can be used from Basic but is not called by standard IBM PC packages.

The M-21's disc drives are also better than the IBM and Compaq ones. They run a lot more quietly, making only locking clicks rather than rasping noises.

The M-21 runs more than twice as fast as the IBM PPC and Compaq. Its average was 7.2 seconds over the standard eight benchmarks, compared to 17.2 for the others. It writes graphics a lot faster, and this was very noticeable with programs like the Flight Simulator, Lotus 1-2-3 and Psion Xchange packages.

Other enhancements also made the M-21 the most impressive of the three. For example, it already has a clock/calendar card, printer driver and RS-232C port built in, which saves a lot of messing about. The keyboard has LED indicators on the Num Lock and Caps Lock keys, so you can see if they are on or not. There is a Reset button on the front of the machine which allows you to escape from crashes where Alt-Ctrl-Del fails to work. The M-21 ran all the same IBM software as the Compaq, and even made a start on the DOS 2 Diagnostics disc.

There are few things to criticise. The feel of the keyboard may not be as good as the IBM PPC's but it is certainly much better than the Compaq. Also the power supply is not switchable; only the U.K. mains are catered for.

Conclusions

● The Olivetti M-21 is an M-24 repackaged as a transportable. The packaging is very good, and technically the machine is conspicuously better than either the IBM PPC or the Compaq.

● The M-21 has the best screen, the best graphics, the quietest disc drives, and runs more than twice as fast as the other two. It is also more compact. The keyboard award just goes to IBM.

● The M-21 has the best specification, as it includes such extras as a built-in clock/calendar, LED indicators, printer adaptor and serial port.

● At £1,545 plus VAT for a 128K version with one disc drive, the M-21 represents by far the best buy of the three. However, bear in mind it needs an extra adaptor to provide the expansion slots if you need to fit more than one expansion card.

● The M-21 is manufactured in Italy and distributed in the U.K. by British Olivetti Ltd, Olivetti House, 86-88 Upper Richmond Road, London SW15 2UR. Telephone: 01-785 6666.

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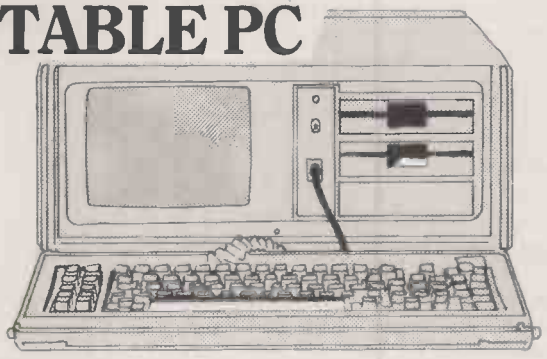

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Lotus – Smyphony: All-in-one integrated package incorporating graphics, communications, spreadsheet (1-2-3 compatible), word processing and database system.

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

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

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

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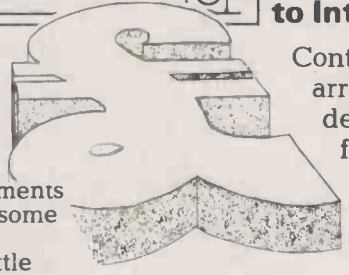

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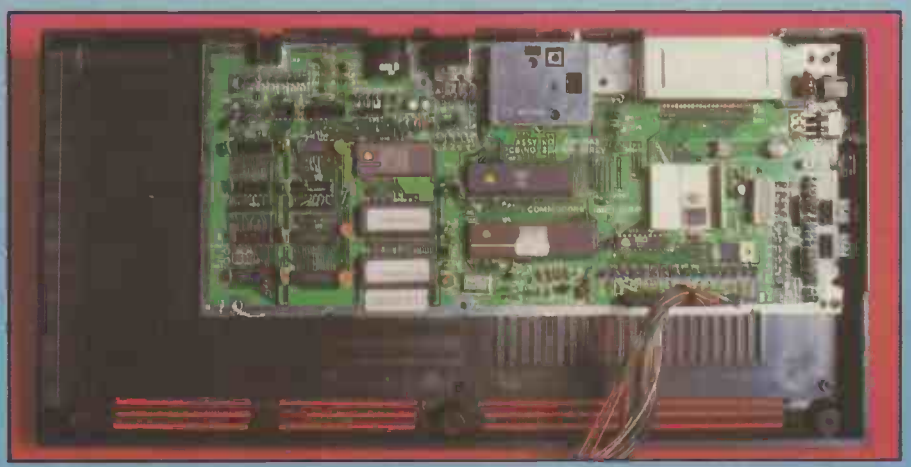
COMMODORE

With two micros that neatly bracket the range, Commodore has regained the initiative to make a two-pronged attack on the home market. Bill Bennett investigates how the new machines stand up against their various competitors, while Glyn Moody tests out the integrated software suite bundled with the Plus-4.

WITH MSX on the way, Commodore has launched two new micros at the opposite ends of the same market as the myriad Japanese look-alikes. Few manufacturers have the confidence to launch anything until the public's reaction to the MSX wave has been gauged, but Commodore is one of microcomputing's superpowers and must be seen to act boldly.

The mention of MSX isn't just in passing. Both the Commodore 16 and the Commodore Plus-4 are blessed with a new improved Commodore Basic, which is much nearer to MSX Basic than the inarticulate dialect of the Commodore 64. The bottom of the home-computer market has always been the toughest battlefield, and the 16K Commodore 16 is pitched here, replacing the Vic-20.

Further up-market is the Commodore Plus-4, which will be seeking the high ground among the BBC Micro, Sinclair QL and the more expensive home computers or cheaper business machines. The trend in this part of the market is towards bundled software, and accordingly the Plus-4 has its own word-processor package supplied on ROM. It is fitted inside the actual machine, as is the word processor on the long-awaited Enterprise computer.



The guts of the 16 are largely empty.

Powerful

But the Plus-4 is more than just a word processor. On the same chip there is a database package, a business-graphics package and a spreadsheet program. This so-called 3 Plus 1 software suite makes the Plus-4 one of the most powerful systems around, and the price of £299.99 means that it meets MSX straight on, undercuts the QL and pulls the rug from under the BBC. On more expensive business micros, such as the MS-DOS machines, the equivalent software alone would cost more than the asking price of the Plus-4.

The 3 Plus 1 programs are similar in concept to the Psion Microdrive software bundled with the QL — with the difference that you cannot lose them. The chip-based versions are much less likely to be corrupted or damaged than Microdrive cartridges, and they have the advantage of linking to a 5.25in. floppy-disc drive. All the bundled software can be accessed directly from the function keys which sit in a row across the top of the main keyboard, and make use of them once they are running.

If there was one overwhelming criticism of the Commodore 64, it was that the Basic

Commodore's 16 — successor to the Vic-20.

16 and PLUS-4

was dreadful: so bad, in fact, that most programmers had to make the effort to learn machine code. Manipulating the high-resolution graphics and squeezing sound out of the Sid chip could only be performed in machine code, or by extensive use of Peek and Poke commands.

Pascal inspired

This is not a problem with the new machines. They come with Commodore Basic version 3.5, which is similar in many respects to the Basic of the 8032 series Pet computer, with the addition of commands to handle sound and graphics. Although strictly speaking it is not structured to the degree that the BBC dialect is, it does nod in that direction with constructions like Do-Loop, While, Until and Exit. All these commands are Pascal inspired, but there are no real procedures or passing of parameters to subroutines.

Basic programmers will love the system commands. They are a great help to program development and aid beginners learning about programming for the first time. TrOn and TrOff get the machine into and out of the Trace mode, which lets the programmer know where he or she has been. This is especially handy for identifying bugs, as is the Trap command, which picks up errors in the same way as the On Error Gosub construction of other computers.

Commands like Auto and Renumber will also find favour among serious programmers, who will certainly have missed such useful functions on the Commodore 64. The Hex$ and Dec functions convert numbers from one base to another — something primary school children can do without blinking, but which causes problem for those of us with only 10 fingers. Of course hexadecimal numbers are mainly used in machine-code programming, and that can be done very easily with the Plus-4.

The Monitor command takes the programmer into a machine-code monitor that can also be entered when a machine-code program fouls up. It allows the user to disassemble code, enter hex codes directly into the memory, and examine various registers.

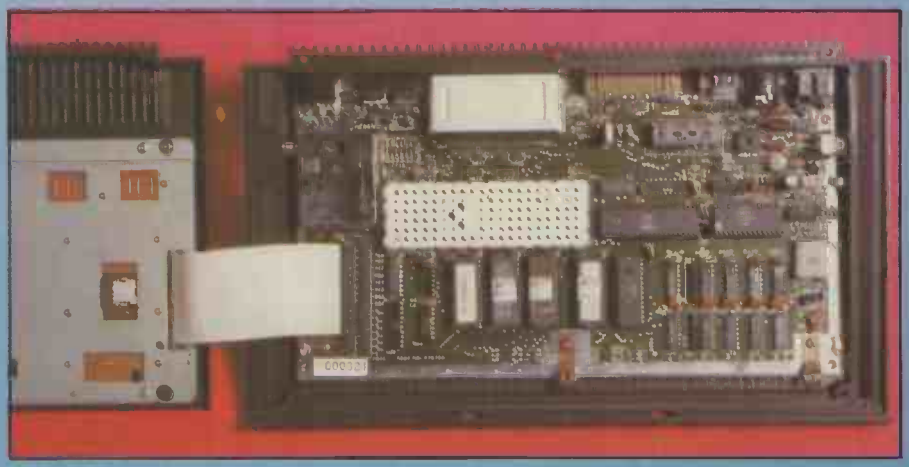
The system includes a tiny assembler which lets you assemble code a line at a time, though it seems to be incapable of handling branch instructions. While you are in the monitor you can dump sections of memory to tape, and load sections back again.

Commodore's programmers have also managed to beef up the disc commands. They were a little unwieldy on the Commodore 64, with the user always having to worry about channel numbers and the like. In addition to DSave and DLoad, there are some extra Basic commands including Header, Scratch, Collect, Copy, Rename and Backup.

One interesting feature of the new disc operating system is that it is possible to use the Directory command to list out all the file names on a disc, without losing any Basic program which happens to be sitting in memory at the time.

The new machines only have two channels of sound to play with. They are easily controlled from Basic: the main

(continued on page 61)



The interior of the Plus-4 is normally well shielded.

The stylish lines of the Plus-4.

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16 and PLUS-4

(continued from page 59)

command for generating music is Sound, where voice, pitch and duration have to be specified.

Business graphics are handled by one of the programs that comes as part of the Commodore Plus-4, but they are not available on the 16. It is also possible to do a great deal with the high-resolution graphics using Basic — though on the 16 only about 2K of memory is free to Basic when high resolution is in use. The Plus-4 offers a hefty 48K of Basic memory space.

High-resolution graphics are initialised by the Graphic command, followed by an integer between 0 and 4 to specify the mode. Mode 0 is just the text screen. It can be printed to, using the Print command together with the usual set of embedded cursor-control commands that can sit inside Print strings. There is also a Print Using on both machines.

Naturally it is possible to Poke characters to the 1K memory map, and colours can be Poked to the colour memory map. In this way the new machines are similar to the Commodore 64, though the screen memory is located at a different position in memory. The Plus-4 and 16 feature an extra pair of screen-formatting codes which allow flashing characters to be switched on and off. Characters flash at the same pulse rate as the cursor, but it is possible to alter the interrupts to change these rates.

Graphics modes 1 and 2 give a screen resolution of 200 pixels down the screen and 320 across — the same as the Commodore 64. Mode 2 opens a window at the bottom of the screen to contain text. Graphics modes 3 and 4 provide higher-resolution graphics, in what the Commodore 64 manuals called "multi-colour" mode. In this mode horizontal resolution is halved, but in return there are four colours to play with. Like mode 2, mode 4 provides a text window in addition to the graphics.

There are a total of 16 colours available on the new machines, just as on the 64. Yet somehow the new colours look brighter than the older set. The screen display is also much steadier, and tuning it in was less of an ordeal. The palette of four colours

(continued on next page)

The Plus-4's switch-like function keys are easy to use, as are the neat compass-point cursor-control keys.

Benchmarks

The Benchmarks show the time in seconds taken to run the eight standard Basic routines. The Commodore 16 and Plus-4 emerge slightly faster than the Commodore 64 — not bad, when you consider how much more powerful Basic 3.5 is.

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Av.
Commodore 16 and Plus 4 — 7501	1.4	9.4	17.9	18.5	20.9	34.2	54.6	100.6	32.2
BBC Model B — 6502	1.0	3.1	8.3	8.7	9.2	13.9	21.9	52.0	14.8
Sinclair QL — 68008	1.9	5.4	9.3	9.1	11.8	24.0	42.4	20.7	15.6
Commodore 64 — 6510	1.4	10.5	19.2	20.0	21.0	32.2	51.6	116.0	34.0

Specification

COMMODORE 16

CPU: 7501, a 6502 look-alike, running at 1.76MHz
RAM: 16K
ROM: 32K containing operating system and Basic 3.5
Dimensions: 400mm. (15.75in.) by 203mm. (8in.) by 63mm. (2.5in.)
Power supply: separate transformer unit
Display: 16 colours and 40 columns by 25 rows; high-resolution graphics mode allows 320 by 200 pixels with two colours available within each eight- by eight-pixel square; multi-colour mode allows four colours but resolution is only 160 by 200 pixels
Keyboard: full QWERTY, with four function keys doubling up to eight with Shift key; four cursor controls
Mass storage: cassette unit supplied as standard; serial port can be used with 1541 disc drive
Interfaces: Serial bus, cassette output, memory expansion port doubling as a cartridge port, two joystick ports, video and UHF outputs
Software: Introduction to Basic Part I and four games
Hardware options: works with 1541 disc drive and any Commodore printer
Price: £139.99 including VAT
Manufacturer: Commodore U.K.; details from Commodore Information Centre, 1 Hunters Road, Weldon, Corby, Northamptonshire NN17 1QX. Telephone: (0536) 205252

PLUS-4

CPU: 7501, a 6502 look-alike, running at 1.76MHz
RAM: 64K
ROM: 32K including operating system and Basic 3.5; 32K holding word-processor, spreadsheet, database and graphics packages
Dimensions: 305mm. (12in.) by 203mm. (8in.) by 63mm. (2.5in.)
Power supply: separate transformer unit
Display: 16 colours and 40 columns by 25 rows; high-resolution graphics mode allows 320 by 200 pixels with two colours available within each eight- by eight-pixel square; multi-colour mode allows four colours but resolution is only 160 by 200 pixels
Keyboard: full QWERTY, with two Shift, two Control and Commodore C = keys; four function keys doubling up to eight with Shift key; cursor controls in the form of compass-point arrows
Mass storage: cassette ports, incompatible with Commodore 64 leads; serial port can be used with 1541 disc drive
Interfaces: serial bus, cassette output, user port, memory expansion port doubling as a cartridge port, two joystick ports, video and UHF outputs
Hardware options: works with 1541 disc drive, and any Commodore printer
Price: £299.99 including VAT
Manufacturer: Commodore U.K.; details from Commodore Information Centre, 1 Hunters Road, Weldon, Corby, Northamptonshire NN17 1QX. Telephone: (0536) 205252

The 3 Plus 1 integrated software suite

The 3 Plus 1 integrated software on the Plus-4 is Commodore's answer to the QL's four bundled packages. The same applications of word processor, spreadsheet and database are offered, together with a graphing facility. The approach is rather different though. Where Sinclair went for software supplied on Microdrive cartridges, Commodore has opted for a 32K ROM.

You call up the programs by pressing the function key f1 followed by Return. The opening screen is the word processor. A document can have up to 99 lines of 77 characters, of which only 22 lines of 32 characters are displayed. The screen acts as a window which you can scroll horizontally by moving the cursor. There is a line and column count at the bottom of the screen.

Text is entered without visible wordwrap, words being broken however they fall at the end of the page. Printed documents do, however, have words properly distributed across line ends. You edit text by moving the cursor to the relevant word and then using the Delete and Insert keys.

A command line is displayed below the main text area. Command mode is entered by pressing the Commodore C= key together with the letter C. Operations like inserting lines, saving to disc and block moves are called up using various two-letter commands such as IL, SF and IB. Search and Replace is called up similarly.

Other operations are carried out by embedding commands in the document in reverse video. Margins can be changed, text centred or justified, and documents linked together at print time. This last procedure allows you to overcome the otherwise rather limited text file size.

In use, the word processor is quick to respond, as you would expect from a ROM-based system. The text window is rather limited and the lack of wordwrap produces messy displays. Otherwise the program provides a perfectly respectable implementation of most standard word-processing functions. The slightly rickety keyboard works surprisingly well even at fast typing speeds.

The spreadsheet package is called up from the word processor using the two-letter command TC. A three-column by 12-row window of the 17 columns and 50 rows available is visible. You move around the sheet using the Up and Down cursors and f1 and f2. The left and right cursors are reserved for editing within a cell. Numbers are entered directly; to enter text you have to press C= and T.

Formulae can be set up in cells in the form

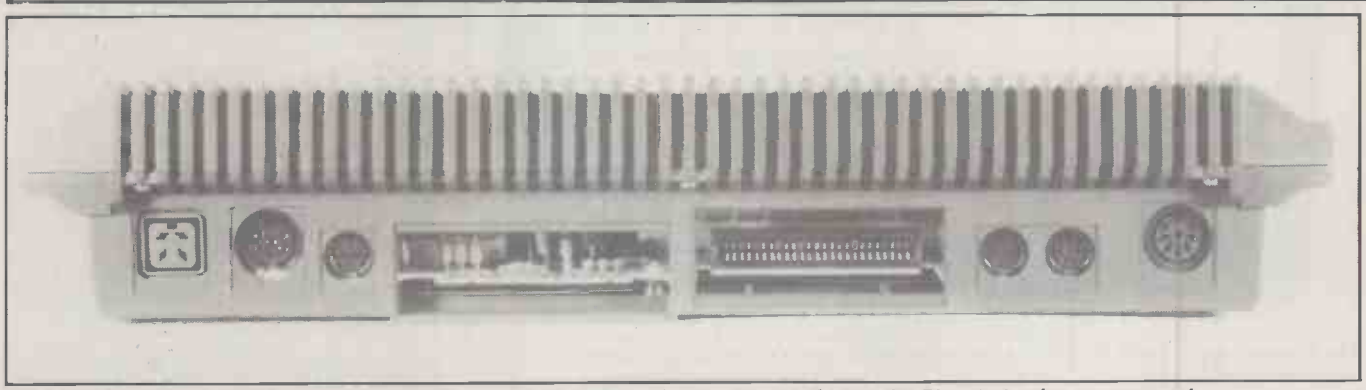
3:1 + 3:4

This expression would add together the values in the cells at row 3 columns 1 and 4, and place the result in the cell containing the formula. There is a Fit command — one of the several that are not in the two-letter format — that allows you to replicate formulae across to other cells, with the necessary changes made automatically.

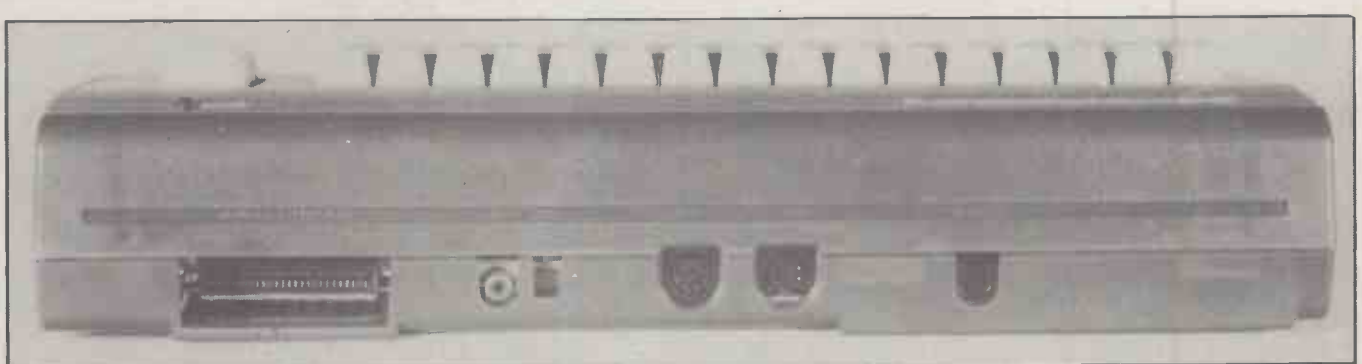
Perhaps the most interesting feature of the spreadsheet is the windowing it offers. First the size of the displayed sheet is halved. Then, by using the command TW, you enter the word processor. You can now switch between the two applications by a few keystrokes, while keeping both on screen.

The integration claimed by Commodore is no mere frippery. To print out a spreadsheet you first transfer it to a text file, and then use the word processor. After you have positioned the cursor at the top left-hand corner of the part of spreadsheet you wish to transfer, the BlkMap command followed by a cell co-ordinate defining the bottom right-hand corner carries out this operation. The partial spreadsheet is transferred to the last position of the cursor in the word processor.

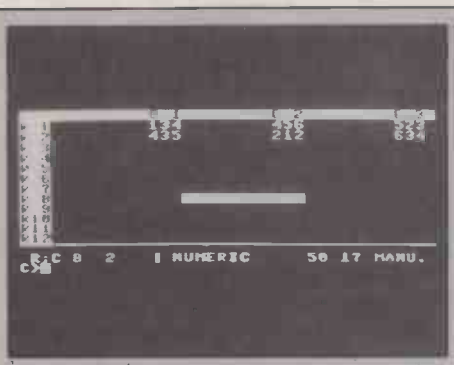
Apart from standard arithmetic operators and functions like Sum, the spreadsheet also offers a rudimentary graphing facility. Once you have set up a spreadsheet, you can graph any of its columns by using the command GR. Stacked # symbols are scaled



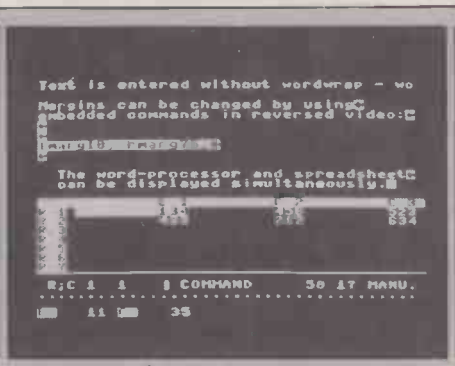
Both the Plus-4 and the 16 have non-standard joystick ports and cassette interfaces; the Plus-4 also has a user port.



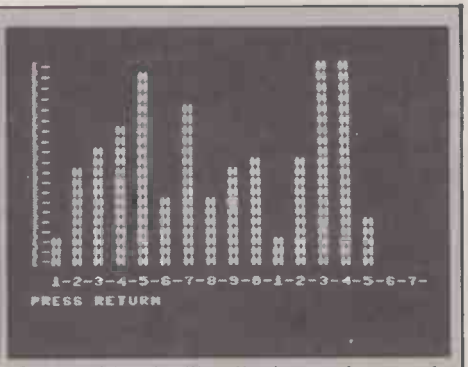
Like the Plus-4, the 16 has an expansion socket incapable of taking extra memory, and a standard Commodore serial port.



The spreadsheet displays a command line at the bottom of the screen.



Windowing is available for simultaneous viewing of two applications.



The graphing facility displays columns of stacked # symbols.

automatically; the scaling factor is held in cell 50;16. The effect is necessarily crude since it uses character, rather than high-resolution graphics. The bonus of this approach is that graphs can be integrated directly into a text document, and for this purpose it is probably sufficient.

The final part of 3 Plus 1 is the database, which you enter using the command TF from either the word processor or spreadsheet. You need a disc drive to hold all the records. In structure the database is like Archive on the QL, and many others.

First you set up the record format, specifying the field name and the length. Up to 17 fields of 38 characters can be used, and up to 999 records, space permitting. Each record is assigned a unique record number. You can call up a particular record using this or the Search command and a keyword. As it looks through each field for the keyword the search command does not distinguish between upper- and lower-case letters.

You can sort records on up to three fields. During a sort, memory space normally taken by the word processor is used, so care will be needed if you are using several applications at once. As with the spreadsheet, you can only print out records via the word processor.

The easy link between the two is put to good use in the mail-merge facility — something that the QL's Archive program lacks. Reversed-out commands are embedded in the document at the appropriate spots where fields are to be pulled in from the database. An End of File marker causes the program to move on to the next record. There is a limited ability to create selective groups on the basis of one field, and in this respect the QL package is much more versatile — but that is hardly surprising, considering its size.

The greatest discrepancy between the Commodore and application suites is in the graphics. Easel is the largest of the Psion packages, and offers fast graphing of figures in a variety of formats. The Plus 1 of 3 Plus 1is little more than an auxiliary command of the spreadsheet.

The spreadsheet itself is more than adequate for home purposes. Psion's Abacus scores in terms of speed of response and ease of use, but as with all the Microdrive cartridge-based programs, integration is a far more cumbersome process. 3 Plus 1 gains in its effortless interchange of data. The price you pay for this speed is in smaller programs which are more difficult for inexperienced users to learn.

16 and PLUS-4

(continued from previous page)

available in the high-resolution mode can be changed using the Color command, which works in all five modes, as does the screen clear command ScnCLR.

A number of commands and functions exist to make programming the high-resolution graphics easy, including Paint, Box, Circle, GShape, SShape, Draw. Locate and Scale. The functions allow the program to read various colours and locations. Paint is an especially good area-fill command, which can handle concave or even re-enterent shapes. Box and Circle use parameter lists as long as your arm, and Circle can be made to do anything except sit up and beg.

There is not much difference between the casing of the Commodore 16 and the 64 — the 16 is black, and certain keys on the keyboard have different functions. The Plus-4 is radically different. For a start it looks very stylish and it is very well built. The casing is rugged, with metal plates to provide screening.

Because the Plus-4 is about the same size and shape as a portable typewriter, it looks good on any desk. The keyboard is just like any electronic typewriter. The odd-looking function keys are actually very logically arranged and easy to get used to. In fact, the whole package looks like a postgraduate exercise in ergonomics.

Both micros have a Reset button, which effectively erases the current program. It does so by moving the pointer so that the computer thinks there is no Basic program there, and so it should be possible to recover any software after a Reset. It was disappointing to find that the joystick ports are non-standard, as is the cassette interface.

At the rear of both machines is an expansion socket, which is not capable of taking extra memory. Also present is the standard Commodore serial port through which you can connect any of the current range of Commodore printers, plotters and disc units. All of them will work with the system quite happily. In addition to all this, the Plus-4 has a user port, which is an extension of the main circuit board.

Conclusions

● The two new Commodore machines attack the concept and machines of MSX from a number of angles; price and bundled software are just two of them.

● While the Plus-4 will sell to small business and professional home users, the 16 will be a strong contender for beginners' cash. The Plus-4 sets a new standard in software bundling.

● Software will play an important role in the forthcoming marketing campaign. With games programs and prestige items like Logo, Commodore certainly has the software "legs" to go the distance.

● The Commodore Plus-4 is an ideal next micro for users wanting to upgrade from Dragon, Spectrum, Commodore 64 and all the other low-cost home computers.

● It is a pity that Commodore has wilfully chosen to make its old cassettes and joysticks incompatible with the new machines. It is also unlikely that memory expansion for the 16 will be available from the manufacturer. Third-party suppliers will doubtless plug this gap.

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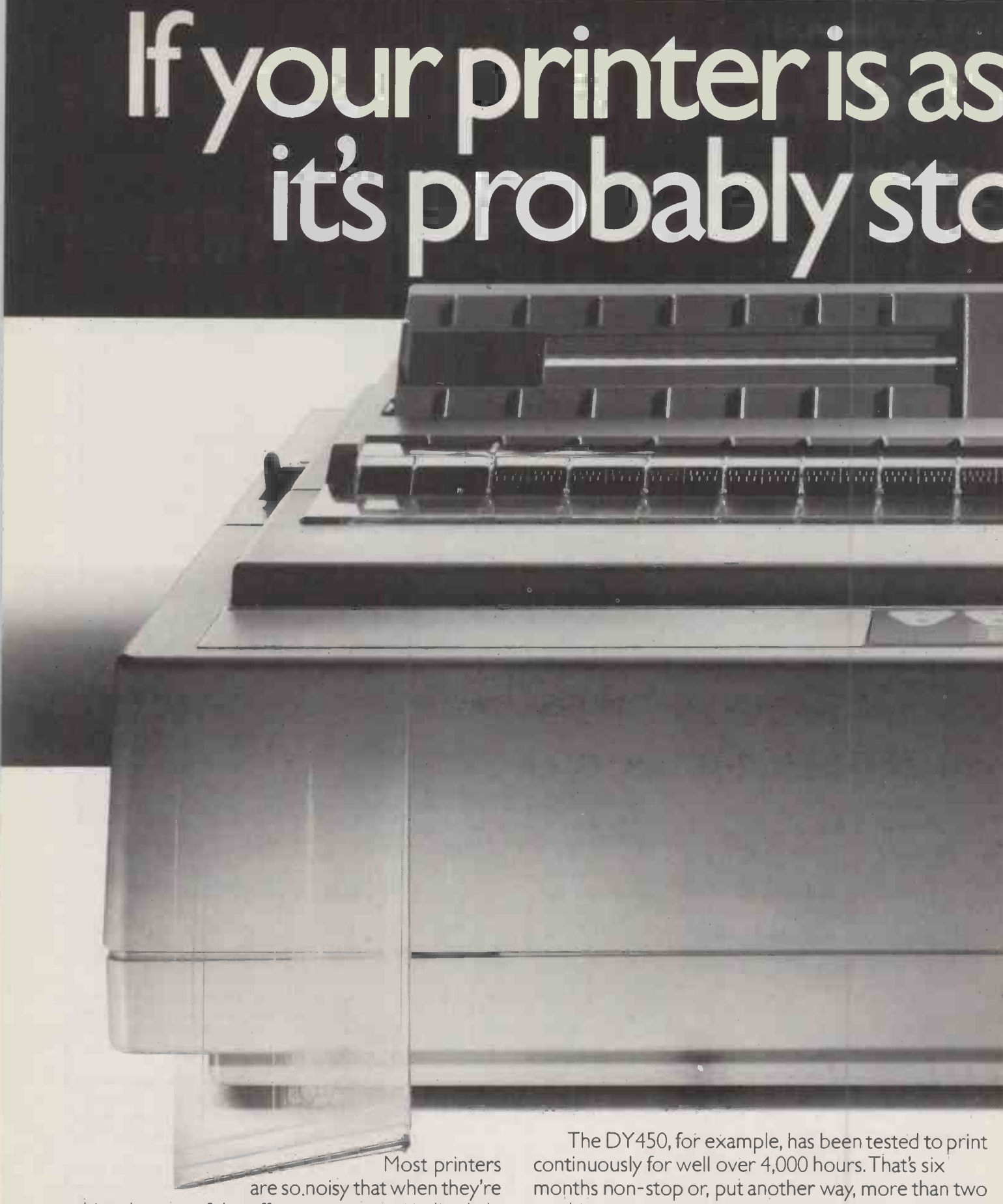

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A clean contest

Both the British-made Tatung Einstein and Japanese Sharp MZ-700 come with only a bare operating system to bring to life their Z-80 CPUs and 64K RAM. John Hooper discovers where the similarity ends.

AT THE END of 1983 Sharp belatedly introduced the MZ-700 home colour computer to the U.K. It was good in parts, but on the bad side it was just the old MZ-80K with colour. Indeed, its lack of a high-definition screen, user-definable graphics and extensive sound capabilities were lamented by press and users alike. The fluffy newborn chick in the advertisement was in fact the same old broiler hen.

A few months ago, Tatung, a Taiwanese firm known in the U.K. for its hi-fi and televisions, announced the Einstein colour computer, which was designed and made in England. If Tatung is to be believed the machine is primarily for office and school use. However, its £500 price puts it way outside most schools' budgets, even if they were not already committed to the BBC Micro. Neither the MZ-700 nor the Einstein seem destined to topple the Apple, Apricot, BBC, Spectrum or Commodore 64 from their top positions, but they could perhaps do as well as, if not better than, the Dragons, Orics and Electrons.

Each computer is the conventional flat plastic box with a typewriter keyboard, a range of switches and sockets, and a speaker. At 21in. deep, providing plenty of room for a monitor to sit on top, the Einstein is enormous, easily the largest of its type I have ever seen; the MZ-700 could almost fit inside it twice over. Naturally, both machines come with power leads and TV cables. On the Einstein the power lead is supplied with a three-pin plug — a thoughtful gesture — while the Sharp's TV cable far too short.

The MZ-700 is available in three different guises. The basic machine, at £250, relies on you using your own cassette recorder to load and save software. It is very overpriced, even with the £50 built-in cassette recorder usually thrown in by the dealer together with a discount. Another £125 buys the neat, built-in four-colour printer/plotter used in the Tandy 100 and the Atmos, but this too is a little dear. At £500 the Einstein also seems expensive. Although it has a Hitachi 3in. 200K single-sided double-density microfloppy-disc drive built in, a Commodore 64 or an Atari, with a single 5.25in. floppy drive, is as good a package for rather less, and they have lots of desirable software.

Both the MZ-700 and the Einstein have an On/Off switch, a Reset button, a sound/volume control, and an extensive range of ports for printers, joysticks and so on. The MZ-700 has sockets for an external cassette recorder, but the Einstein lacks these. This is a grave mistake, for with discs costing £4 plus, tape is a useful, cheap, long-term storage medium that appeals to the home, business and school user alike. However, the Einstein's ports are marvellous in both number and kind, and make the machine ideal for anyone with aspirations to monitor and control machinery, or interface with other

The bulky Einstein (left) contrasts with the neatly designed MZ-700.

computers. But it is a pity that, unlike the MZ-700's shielded edge connectors, the major Einstein ports are unprotected multi-pin sockets.

Each machine's keyboard has proper keys that repeat, have a reasonable feel, and bear the graphics symbols they output when in graphics mode. The Einstein has eight function keys which can be used Shifted, to give in effect 16, and each can hold any number of characters up to a total for all the keys of 128. It has no Clear Screen or Home keys, though Ctrl-L and Ctrl-↑ have the same effect. The MZ-700 has only five function keys, which can be used Shifted to give 10. No ShiftLock is provided, but Ctrl-E gives lower case and Ctrl-F restores upper case.

The Einstein keyboard is adequate but looks stodgy, and makes a nasty ringing noise when struck. The MZ-700's MSX-like keyboard has a better design and is much nicer to use. Its hardware-formed key-generated Sharp-standard graphics characters are far superior to those offered by the Einstein. In fact, the output of the majority of the Einstein keys is rather badly formed and the appalling lower-case set will make word processing unnecessarily difficult For some uses this may not be a problem since the output of all the normal alpha keys can be redefined using Basic's Shape command.

User RAM

Both computers come with 64K of user RAM, though a large chunk is taken up by any language you load. Basic leaves about 30K on the MZ-700 and 40K on the Einstein. CP/M or a high-level language such as Basic must be loaded in when you switch on, and here the speed of the disc-based Einstein wins hands down.

The MZ-700 ROM and RAM monitors — the latter of which is swapped in with Basic — handle keyboard and screen I/O. You can load programs, dump, transfer, modify, jump to, save and verify memory, find a string and get a subroutine. The Einstein ROM operating system does most of this, and lets you do hexadecimal arithmetic, execute from the program counter address, perform a cold or warm start, and display the register contents.

On the MZ-700 the next level up is a high-level language like Basic, but on the Einstein we progress to the disc operating system, Xtal-DOS, from Crystal Research Ltd of Torquay. It allows you to manipulate both memory and discs. You can see the disc directory; display ASCII files; change default drive; erase files; execute the currently loaded program; and load, run, lock, unlock, rename and save a Basic file. With the Backup and Copy utilities you can format and copy whole discs, as well as copying individual files. Xtal-DOS also allows interfacing with transient programs, just like CP/M, so that a very large stock of business software, like dBase II and WordStar, should be available. However, so far there do not seem to be any Xtal-DOS versions of the better-known CP/M programs, nor is there a version of CP/M that can be used instead of Xtal-DOS, but they may be on their way.

The Einstein Basic is Xtal-Basic, an MSX-like version by Crystal Research, which has written a number of Basics for the Sharps. The MZ-700's Basic is so similar to the MZ-80K's SP-5025 that MZ-80K programs written in SP-5025 can be loaded into the MZ-700 and internally converted. In the future, the MZ-700 and the Einstein could well run the same Basic.

Both Basics are fairly conventional, but have a number of unusual extras and some odd deficiencies. Neither allows the use of labels or procedures, but each has most of the standard Basic commands and functions. Some interesting ones are listed in the box on the next page.

Notable omissions in the Einstein Basic are: Find, to find a string; Old, to retrieve a program Newed by mistake; On Sprite, to detect sprite collisions; Print Using for print formatting; Repeat-Until; Resume, to return after an error-handling routine; TrOn/TrOff, the trace utility; and a windowing facility. Noticeable omissions in the MZ-700 Basic include Else to go with If-Then, Find, Old, Repeat-Until and a decent TrOn/TrOff. One compensating feature is the ability to use the keywords in the

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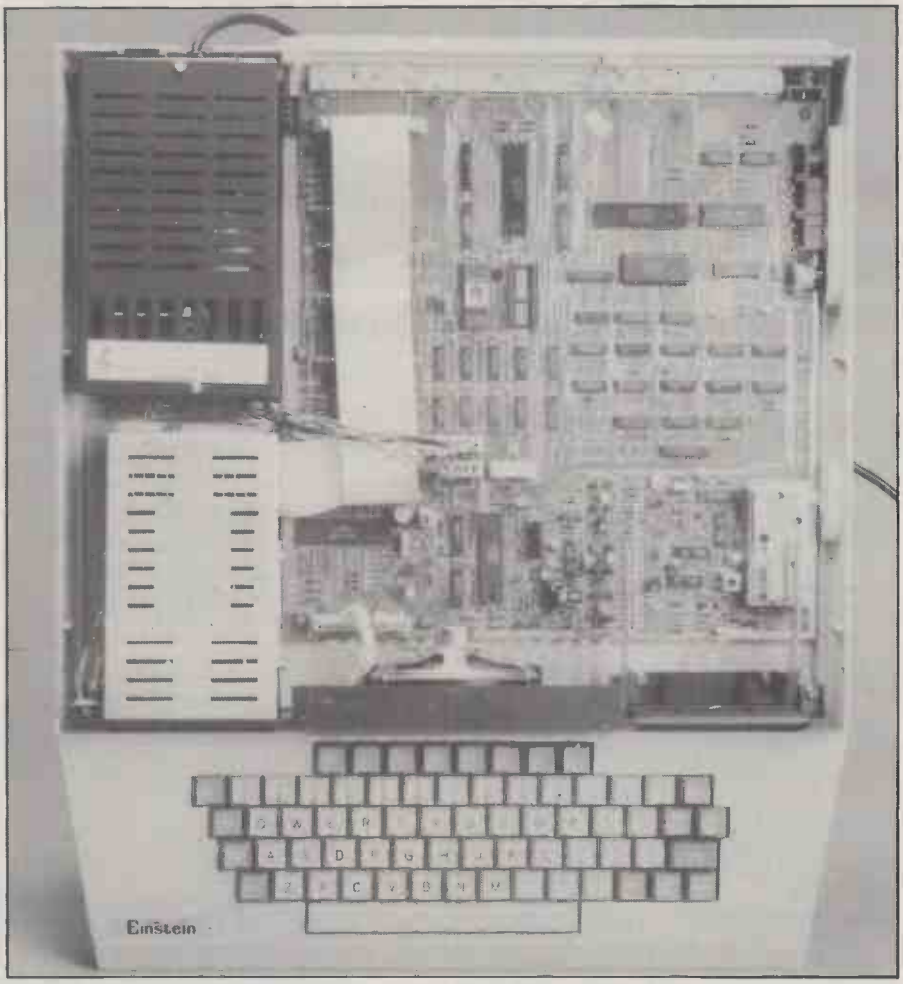


There is space inside the Einstein's casing for a second disc drive.

Benchmarks

The table shows the time in seconds to run eight standard Basic routines. The Sharp MZ-700, Sharp MZ-80K and Tatung Einstein timings are given to the nearest 0.5 second.

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Av.
Sharp MZ-700—Z-80	1	3	9	8	9	17	32	82	20.1
Tatung Einstein—Z-80	1	5.5	11.5	12	13.5	22	34.5	49.5	18.7
BBC Model B—6502	1.0	3.1	8.3	8.7	9.2	13.9	21.9	52.0	14.8
IBM PC—8088	1.2	4.8	11.7	12.2	13.4	23.3	37.4	30.0	16.8
Sharp MZ-80K—Z-80	1	9	16	22	25	36.5	53	98	32.6
Sinclair Spectrum—Z-80	4.8	10.1	26.7	29.7	31.4	47.5	63.6	323.0	67.1

(continued from previous page)
shortened form of the first letters plus a full stop.

Each micro has an excellent full-screen editor, allowing you to cursor around and enter lines anywhere. The MZ-700's screen can be scrolled both up and down. The Einstein has an alternative line editor, and will open up the listing automatically at the end of current line.

The MZ-700 manual is much in the style of the extraordinary MZ-80K manual, with little jokey cartoons. It tries to be everything to everyone — a Basic primer, a machine handbook, a guide to machine code and assembler — and does not do any well. The current edition does at least do what the earlier ones did not, and tells you about the second set of 256 Pokable-only characters meant to overcome the lack of user-definable ones.

The three Einstein manuals consist of a Machine Introduction, a Basic Reference and a MOS/DOS Introduction. They seem confused as to the level they are aiming at. For example, most of the Machine Introduction is elementary, and yet elsewhere it thrusts you into a detailed explanation of sprites.

The Basic Reference Manual mainly describes the Basic keywords, but it includes short sections on variables, arrays, expressions, operators, error handling, chaining and file handling, together with an explanation of Xtal Basic's unique file descriptor system. On the whole it is not bad, despite typographical errors and omissions which would confuse the novice. However, some keywords are poorly explained such as the logical operators And, Or, Xor and Not, and the Music, Print # PSG and Voice commands. Also it does not say that Save will overwrite a file of the same name without any warning.

Omissions

Both machine's manuals are nevertheless sufficient and understandable with a little effort, though they do have two unforgiveable omissions. Neither has an index, or an alphabetical list of all the reserved words each with a brief explanation. For the Einstein this is partially made up for by the provision of a handy reference card which does list the key MOS, DOS and Basic commands, and the control and colour codes.

Both computers performed quite satisfactorily with my ancient colour television, though I imagine they would do even better with proper monitors. An Einstein monitor is available. The Einstein gives a full-width but not a full-height picture, and you can select either 40 thinnish columns or 32 slightly fatter ones. By contrast, the MZ-700 leaves a black, untouchable border all round, but at least you can then see the edges of the picture, which on many domestic televisions is normally expanded off the sides of the screen.

Graphics

Visually, where the Einstein really triumphs is in its 256- by 193-pixel medium-resolution graphics screen. Related to this are the Shape-defined characters and their assignment to the 32 sprites. They can be moved about the screen without affecting whatever they overlay, passing behind or in front of other sprites depending upon their priority.

The Einstein's 16 colours also definitely have the edge over the eight of the MZ-700. Neither machine's colour handling is brilliant: for example, you cannot assign a colour attribute to a particular character so that it always has that colour wherever it is used. But both are quite acceptable, and allow some very good displays. Even so, the way in which the Einstein controls its graphics displays leaves much to be desired; drawing a line across some other graphics area — say, a filled shape — can leave unsightly blocks of a contrasting colour.

The MZ-700's sound is, like the MZ-80K's, minimal with only one channel of three octaves, though it is consequently quite easy to use. By contrast, the Einstein's three channels of six octaves each — the lowest is badly out of tune — are not easy to use. The problem lies partly in the Basic, which does nasty things like keeping the

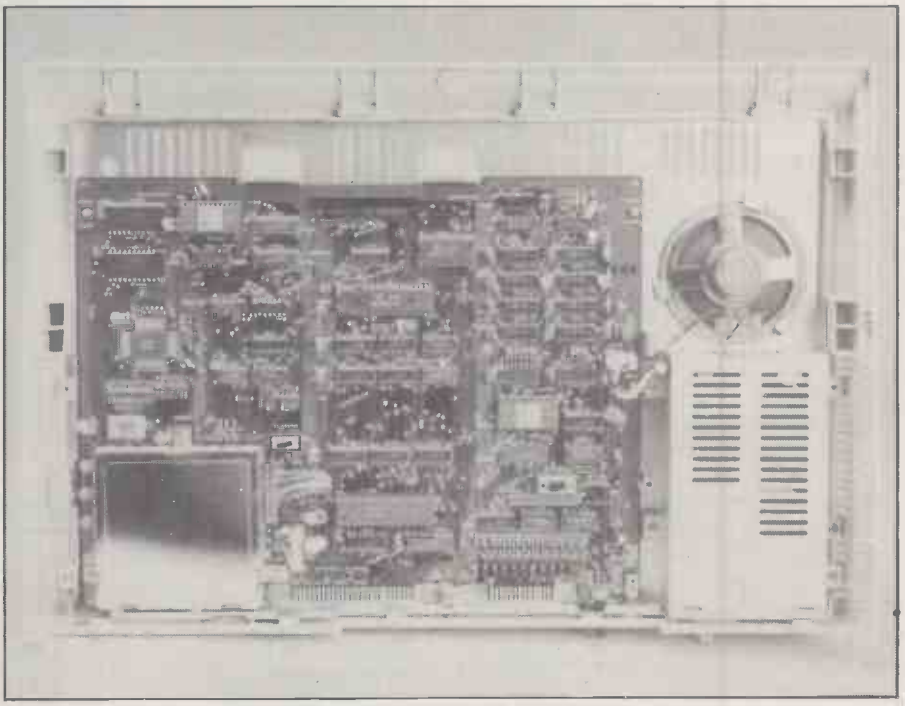
Specification

EINSTEIN

CPU: eight-bit Z-80A, running at 4MHz
RAM: 64K, with 16K video RAM
ROM: 8K operating system, expandable to 32K
Dimensions: 432mm. (17in.) x 114mm. (4.5in.) x 533mm. (21in.)
Weight: 6.35kg. (14lb.)
Display: text 24 lines by 32 or 40 columns, 80-column card soon; 256 x 192 pixel medium-resolution graphics, 32 sprites, 16 colours
Keyboard: full-size QWERTY with 67 keys including eight function keys
Interfaces: printer, user I/O, CPU bus, two joysticks, UHF, video, RGB, RS-232C and external disc drive ports
Mass storage: built-in 200K single-sided double-density Hitachi 3in. microfloppy; second built-in drive in kit form and ready-built double external drive
Operating system: Xtal-DOS by Crystal Research
Languages: Xtal Basic by Crystal Research, DR Logo, Forth
U.K. price: £500, extra disc drives about £200, monitor about £200
Manufacturer: Tatung (U.K.) Ltd, Bridgnorth, Shropshire WV15 6BQ. Telephone: (07462) 15721

MZ-700

CPU: eight-bit Z-80A, running at 3.5MHz
RAM: 64K with 4K video RAM
ROM: 6K monitor/character generator
Dimensions: 432mm. (17in.) x 114mm. (4.5in.) x 305mm. (12in.)
Weight: 6.35kg. (14lb.)
Display: text 25 lines by 40 columns; character graphics; eight colours
Keyboard: full-size QWERTY with 69 keys including five function keys
Interfaces: printer, user I/O, CPU bus, two joysticks, UHF, video, RGB and external cassette ports
Mass storage: optional built-in cassette recorder; single 5.25in. floppy-disc drive, £400; and built-in 3in. microfloppy about £250
Languages: S-Basic by Sharp, Pascal, Pilot and Forth
U.K. price: £250, plus £50 for cassette recorder and £125 for printer/plotter
U.K. distributor: Sharp Electronics (U.K.) Ltd, Sharp House, Thorp Road, Newton Heath, Manchester M10 9BE. Telephone: 061-205 2333



Inside the MZ-700 — it can be opened up only with difficulty.

sound going and the amplifiers humming until positively turned off. It also lies partly in the manuals, which are not only wrong but take far too simple a view of the complex Play and Envelope commands, Music and Voice. The Einstein will allow good sound effects, but it is hard work getting them.

Neither computer comes bundled with any useful programs, which I find particularly surprising in the case of the Einstein bearing in mind its alleged business use. Indeed, at the moment little software of any kind exists for either machine other than programs that were originally written for the MZ-80K or MZ-80A.

The major software suppliers for the MZ-700 are Knights, Kuma, Sharpsoft and Solo Software, while a few minor outlets, GM Services, Peterson Electronics and Sheldon Software, mostly sell what they get from the bigger ones. The major Einstein outlets again are Kuma and Solo.

Software

On the MZ-700 games front my two children and I have enjoyed Solo's versions of Nightmare Park, Dragon Caves and Mr Fixit, while Kuma's Star Avenger, Super Space Invaders or Moonlander are just as good as their MZ-80K counterparts. Business and utility programs for the MZ-700 are fewer, and rather pricier. The word processor originally written for the MZ-80K, Wdpro, is available from Kuma, and all the suppliers sell various improved Basics and other high-level languages — Kuma has a Basic compiler — as well as a small collection of spreadsheet, database and utility programs.

Einstein programs are potentially flashier because of the better graphics capabilities. Games like Chucky Egg and Oh Mummy have been converted nicely, and Kuma's Wdpro is there, as are its two databases, a Disk Doctor, the well-known Zen assembler, and a version of Forth. There is also a very interesting spreadsheet called The Cracker written for CP/M machines by Software Technology Ltd. Tatung provides a few games programs with the Einstein, including Mastermind, Snakes, Othello, Hangman and Picture Pen. But despite the supposed CP/M compatibility of Xtal-DOS, there is no significant evidence of the vast quantity of CP/M-based software being available for the Einstein.

So far I have not comes across any books on the Einstein. For the MZ-700 I know of only two, namely G P Ridley's *Peeking and Poking the Sharp MZ-700,* which is not bad value, and T Marriot's *The MZ-700 explained,* which I have not seen.

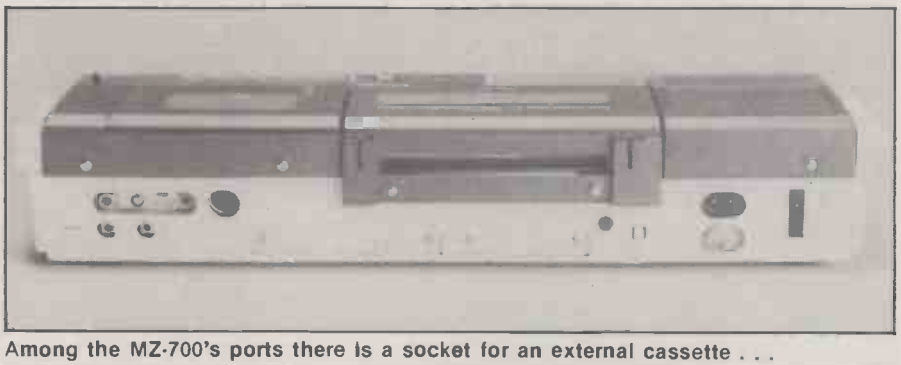
Both computers can be connected directly to printers, and to two joysticks. Both can also be fitted with an 80-column card. The Einstein can handle a second internal disc drive and a pair of external drives, while a single 5.25in. floppy with a database and spreadsheet thrown in is available for the MZ-700. Also for the MZ-700 is the Quick Disk from Solo, used in place of the cassette deck, the Speakeasy Speech Synthesiser, also from Solo, and a 320- by 200-pixel high-resolution board.

Conclusions

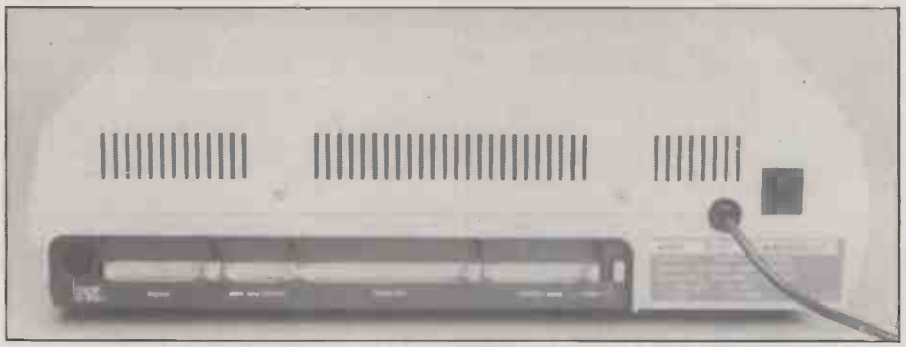
● The Einstein is £500 worth of slightly old-fashioned eight-bit 16-colour micro with a medium-resolution screen, user-definable graphics, and a built-in 3in. microfloppy. The MZ-700 is beautifully made, but only in its £350 expanded version does it begin to look worth having, and then only as a home computer.

● At first sight the Einstein looks attractive to the small business, and its multitude of ports makes it a natural for monitoring and controlling equipment. However, by the time you pay an extra £200 for a VDU, and possibly another £200 for a second disc drive, it becomes too expensive for such uses. Even as a home computer, the MZ-700 is seriously hampered by its lack of a high-resolution screen and user-definable graphics. When coupled up to a Quick Disk and a high-resolution graphics board, it becomes quite a different machine — but it also becomes far too expensive for the home user, and yet not big enough for business.

● There is little software of any kind for the Einstein, either games or business. Though some sort of CP/M compatibility is claimed, significant quantities of the standard CP/M-based programs have yet to appear. The MZ-700, too, has little software written for it and there is unlikely to be very much more in the short term.



Among the MZ-700's ports there is a socket for an external cassette . . .



. . . a feature missing from the Einstein, whose naked pins look vulnerable.

Some Basic commands

EINSTEIN

Append—adds data to the end of a sequential disc file
BCol—sets the screen border colour
Eval—evaluates a string as though it were a mathematical formula
FMT—allows formatting of printed numeric output
GCol or TCol—sets foreground and background colours for graphics displays or text
Hold—holds part of a listing in view while the rest temporarily disappears so you can modify the held part
Inch and Inch$—waits for a keyboard input
IOM—sets up the entire machine I/O mode
Mag—magnifies all present sprites
Music—plays three sound channels at once
PSG—allows access to programmable sound generator chip
Scrn—returns all the characters In a screen line
Shape—assigns a graphics character to any ASCII number
Sprite—sets up and positions sprites
Swap—swaps the contents of two similar varlables
Voice—sets up a sound envelope for use with Music

MZ-700

Color—selects at the defined x,y co-ordinates the foreground and background colours
Console—defines the size and position of a window within which all future printing etc takes place
Merge—merges two programs
Music—plays the single sound channel
Print (f,b)—temporarily reassigns the foreground and background colours
Set and Reset — plots a point on the screen using pixel graphics

Give us a tune

It is still early days for music systems based on home micros: Graham Bland tries out two which have just been released for the BBC machine.

ALMOST ALL the popular home computers possess a specialised sound device. It can range from the fairly primitive AY-3-8910 to the sophisticated Sid found in the Commodore 64. Unfortunately, musicians have to forsake their accustomed means of communication via a piano keyboard or conventional music notation and learn the complexities of the device in order to produce any sort of reasonable sounds.

Organmaster and Miditrack, two packages for the BBC Micro, offer different ways generating music. The Organmaster system includes a three-octave piano keyboard plus the software to link it to the BBC Micro's sound chip. Miditrack combines with the micro to control commercially available digital synthesisers.

Happy pianists

The Echo I unit supplied with Organmaster software is a keyboard containing logic hardware to decode the array of key-switch contacts. Though it spans only three octaves, the keys are full-depth and full-pitch, unlike mini-keyboards found on the Yamaha CX-5 and cheaper Casio instruments. This should keep the more experienced pianist happy, and start the novices out on the right foot. Connection to the eight-bit user port on the BBC Micro is made via a length of ribbon cable.

We had a prototype of the system which lacked a manual. Fortunately, Organmaster displays virtually all the commands available on one screen. At the top of the screen is the percussion section. In the middle a diagram of the computer keyboard is displayed which details the voices available and the key to select them, and finally there is a list of miscellaneous commands at the bottom of the screen.

After the package has been booted from tape or disc you may play the Echo I keyboard in the default voice, which is the piano. The name of the currently selected voice is displayed in bold on the screen, which is probably all to the good as quite a few of the pre-selected voices are indistinguishable other than by name. For example, Horn sounds like Piano minus sustain.

Good Vibes

Verisimilitude apart, some of the presets are actually quite good. Organ, Vibes, Viola and Synth 1 were my particular favourites; on the other hand Mandolin could best be described as unpleasant. Voices may be enhanced by adding sustain or tremolo, otherwise known as amplitude modulation. The octave range may be transposed up or down, and the duration of notes after the key has been released may be altered.

The percussion section is something of an oddity, and I suspect its main purpose is to demonstrate the range of sounds the BBC machine is capable of producing. A variety of instruments can be selected, ranging from Snare Drum to triangle. Some, like the Bass Drum, are triggered whenever a note is pressed; the rate at which it sounds is related to the pitch of the note being played, low frequencies producing a slow beat. At higher pitches, the Bass Drum sounds remarkably like a Geiger counter near a radium source.

Inept composers

Automatic chord generation is the final performance aspect of Organmaster. Function keys are used to select either major or minor chords. Using this feature even the most inept musician can produce tunes.

As well as the pre-sets, four user-definable voices are available. To set up a voice of your own, you need a substantial knowledge of the BBC's Envelope command. Organmaster lets you modify the Envelope parameters simply by pressing + and − keys. For those who want a complete music system, LVL also provides Echosound, which consists of an output adaptor board and 6W amplifier and speaker.

Suppliers and prices

Organmaster is available on tape or disc together with the Echo I keyboard for £99.95 including VAT. LVL Ltd, Electron House, Bridge Street, Sandiacre, Nottingham NG10 5BA. Telephone: (0602) 394000.

The Miditrack interface box plus disc- or cassette-based software costs £159 including VAT. Electromusic Research, 14 Mount Close, Wickford, Essex. Telephone: (03744) 67221. A complete package consisting of Midi synthesiser, BBC model B micro, cassette recorder, Miditrack software and interface, and all leads and cables is available from City Music. Pinner Road, North Harrow, Middlesex. Telephone: 01-863 1841. Prices start at £999.

The cost of the entire system pictured is around £150. Serious musicians will probably exhaust the useful possibilities of the BBC's sound chip quite quickly, and as a novelty add-on the appeal of the voices pales fast. The most obvious use for Organmaster lies in the educational field. With suitable software, interactive tutoring is possible, for training in chords, harmony and so on.

Miditrack Composer from Electromusic Research is the first piece of software for the BBC that lets you use the micro to control a synthesiser based on Midi — the Musical Instrument Digital Interface. Midi is a specification which evolved out of a need to standardise the means of communications between the latest generation of music hardware. It comprises a hardware specification and a standard data-exchange protocol, and has been adopted by leading manufacturers like Korg, Sequential Circuit and Yamaha.

Conventional

No radically new technology is involved, the RS-232 interface being the basis of the connection between systems. A data rate of 31.25Kbaud is employed to ensure that music data is transferred fast enough in live situations. Midi-to-Midi linkup is made quite simply through five-pin DIN cable connectors.

EMR's package is made up of an interface box, and disc or cassette-based software. The interface connects to the user port and 1MHz bus of the BBC Micro. The 31.25Kbaud clock rate is achieved by division of the bus signal. The ribbon cable is, once again, too short. The interface box is very compact and, as such things go, quite pleasing to the eye. Midi data is received through the Midi In sockets, and may be fed out through two Midi Out sockets. LEDs pulse when this is happening, just to let you know when there is some life in your system.

After setting up your Midi synthesiser you can start to make music using the Miditrack software. The package may be booted automatically from disc, which will lead you to the track assignment

screen. This menu allows you to determine the number of tracks that may be played at once, up to a maximum of six. Available memory is divided equally among the tracks, even if some of them eventually hold no more than a note or two. This rather crude and inefficient allocation of memory imposes a nagging limitation on the user, which dynamic allocation of RAM would easily eliminate.

Though the first screen is more or less self-explanatory, the following screens are not, and good documentation is called for if you are to know what to do. In this respect EMR has let the user down dreadfully. A slim photocopied document is all that is provided to introduce novices to the operation of software and the relatively new technology and terminology of Midi. Many assumptions are made about the user's competence in the field of computer music, the software is explained poorly, and the whole thing seems more like a grudging addition to the package than an essential part of it. Given time you can make some headway, but it's hard work.

Drums

The second screen is used for channel mode selection, and the third allows the track to be assigned to one of the 16 possible Midi channels. Drum computers may be connected to the system as an external synchronisation clock on screen four.

Finally, the fifth screen allows you to get down to the business of producing some music. Two pieces are supplied with the software, Lennon and McCartney's *Yesterday* and a composition named *Carnival*. From this screen, you can request a disc directory, and load and save music. Loading a file like Yesterday and playing it is simplicity itself. Once it is in memory, the piece is played back by pressing P and the number of repeats required. The playback speed may be increased or decreased over a wide range.

Note by note

Entering your own composition turns out to be a very awkward thing to do. Although you have a sophisticated input device — the synthesiser keyboard — interfaced directly to the micro, you are forced to enter scores note by note, using an arbitary notation. Each event, as the terminology has it, requires five pieces of data to be supplied: Track Number, Value, Dynamics, Note Length and Style.

Value may be a musical note or rest, a synthesiser voice number and other such options and, most important, an End of Sequence marker. Dynamics determines the force at which note is to be sounded: pianissimo, forte, etc. Both Note Length and Dynamics are set from the function keys. The Style parameter determines playing methods, such as legato, etc.

Composing a full six-track piece takes a long time and the patience of a saint. Notes may be corrected with editing options like Delete and Replace, and repetitive bars of music may be copied within tracks and to other tracks.

Though this package is hardly an ideal compositional tool, it works adequately as a multi-track sequencer. Its major flaws seem to be in its lack of reasonable user interface, and its inability to take advantage of a keyboard to simplify the task of track creation. It does work towards a more widespread acceptance of the role of the computer in serious music production, and at a price that is becoming far more reasonable as the technology advances.

Other Midi packages are available for the Spectrum and Commodore 64, and this one is pricier than most at £159 including VAT. A Midi musical instrument will set you back over £600. The review system supplied by City Music costs well over £1,000, so for the time being it remains the domain of the semi-professional musician or keen amateur.

Organmaster's keyboard links to the sound chip of the BBC Micro.

Miditrack converts the micro into a sequencer for Midi synthesisers.

Conclusions

● At £99.95 including VAT for the software and keyboard the LVL Echo I/ Organmaster is good value. Its keyboard is very well made, but the software is no more than adequate. Only half the 17 presets are sufficiently distinct to be worth having.

● EMR's Miditrack is the first Midi interface available for the BBC Micro. Its major fault is the way you enter notes — you have to use the computer keys, employing an artificial music notation — which rules out the Miditrack for real-time note entry during a performance. The manual is terrible.

● Organmaster probably has more potential simply as a hardware unit driven by other people's software than in its present form.

● At £159 including VAT for the interface box and software, Miditrack is worth investigating if you already have a Midi synthesiser.

dBASE III

Chris Bidmead reluctantly ventures out from the familiar environment of dBase II to investigate how well Ashton-Tate's new product exploits the possibilities of 16-bit processing.

IN COMMON, I suspect, with many other dBase II habitués, I am feeling a little uncomfortable at the arrival of dBase III. dBase II version 1.24 is a stable production which forms a bridge across MS-DOS and the various flavours of CP/M — including good old-fashioned CP/M-80, the operating system I still refuse to be parted from. There is nothing that dBase II will not do for programmers with time and patience and I use it extensively for my own accounting, filing and general messing about. The last thing users need when they are flocking together around a standard is a whole new ball game, and dBase III is just that.

But the advent of the 16-bit standard made dBase III inevitable. The original program, tightly written in 8080 assembler, was simply cross-compiled for its initial appearance under MS-DOS. The result was inefficient code that offered no advantage over the eight-bit version, although cosmetics like handling colour were subsequently tacked on. But the new product is recoded in C from top to bottom, and takes full advantage of the larger address space available to the 8088 and 8086.

Front end

The new version is handsomely packaged, with a dwarf-format manual printed in two colours. I loaded the software on to the Advance used for the purposes of the review. The first thing you notice is that the front end, which used to be merely a dot representing a command-line prompt, has luxuriated into neatly designed screenfuls of help for the first-time user. For the complete novice there is even a utility called Assist that lets you work dBase by way of a series of menus. Keep your eye on the highlighted line at the bottom of the screen and you will see the dBase command line being built to your specification as you select from the menus. That way you are learning to walk while using the crutches.

These cosmetics will certainly help sell the package, but they can be disposed of once you know your way around. Beneath them you will discover that some real improvements have been made to the database proper. For example, there are more and bigger files. The old limits of only two data files open at any one time are gone. The new product offers the luxurious top limit of 10 simultaneously open data files. A database can contain 128 different fields where the dBase II limit was 32, and the previous limit of about 65,000 records per database is raised to a virtually limitless one billion.

There are two new data types. dBase III understands and manipulates dates, and a new text-file pointer mechanism allows a data type called Memo, which means you can keep up to 4K of free-form text in a single field.

Further, many of the old quirks of syntax have been ironed out, and dBase has been dragged more into line with modern programming practice. The language is more self-documenting and the structure commands have been improved and augmented. A Set Relation To instruction makes it easier for the programmer to marry up related data in a pair of flat files.

On the whole dBase III follows the syntax of the earlier package. Where commands have been revised the dBase II version of the syntax has sometimes been retained, giving two ways of doing the same thing. Thus the eccentric

```
STORE 'Jennifer' TO name
```

is still permitted, but the preferred dBase III syntax is the more rational

```
name = 'Jennifer'
```

But dBase II users are going to find many discrepancies. The succint but cryptic If * of dBase II now becomes If Deleted(), and there are several such revisions to make the code more self-documenting. An improvement certainly, but it will not make life easy for software houses who have to keep switching between the old and new versions.

I particularly missed the command line editor that gives you a chance to revise clauses the interpreter does not understand. Instead dBase III offers to explain the first command you have written in the line, which is not always useful, particularly when you have simply made a typing error.

For example, if you try the standard dBase command

```
SET DATE TO 8/28/84
```

the system replies

```
Do you want some help (Y/N)
```

and continues with a screen that explains Set in a single sentence too brief and broad to be useful to anybody but the rawest beginner. Entering the word Date into the Help screen produced and explanation of how to read the system date but not how to set it. But to learn more about Set — and deduce that the Set Date To command no longer exists — you have to guess that a request for Commands bridges you into a screen that displays all the Set commands.

Dates

It turns out that the only chance you get to set the system date is on booting up. This is a pity, because the MS-DOS routine for doing this is raw and fiddly. Also with dBase III it would be simple to provide a date-setting utility that defaulted to the last date set rather than the unhelpful 1st Jan 1980 provided by MS-DOS; checked the date you enter for inconsistent values, and gave you a validation by translating the numerical date into a character string of the day of the week and month of the year.

dBase III can do all this with the minimum of programming because special functions have been included for the purpose. dBase II keeps the system date as a function, Date(), and will store dates as a simple eight-character string of the form 08/09/84, but there is no simple way of adding and subtracting days, or sorting in date order.

Dates are stored as quasi-Julian numbers — the number of days since an arbitrary base date. As you might expect, there are functions to convert string

The Road from Vulcan

There was never a dBase I. Written in the late seventies for rocket experimentation work at the Jet Propulsion Labs at Pasadena, the package was initially known as Vulcan; Wayne Ratcliffe, its author, was a *Star Trek* fan. He was selling Vulcan by mail order from his own back room, with unspectacular results, when the product came to the attention of one George Tate, a microcomputer enthusiast who had given up repairing stereos to start his own software distribution company. George Tate brought some very valuable marketing ideas to the becalmed product.

The name Vulcan was the first thing to disappear since Tate felt his customers needed something solid and technical. The II was appended to dBase to suggest that it was a new and improved version of something, which it in fact was by the time the product sprung fully fledged to the public attention in mid-1981. It arrived on the market supported by one of the largest advertising budgets ever lavished on a micro software product, and has not looked back since.

dates to Julian dates and back again. But without the complicated substring searches necessary in dBase II you can also extract a numerical value corresponding to the day of the week, the day of the month and the year. Other date functions will digest a Julian number and supply you directly with the day of the week and the month of the year as character strings, making it a cinch to confirm the date.

On a dual-floppy system like the Advance you will probably be working with A: as the system drive, keeping your data on drive B:. To avoid having to prefix all your file requests, you can tell the system on entry to Set Default To B:, a facility carried over from dBase II. New though is the ability to create a configuration file called Config.DB to set up this and other defaults automatically. But a word of warning: the manual incorrectly states that you can begin this config file with the Set Default command as above. For some reason this actually creates a syntax error. The correct form for the purposes of Config.DB is

```
DEFAULT = B:
```

One of dBase III's welcome additions is the command Type that works just like the same command at operating-system level. Use it to take a quick peek at command files or text files without evoking the editor. But beginners are going to be confused since it bears no relation to the Type() function carried over from dBase II that reports on the type of a variable.

Rounding

Another welcome newcomer is the function Round(), which rounds real numbers to a specified number of decimal places. Its absence from dBase II is something of an oversight, and means that things like VAT calculations sometimes appear to drop pence. Experienced dBase II programmers have learnt to kludge round it with the cumbersome

```
STORE (INT(TEMP * 100 + 0.5)/100.00)
  TO TEMP
```

Earlier versions of dBase II can lead you into a situation where opened files cannot be closed, and in versions before 2.4 dangerous lurking bugs make it possible to lose

Cat	Owner
Felix	Jane
Bubbles	Jane
Ruby	Jackie
Marmalade	Sylvia
Melinda	Sylvia
Tommy	Sylvia
Ratter	Sidney
Mrs Purr	Sidney

Owner	Vet
Jane	McGuinness
Jackie	McGuinness
Sylvia	McTavish
Sidney	Maclean

Figure 1.

files altogether. dBase III has added a new command, Close, that allows you to close groups of files explicitly as, for example, Close Databases.

Unfortunately there are still traps for the unwary, and you may find dBase refusing to allow you to modify a command file

```
.modify command test
File is already open
```

The natural response is Close Procedure but during my first trial with dBase III I found this made no difference; my Test.Prg procedure file remained resolutely open. After scouring the manual in vain for a way out, I had to resort to the dBase old-timer's universal fix-it command Quit.

Interaction

The problem was an interaction between MS-DOS and dBase III, but if I had read the manual carefully I would have avoided it. MS-DOS 2.0 defaults to allowing only eight files to be open at once, and reserves five of them for operating-system requirements, leaving only three spare. My Test.Prg command happened to open two database files and an index file, making four open files in all, and when exiting from Test.Prg the operating system refused to close it. Luckily this is easily remedied by creating a file called Config.Sys on the screen disc, which includes the line

```
Files = 20
```

As well as the syntax differences, dBase III data files use a different format from the earlier version. So dBase II applications have to be run through a utility called dConvert. An enthusiastic booklet written by Adam Greene accompanies the manual to take you through the process.

The 450-odd record name and address file, or NAD, ported across by way of Move-It from my dBase II system, formed a useful test of dConvert. The NAD occupies some 155K of disc space, each record being around 340 bytes long. This left about 200K spare for dConvert to work with on the Advance drive B:, which I had to log on to because dConvert uses the default drive to build its destination file.

The NAD includes a Date:Last field to keep track of when the record was last updated. Date:Last had to be renamed Date_Last to accord with dBase III field name rules, but in order to make use of the abundant date facilities in dBase III it was necessary to add a new field, Date, by using the dBase Modify Structure facility. The dBase II version of this command deletes all the records, forcing you to do a not too complicated Copy out to a temporary file and an Append back again. The new version takes care of this multi-stage process automatically.

During this part of the operation dBase ran out of disc space since I still had the old dBase II type of data file on the disc, now renamed to .DBB. At this point instead of dumping me back to the operating system, or returning me to the dBase prompt, dBase III produced the message "Abort, Ignore, Delete Old Files". When I chose the Delete option it displayed the files on the disc in order, inviting my Yes/No response to each one.

Filling the new date field from the old character date field was simply a matter of writing

```
REPLACE all DATE with CTOD
  (DATE_LAST)
```

and in just under 4½ minutes the new date fields were all in place. Now it became elementary to look, for example, at all the records added this year, with a command of the form

```
LIST ALL FIELD NAME, PHONE FOR
  DATE >CTOD("12/31/83")
```

The dConvert utility will also translate dBase II program files to the new syntax. Unfortunately it cannot do the job completely, and some cleaning up afterwards may be necessary. But dConvert is intelligent enough to leave remarks in the file to indicate where hand conversion may be necessary.

It was during hand conversion that I came across an unexpected limitation. The

```
MODIFY COMMAND <file name>
```

familiar from dBase II evokes the text editor, now somewhat pompously renamed the "dBase word processor". But I found that the last 20 lines of my command file were missing. Some further research showed that it was impossible to fit the whole text into the word processor, which is limited to handling files no larger than a mere 4K.

Here Ashton-Tate has a problem, since of the 30-plus .Prg sample files provided on the Sample Programs and Utilities disc, a quarter exceed 4K. The CP/M-80 version of dBase II has the same 4K buffer size, but not the same problem. You can internally edit files up to any length because the software automatically scrolls through the disc file. The only restriction is that you cannot back up the cursor over a section of the text that has already been scrolled off.

Such a surprising shortcoming in glossy new dBase III is not insurmountable because it uses ordinary ASCII text files, which can be edited by Edlin or other word-processing software. There is a Run command in the new package that allows you to run MS-DOS programs without exiting to the operating system, and I hoped to be able to access Edlin from inside dBase III this way. Unfortunately the system reported back that the 256K Advance did not have sufficient memory to use this facility.

On the positive side, improvements that go some way to justifying the built-in editor's new title are: wordwrapping, word-forward and word-backward cursor movement, plus the ability to read in external files and write the text out under another file name. These facilities are

(continued on next page)

dBase III

(continued from previous page)

evidently modelled on WordStar and use similar keystrokes. Also one annoying feature of the dBase II editor has been remedied: the cursor no longer reverts to column 0 every time you move from one line to another.

The dBase system has always called itself relational and it does provide many of the tools to create databases along these lines. However, it has never been much help at breaking down your data into relations and writing code to link those relations again. The first and considerable part of the problem remains but dBase III makes a big stride forward by providing the command Set Relation To.

Readers who understand a little about relational theory will know that a database of cats, their owners and attendant vets can conveniently be broken down as in figure 1. To find out Marmalade's vet, you go to the Cat/Owner table to extract the name Sylvia, and then use that name in the Owner/Vet table. The name Sylvia is called the common key between the two tables.

In dBase II you would have to follow these steps explicitly, writing code to look up one table and then the other. dBase III's Set Relation To command allows you to make a generic welding of the two tables before you start your search, and the two tables then behave as one. In this case you would say

```
SELECT 1
USE CATOWNER
* we've now opened CATOWNER in
  memory work area 1
SELECT 2
USE OWNERVET
* likewise
SELECT CATOWNER SET RELATION TO
  OWNER INTO OWNERVET
```

To make this work the Ownervet field would have to be indexed on the key field, in this case Owner. While you remain in the Catowner work area you can treat the two files as one, with instructions of the form

```
LOCATE FOR CAT = 'Bubbles'
? CAT, OWNERVET→VET
```

The awkward arrow replaces the convention in dBase II of using a dot to link the work area name to field name. This is a pity because the dot is well understood in this sort of context by programmers in Lisp, Prolog, Pascal and C. The new Set Relation feature works as a powerful superset of the old Set Linkage On command, which in effect uses the record number as the key linking field.

dBase III allows you to work on up to 10 data files simultaneously, so the possibilities of this new command are very exciting. But astonishingly the account of it in the manual is perfunctory, being restricted to a couple of pages of bald description with some utterly trivial examples.

Nevertheless, the brave souls who wish to explore this uncharted territory will be able to create a report form that gathers its data from more than one file, something impossible to do directly in the earlier version.

One small improvement in dBase III is the inclusion in the data file header of a list of all the index files created, so that when printing out data file structures with the Display Structure command, index file names are included along with all the fields and their sizes. This is useful because dBase II is not an easy language to document. Source code tends to be unwieldy particularly because you are not allowed to include subroutines in your main program file, and instead have to do them each as a separate file.

Subroutines

A far-reaching improvement has been made in the handling of subroutines. Now grandly called procedures, they can be gathered severally into a single file. Thus a file called Proceeds might contain a collection of small utilities, laid out something like

```
PROCEDURE Task1
  <code for Task1>
RETURN
PROCEDURE Task2
  <code for Task2>
RETURN
```

and so on.

As many as 32 procedures can be kept in a single file. The system allows any number of these files, although only one is in play at any one time. You mount a procedure file using an analogous process to mounting a screen format file, with a command of the form

```
SET PROCEDURE TO <file name>
```

As well as simplifying the documentation the new facility helps speed up programs by cutting down the number of files that have to be opened and closed during the course of a run.

Another big stride forward is the way values and variables can be passed to procedures or to other programs. The procedure is called with an extended command that takes the form

```
DO Task 1 WITH <parameter list>
```

The called procedure identifies the parameters by position, and is told which parameters are which by a line that contains the Parameter instruction.

So if your Proceeds file includes a routine to calculate the area of a rectangle, it might look like

```
PROCEDURE R_AREA
PARAMETERS wide, long, area
  area = wide * long
  RETURN
```

The procedure is called very simply by

```
*mount the proceeds file
SET PROCEDURE TO PROCEEDS
* create a variable called area
area = 0
do R_AREA with 5, 12, area
? area
```

A big improvement, in theory at least, over dBase II is a greatly speeded up Sort command. It is certainly faster and, unlike the earlier version, can rearrange the records on multiple keys. But there are some questionable characteristics: the sort uses large temporary disc files, which means that a decent-sized database that fills half a disc will probably foul up with an out-of-space error.

On a dual-floppy machine with the dBase system disc in A: and the data disc in B: you can get round this by entering Sort, then swapping the dBase system disc for a second data disc, and using A:Filename as the target file. But if you enter a dBase command with the data disc where the dBase disc should be, the system bombs out when it fails to find the overlay, and the only thing to do is reboot.

Sorting the modestly sized NAD file on a single key took over 12 minutes. The same process ran to nearly 17 minutes using dBase II on my CP/M-80 machine, and that has the benefit of a Winchester disc. But Sort timings are not relevant to the seasoned dBase programmer, because it is nearly always smarter to use indexing. That way only the chosen key fields are sorted to a quickly created index file, which is then used to display the records of the main file in the selected order.

Conclusions

● dBase III is the first version of dBase to take proper advantage of the possibilities of 16-bit processing.

● It has a hugely friendly front end. The copious help text doesn't always grasp the point of your difficulty, but on the whole it works well at piloting the beginner into the system

● The built-in editor makes text handling a lot easier, although oddly it copes with less text than dBase II.

● People steal software, so following the 16-bit trend this latest version of dBase now comes with a fearsome copyright warning on a patented disc called Prolok. You cannot take sensible backup copies, and even hard-disc users are going to have to fish around in their disc library every time they want to load the software.

● The documentation is chummy about the simple stuff, duplicating the work of the built-in help, but is tight-lipped when it comes to more serious programming. Something may be missing from my version of the manual, which carries index references to part 7, although the volume only runs to five parts.

● Programming facilities have been much improved, and building relational databases is greatly eased by the Set Relation To command. New date and free-text data types make this a very powerful data-handling package.

● Comparisons are complicated by the fact that an entirely revised version of dBase II is promised shortly. It appears that the essential system restrictions on file size and number of buffers will remain, but the syntax will be brought more into line with dBase III.

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Cutting the keystrokes

Once text has been typed into a word processor it should be a straightforward matter to feed it to a computerised photo-typesetting machine — or that's the theory. Neville Ash has been investigating the practical details.

FAR FROM DISPLACING the printed word, microcomputers produce tons and tons of paper output. Most of it is printed using ordinary thermal, dot-matrix or daisy-wheel printers and cheap fan-fold paper. However, it is possible to feed the output from a micro to a photo-typesetting machine, and thus produce a much higher-quality result.

Through typesetting, a much wider range of sizes and type styles becomes available. There are many special typefaces for headlines and general display use, as a glance at a few printed books and magazines will quickly show. When a text is printed, it is also possible to incorporate photographs and other good-quality artwork.

Available now

Contrary to popular opinion, computer typesetting is nothing new. Many typesetters have been using computerised machines for around 10 years. What is new is the idea of setting type directly from articles produced on a cheap micro. However, the technology to permit this is widely available: the micro and word-processing program, the tape cassette or floppy disc, the modem and the telephone line.

It does not really matter which brand of micro and word-processing package is chosen. Although there are a wide range of disc formats in use, most typesetters can handle them. When they can't read them directly, most can be converted, though at an extra cost. If a disc still cannot be read, the problem is solved by sending the text in ASCII form down the telephone line to the typesetters, where it can be downloaded on to a disc of the required format.

The situation has been complicated by restrictive practices which largely prevent the use of direct input. This is where authors, journalists and advertising copy-takers type text on to computers for typesetting. This threatens the jobs of the print workers who would normally have typeset the copy from a typewritten version. But when text is produced on a micro anyway, for all that typing to be repeated at the typesetting company is sheer waste. It also takes longer, and introduces the extra strain of proof reading.

Text produced on a micro still needs the skilled attention of a typesetter before it can be printed out, because of all the special formatting commands required. This means putting in the appropriate instructions for the size and style of type chosen. Lists and tables can be particularly difficult to handle. Also, of course, the spacing is likely to be completely different: typeset characters are proportionally spaced, so the W is much wider than the l, whereas almost all word-processing micros use equal-width letters like a typewriter.

Using copy produced on micros could lead to extra work for typesetting companies. Many firms, including software houses, use dot-matrix or daisywheel printers to produce their small books and manuals, and the photocopied manual is still not unusual. Such firms often cannot afford or will not pay a £1,000 typesetting bill, but if their original discs can be used they will pay £350 and have the manual photoset properly.

There are four separate areas to consider when linking a micro to a typesetting machine. These are: people who want to use their existing equipment at minimum expense; the programs that cut through the complications of typesetting; the hardware that makes the process easier; and the typesetters who are willing to accept copy from customers who supply it on disc or down the line.

These four categories are supplemented by hiring a specially equipped micro-computer, modem, data collection device — known in the trade as a milking machine. We found six systems for using existing equipment, 12 programs, plus seven hardware items including four micros and 14 typesetters.

Drawbacks

The advantages of direct typesetting can be seen from the box, but there are drawbacks too. Make a mistake in your text and this will be an extra cost. It is your fault. You must know what you are doing and have a good idea of how the typesetting will look in the finished job. Why? Because there are literally thousands of typefaces, type styles and sizes. So although a small sample of one particular typeface may look attractive, it is not the same as a whole page.

Although you will have learnt to understand the special words used in the world of computing with ROMs, RAMs, CP/M, DOS, bits, bytes and chips, typesetting has its own gobbledegook. This can be just as confusing for the first time user.

How you decide to have this typesetting done will depend on two basic considerations: the amount of involvement and the budget available. There are programs available to help you present the text for typesetting. Software

Advantages of direct typesetting

1. Compare sheets of typing with the typeset result and the saving can be up to 50 percent in space alone. With double-spaced text the saving is even greater. This saving in space will be shown in lower print costs.
2. A job can be printed far quicker this way.
3. Any job will look more impressive.
4. More work could be done within an existing budget.
5. Work which could not even be considered for printing because of typesetting costs, can now be produced.

is available in a variety of forms. Hardware can be purchased to make the production of the text easier and more attractive to the typesetter, also microcomputers specially adapted to produce this text can be used.

With these micros although their main use will be the production of copy to be typeset, they can also be used for word processing, database management, spreadsheet analysis — all the normal uses. Or you can use your existing word-processing package and add the relevant typesetting commands within the text.

Once you become involved in typesetting there is a whole new vocabularly available. There are founts — a complete assortment of letters and characters of any one style and size of type. They can be in Roman — upright, or italics — slanted. These same founts can be light, bold, expanded or condensed.

New terms

There are measurements of type. The point which measures 1/72nd of an inch, the pica often used for linear measurement of type. One pica equals 12 points so six picas equal one inch. Now the em is another important typesetting term. Strictly an em is the square of the type body of any size of type and is used for measuring the quantity of type. All word spacing is based on the em.

So when you calculate these type sizes, the line measures and areas of copy — the technical term is casting off or copy fitting. And before any amount of copy can be set into type you must know the size and style of type being used plus the amount of space it will take up. So although the words you have turned into typesetting will be the same as the ones appearing on your computer printout, everything else will be different.

Cost and content

How much you get involved mainly depends on the type of work and how much you want to spend. Use your existing word-processing package and add some instructions with the text. This can be done by using a system known as Aspic or Wordsmiths' WS Typo and Typewise for the BBC Micro. The text can then be saved on disc and posted to the typesetter. Or if you have a modem — sent down the telephone line.

The most economical way of sending copy this way is when the typesetter has an electronic mailbox and you can send the text through when the telephone charges are low. In terms of cost one of the Aspic or similar coding systems will cost just £20 for the manual. Then there is the typesetting charge. WS Typo and Typewise are free; but you must send the work to Wordsmiths and be using either WordStar or Wordwise for your word processor. However, there are plans afoot to increase the number of word processors.

Alternatively hire the hardware from Budget Typesetting when you need it.

If you want to be more involved with the text there are specialised programs available from Baron Typesetting, Serious Software, Data Communications and Wordsmiths, with prices starting around £300 and going up to £1,750.

While using a system is an extremely practical method of producing copy for typesetting, and the programs are also

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Software

A number of companies produce programs which help in converting conventional text into typesetting. They can make the change from text to typesetting easier and minimise complications. As the programs are extremely specialised, this tends to be reflected in their pricing.

Baron Typeset

Program for the Apricot and Sirius providing facilities to create or amend a document, print it, enter parameters for founts and user-defined keys, then transmit the document to a photo-typesetter. So the document created will include typesetting commands. The system will interface with the Compugraphic MCS range through an Advanced Communications interface.

Eight fount types are supplied as standard and many more are available. During the transmission of text, the system translates the text and commands into Compugraphic format. Price: £1,600, including support.

Baron conversion

Conversion from WordStar files to any photo-typesetter — text only — non-counting. For Apricot and Sirius. Price: £85.

Contact Baron Systems, 1 Creskeld Crescent, Bramhope, Leeds LS16 9EH. Telephone: (0532) 677736.

Castoff

For authors, publishers and designers to accurately calculate and mark up copy for typesetting. Supplied with 12 width tables from Serious Software's range.

Faltcom

Multi-purpose package for data communications via modem while at the same time carrying out characters and multiple string translations. Faltcom can accommodate the differences in word processors and micros by letting the user create or edit translation tables for specific systems.

202 Out

Output program for driving the Linotron 202 photo-typesetting. Serially driven at 9,600 baud through the RS-232 port. All programs available for Sirius, Apricot and IBM PC prices on request.

Contact Serious Software, 55 East Road, London N1 6AH. Telephone: 01-253 2287.

Typecount

Driver programs for Linotron 202/101, VIP, MVP/Linoterm, CRTronic, Scantext. Full text-handling facilities, user-definable format keys. Justification, disc files of any length. Background output to a printer. Built-in communications providing background input to disc file and background output to typesetter. Fount widths stored on disc. All typesetting commands checked for correct input syntax. Price: £1,795.

Typesort

Alphanumeric sort program with 20 user-definable sort fields, 10-level sub-sort facility. Extendable test option. Sort option includes user-entered typesetting instructions. Price £795.

Typeclass

Classified programs for newspaper and directory applications. Price £795.

Typetran

User-definable translations by character string to string, control code toggle. Price £495. For the Apriocot, IBM PC, Sirius and Sanyo 1150.

Contact Data Communications Ltd, 239 Horn Lane, London W3 9ED. Telephone: 01-992 6042.

Typefit

Editorial pre-typesetting program for authors, journalists, anybody who writes or edits copy to fit. Provides direct line-for-line copyfitting from word-processor files.

The word processor's instructions are changed into typography automatically, using instructions held in a simple typography file. The program reads this text file and creates the revised version with the new line and page breaks according to the required layout. Typefit handles multiple founts, multiple sizes, pi characters, kerning, indents and page structures including multi-column layouts.

Later this year there will be two additional modules to complement Typefit. Type-Edit, the editing module, allows the user to intervene in the process by altering text or the typgraphy for a better fit. Type-Trace will trap the mark-up errors and have a page display function.

Typefit costs £300 with two overlays and is available under CP/M-80, CP/M-86 and MS-DOS, and the first versions are intended for use with WordStar. Later versions will be for Microsoft Word, Perfect Writer and Spellbinder. Type-Edit will cost around £200 and Type Trace £150.

Contact Wordsmiths/Anvil Systems, 19 West End, Street, Somerset BA16 0LQ. Telephone: (0458) 45359.

(continued from previous page)
useful, if large amounts of text are going to be set on a regular basis an investment in specialised hardware is worth considering. This can be the best route, especially if a micro is to be bought for the first time or if expansion from the existing system is planned. Use of extra hardware can cover facilities for dumping text on to cassette, specialised micros adapted from existing models and adapted printer.

For dumping text on to cassette Data Communications supplies the Konnect-2, and Typecraft supplies Typetrack, another collection system.

Three microcomputers are available complete with specialised software creating discs which can be read by the leading brands of typesetting equipment. Apple Lisa with the Personal Composition System supplied through Gestetner can be linked direct to a Compugraphic typesetter. Profis supplies the Book Machine, based on a Sirius computer from ACT. Typecraft supplies its own system based on the Commodore 8296; it also supplies a Commodore SX-64 as a data input terminal for the system. Prices for these systems start around £4,000.

Typesetting firms apply a number of different methods of charging for typesetting. They will depend on whether the typesetter works direct from the text supplied. Does the disc have to be converted? Costs can be by the foot of bromide paper used for setting. By the 1,000 ens, by the job.

There can be setting-up charges, conversion charges, time charges, extra costs for correcting your mistakes. Plus many companies make a minimum charge to discourage time wasters.

Talking to a variety of typesetting organisations they all agree on the savings which can be made by direct input. From about 50 percent upwards seems to be an agreed figure. However, this is purely in the typesetting areas.

Direct-input typesetting saves time in the editorial area too. If you consider where the text has been marked up and the typesetter can return a page instead of galleys then the savings could be up to 90 percent.

Naturally the computer companies have been quick to understand the benefits of this type of setting. Now many manuals

Hardware

Although there are a number of specialised terminals and computers specifically designed for use in the typesetting process, here we have examples of equipment which can provide assistance but in the case of the microcomputers can also be used for the normal computing tasks when not involved in the typesetting side.

Apple Lisa

A combination of the Apple Lisa microcomputer with the Compugraphic Personal Composition systems is now available through Gestetner Office Automation Ltd. The system comprises the Apple Lisa with its six packages plus the Personal Composition Software. Currently 14 digital founts are available; however, this is intended to increase to their library of around 1,500 type styles. Use of Apple's mouse technology helps to eliminate the complicated operating systems and extensive keyboarding. An Apple Lisa with its six packages and the Personal Composition Software costs around £13,000, including training. Including one of the Compugraphic typesetters a complete system would cost from around £32,000 — far less than any other system of this specification.

Contact Gestetner Office Automation Ltd, 210 Euston Road, London NW1. Telephone: 01-387 7021.

Konnect 2

Low-cost compact data-capture unit controlled by a 64K microprocessor. Data stored on mini-cassettes with up to 64,000 characters on each side. Interfaces to the microcomputer via a standard RS-232/V-24 printer or communications port. Handles both serial and parallel interfaces for both Input and Output. Price: £1,395.

Konnect 2 users are throughout the U.K. Here are some examples:
Avon Dataset Ltd, Warwickshire. Mr K Ramsbottom
Afal Ltd, Mr E Davies
Clerkenwell Graphics Ltd, London EC2. Mr Stock
Flexiprint, Worthing. Mr Squires
Graphiti (Hull) Ltd, Hull. Mr J Harris
Monarch Origination, Suffolk. Mr J Pryke
Minstrel Reprographics, Sale. Mr M Corcos

Typeprinter

Dot-matrix printer with a modified character set to print all typesetting symbols. Price £550. Contact Data Communications Ltd, 239 Horn Lane, London W3 9ED. Telephone: 01-992 6042.

Prefis — The Book Machine

Combination of hardware and software, Prefis has developed a system which will edit, select typefaces and sizes, cast off and paginate or index at the stroke of a key. Discs generated by The Book Machine will drive the photo-typesetter's equipment without an intermediate stage.

Based on the 256K 16-bit Sirius microcomputer, The Book Machine has twin floppy-disc drives. The system has all the typewriter character shapes plus 250 specials selected through market research. Seven typestyles can be shown on screen and the same number plus underscore and double u/s printed out. Six point to 48 point can be displayed on screen.

Commands available include Letter, Word, Line, Sentence, Paragraph, Page, Document and String. Up to six documents can be held in memory for immediate access and there can be two screen windows. Comprehensive search and replace facilities, full justified page-proofing facilities and pagination as for a final typeset book.

Other features include frequency counts, characters and words, spelling check and indexing. Price £5,980 includes computer, screen, keyboard, disc drives, discs and printer. Author's keyboard available £295 extra.

Contact Prefis — The Book Machine, 64 Baldock Street, Ware, Hertfordshire SG12 9DT. Telephone: (0920) 5890.

Typecraft

Fully counting front-end system that composes and edits text for typesetting. The text is composed on a standard keyboard and transferred to the typesetter directly or by telephone modem link — where it interfaces with Compugraphic or Linotype typesetting systems. The system is based on the Commodore 8296 microcomputer and is supplied with 128K of RAM, Disk Unit 40 holding 2Mbyte.

Standard QWERTY keyboard with special typesetting engravings; 18 lines displayed on screen with up to 117 characters without wordwrap. Typeface display shows fount number and name in use. Horizontal and vertical count with picas and points used.

The system can search and replace specific copy and can handle columns and tabular formats. All deletions, addition and alterations are immediately counted and justification is automatic.

Status line set at the bottom of the screen displays current fount by name, measure, point size, width, horizontal and vertical counts, tab columns and typesetting commands. Disc filing system allows creation of documents with multiple chapters. The Typecraft system is based on the Wordcraft word-processing package. Price: £3,995. Over 50 typesetting bureaux throughout the U.K. accept the discs, addresses direct from Typecraft.

Typecraft Input Terminal

Version of the Commodore SX-64 portable microcomputer complete with software. Produces discs compatible with Typecraft copyfitting keyboards. Price: £1,500.

Typetrack

Data-collection system using cassette. Up to four million characters of storage per tape. Eight switch-selectable data rates up to 19,200 baud. Data transfer rate up to 1,920 characters per second. RS-232C compatible, two ports provided. Price: £1,750.

Contact Typecraft (U.K.) Ltd, Shirley Lodge, 470 London Road, Slough, Berkshire SL3 8QY. Telephone: Slough 49444.

are computer set, because otherwise the cost would make it impractical. Magazines containing pages of listings which always have to be updated are another key market.

If you already have a microcomputer, disc drive and word-processing package then Aspic or WS Typo will get you started. Own a modem and you don't even need to send a disc. The cost in setting up can be £20 for Aspic or completely free with Wordsmiths or the typesetter receiving text down the telephone line from your existing word processor, as long as you supply the extra details needed for the setting.

With the increasing number of programs which allow you to produce fancy typefaces with dot-matrix printers isn't the day of the typesetter limited? Frankly, the results produced with these types of programs are certainly impressive, but are no replacement for typesetting. They do fill a gap where conventional typesetting would be impractical but that's all.

Companies

The following companies have been contacted and supplied details for inclusion in this article.

Biggleswade. Watkiss Studios Ltd, Holme Court, Biggleswade, Bedfordshire SG18 9ST.
Chipstead. Albany Insurance Systems Ltd, Chipstead Offices, Station Approach, Chipstead, Surrey CR3 3TD. Telephone: (07375) 52544.
Colchester. Facsimile Graphics Ltd, 5 Queen Street, Coggeshall, Colchester, Essex CO6 1UF. Telephone: (0376) 62323.
Dunstable. A J Latham Ltd, 28 West Street, Dunstable, Bedfordshire LU6 1SL. Telephone: (0582) 609721.
Hove. Direct Image Photosetting, 16 Church Road Lane, Hove, East Sussex BN3 2LU. Telephone: (0273) 772834.
Hull. Graphiti (Hull) Ltd, Acorn Industrial Estate, Strawberry Street, Hull, Humberside HU9 1EN. Telephone: (0482) 29373.
Leicester. PDR Typesetting Ltd, Tyrrell Street, Leicester LE3 5SB. Telephone: (0533) 50403.
London. Budget Typesetting Ltd, 21 High Street, London SE20 7HJ. Telephone: 01-659 6622.
Electronic Village Ltd, St. Johns Studios, Church Road, Richmond, Surrey TW9 2QA. Tel: 01-948 5322.
Serious Software, 55 East Road, London N1 6AH. Tel: 01-253 2287.
Oxford. Oxford Publishing Services, The Old Toffee Factory, 120a Marlborough Road, Oxford. Telephone: (0865) 245644.
Stowmarket. DTR Interfacing, PO Box 15, Stowmarket, Suffolk IP14 1PQ. Telephone: (0449) 677663.
Street. Wordsmiths, West End, Street, Somerset BA16 0LQ. Telephone: (0458) 45359.
Sudbury. Mill Studio, Walnut Tree Lane, Sudbury, Suffolk. Telephone: (0787) 74010/73710.

Systems to help with typesetting

Many people will want to have their work typeset without buying any additional software or hardware, and there are six systems which can be used by most owners of microcomputers.

Aspic, Magic and Music

These three words are in fact acronyms for sets of codes to make marking up text for typesetting far easier. Aspic stands for Authors Standard Pre-press Interfacing Codes; Magic for Managers Alphanumeric Generic Interfacing Codes; and Music equals Marker-Uppers Alphanumeric Simple Interfacing Code. All mouthfuls, hence the acronyms.

Unlike other systems, the use of these codes makes it possible for virtually any word-processing program on the market to be used as the basis for typesetting. So whether the program runs on an Apple, Commodore, BBC, IBM PC, uses a proprietary operating system or CP/M, MS-DOS it really doesn't make any difference. The system is hardware and software independent, although in most cases the text is likely to be supplied in disc form.

The three systems work from the person wishing to know the least, technically speaking—Aspic, through the manager — Magic, to the typographer and designer — Music.

Aspic uses the natural hierarchy of headings — chapter, section and subsection, and of text — main text, extracts and footnotes, to indicate what codes are inserted where. Headings and text are specified by h or t, each one followed by a number and each one enclosed in a square. It can also be used before a decision has been made about the final typographical style. Aspic was developed by Tony Randall of The Electronic Village and the system is now approved by the British Printing Industries Federation.

Magic is a print-orientated and precise code set, designed for everyone connected with print who has managerial responsibility for getting text turned into type. The codes are alphanumeric and are printed out within the text. The standard code set is compatible with the Compugraphic CG-8600 digital typesetter driven by an MSC front end. But it is also capable of being adapted to other systems with similar characteristics.

Music is for typographers and graphic designers and is based on the manner in which they mark up copy by hand. All that is needed to start using one of these systems is the manual — nothing else. Any one manual costs £10 and a complete set of three costs just £20 from The Electronic Village, St. Johns Studios, Church Road, Richmond, Surrey TW9 2QA. Telephone: 01-948 5322. Aspic is also available from the British Printing Industries Federation, 11 Bedford Row, London WC1R 4DX.

WS Typo, WS Manual and Typewise

WS Typo is an easy way of preparing text for typesetting simply by using specially defined WordStar commands in the text files. No additional software is required. To use WS Typo first the specification for Anvil Typesetting is completed. The type, size fount, line length, justification, etc. which is required in the text being supplied. Then insert the WS Typo commands which give the instructions to the typesetter.

When the typespec is received by the typesetter, a special format file is made up. This file is then sent to the phototypesetter through the Anvil Interface which translates the special WordStar commands in the file to typesetter code using the format file as the key.

When the typespec is received by the typesetter, a special format file is made up. This file is then sent to the phototypesetter through the Anvil Interface which translates the special WordStar commands in the file to typesetter code using the format file as the key.

WS Manual

This system is an extended version of Anvil Systems' WS Typo, which has extra facilities for the special requirements of computer publications. Apart from the codes already described, WS Manual adds Ctrl-D for in-line computer text in which ordinary and computer terms are missed, and Ctrl-Y for line-by-line computer texts like listings or screen displays. Plus a number of other codes to cover the specialised needs of computer-related publications. WS Read will display on the screen or print out the text file highlighting printer and Anvil control codes line by line for checking.

Typewise

This is a system of using the Wordwise program for the BBC Micro to typeset direct from standard text files, using Wordwise's existing commands and some extra ones embedded in the text. No extra software is required. First make out a format table for the typesetting, then add the Typewise codes into the text.

WS Typo, WS Manual and Typewise are all available free of charge from Anvil/Wordsmith Systems, 19 West End, Street, Somerset BA16 0LQ. Telephone: (0458) 45359.

From accounts to Apricots

Roger Foster is managing director of ACT and the inspiration behind the Apricot micros. He told Glyn Moody about his company's success and its future plans.

"TOTAL COMPUTING" — so reads the sign over the entrance to ACT's headquarters in Birmingham. Applied Computer Techniques (Holding) plc, to give the company its full name, has blossomed from rather shaky beginnings in 1965 as a mainframe accounting bureau. Now it embraces microcomputer manufacture, distribution in the U.K. and overseas, bureau services, software development and distribution, office and computer supplies, and retailing. Profits and turnover for the year ending March 1984 were a healthy £5 million on £50 million.

The driving force behind the company has been its founder and current managing director, Roger Foster. He left Wolverhampton Grammar School in 1957, and after qualifying as an accountant in 1962 started a three-year spell at GKN. It was here that he had his first taste of computers. "Computers were basically unheard of in schools in those days", he says.

It proved a decisive encounter. "The first time I ever saw a computer, which was probably about 1963, I think I had an instinctive desire to get involved with them. They were clearly the way of the future." In 1965 Foster left GKN to set up Applied Computer Techniques.

To tide them over a rather quiet patch, Foster and his associates wrote a book. "It was about the future of computing. We wrote a book which finished up illustrating the VDU as the ultimate development." Another prediction was the integration of software. "It was one of the pillars of the software that we prepared during those late sixties when we wrote an integrated accounting system for mainframe computers. One which has been refined and developed over a period of 15 years now, and which we sell as Pulsar on the micros." Foster admits that his ambitions have always been galactic: "Cosmos was our first integrated system, then came Nebula."

A minicomputer division was set up in 1976, and a continuous stationery manufacturer bought in 1977. To fund further growth, ACT floated 10 percent of its share on the stock exchange in 1979. It did this under a rule that was later to be established as the basis of the unlisted securities market, which has since proved very popular with high-growth and high-tech companies. ACT went to a full stock exchange listing in 1980.

Roger Foster: ACT's driving force.

It was about this time that ACT first became involved with micros. It distributed an eight-bit micro from Computhink called the ACT System 800. Unfortunately its name proved apt: only about 800 were sold. More important were ACT's deaings with Commodore. "We got involved with a company called Petsoft, which did little cassette programs for the early Commodores."

Through this company ACT came to know Chuck Peddle, who soon left Commodore to design and produce the 16-bit Sirius machine. Peddle asked ACT to have a look at his new machine, and Foster's reaction was typically bold. "We bought it straight off the drawing board, effectively based on the specification we could see and the credibility of the design group. There's no doubt the Sirius was a phenomenal machine for its period. We concluded an exclusive distribution deal for that product. It was very much a turning point in the company."

That was in 1981. Since then some 25,000 Sirius machines have been sold in the U.K. When Victor, the manufacturer of the Sirius, ran into financial difficulties, ACT made efforts to acquire the company. These lengthy negotiations eventually fell through, something ACT does not now regret. For in the meanwhile, with its appetite whetted by its experiences with the Sirius, it had moved into full-scale independent micro manufacture with the launch of the Apricot in 1983.

This was less than a year after the Apricot project had been conceived by Foster. "It would be fair to say I led the design team in terms of system design." But he attributes the success of that design to ACT's history. "I think being a distributor for many years and a software company we approached the design of computers from the point of view of what the market wants. Too many products are designed by electronics engineers for their own electronics standards, and they then try and find a market for the product, having made it."

However, some calculated risks were taken. "We pioneered quite a few things — the 3.5in. disc was probably one of the biggest gambles." But Foster feels it is a gamble that has certainly paid off: "I think it is only a matter of time before IBM announces a 3.5in. product. Then the battle will be won."

More recent products like the Apricot F1 and Portable have been designed with a similarly close eye on the market. And development continues. "We are already working on products for 1985 and 1986. We intend to stay at the sharp end of technology."

Part of that sharp end involves the next generation of chips now beginning to come through. "ACT does have a deep regard for the Intel chip family. Inevitably we will use the newer chips as they become freely available from Intel, and that means the 186, the 286, and in due course the 386." Foster does not see ACT being seduced by the charms of the Motorola family. "I think the 68000 is a very nice piece of silicon; unfortunately the big software base is on the Intel chip family, and I can't see anything to change that."

On the software side of things, one area that Foster is convinced will be increasingly important is artificial intelligence. "I think over the next few years you'll see front ends to software which do enable you to put some sort of so-called 'intelligence' into it. I do believe in this artificial intelligence; I don't think it's a one-day wonder."

A related area of particular interest to ACT — and one in which Foster feels it has considerable strengths — is speech recognition. The new Apricot F1 is probably the first micro to offer a speech-recognition facility as standard. Foster

sees this advance as a crucial one.

"I think when you put AI together with speech recognition then you really are starting to get a new generation of computers. I think the progress of computers over the next five to 10 years is going to be dictated by how easy they are to use. Cost will not be a problem." To win over the estimated 95 percent of people who still do not use a computer as a matter of course in their work, Foster believes future machines will be "very graphical and with speech recognition; after three to seven years artificial intelligence will become significant."

Local area networks too, he believes, are "absolutely key". He disagrees with predictions of a fairly modest growth in their use. "I think now that LANs are a workable reality there is a fantastic dimension to the personal computer. Of course you want to be linked to someone else's. We all transfer information every hour of every day. The whole of the business environment is one of interaction. I just could not be more of a believer in both LANs and external communications."

One manifestation of this could be in the increasing use of external databases. "In my view that is going to be the biggest single growth area in the next five years. It is getting your personal computer to look out at the world and access databases of information."

ACT is preparing to launch a whole range of databases in October. "We have a new service which will major on the provision of Vans — Value-Added Network Services. Basically it is allowing any personal computer via internal modems to access databases via a very friendly icon-driven interface." To a certain extent these databases will employ the resources of ACT's old bureau machines now being replaced by companies' own computers.

Foster accepts that the micro is the area of greatest growth. "I think micro-related activities not only will but do dominate the company." Foster sees even traditional minicomputer markets as likely to be susceptible to penetration by micros linked together by LANs. "We're intent on going up-market with our new Point 7 and Point 32 systems, and really offering serious competition over the next few years to products like the Vax, and Data General and HP minis. We think the minis have had a very good run but are really going to come under pressure from micros using a network."

Top of the range

To consolidate the Apricot's strength in this market, ACT will be launching top-of-the-range machines to work with the current Apricot series. "I think you will see in 1985 high-end products to complement it."

ACT is also making a strong pitch for the low end of the market with the Apricot F1E. This cut-down version of the F1 is designed to offer higher-educational establishments the possibility of moving a stage beyond the BBC Micro to a real 16-bit business machine. In fact ACT has been trying for some time to fix up a similar deal to Acorn's. "We are still very much talking to the BBC. We firmly believe the BBC should recommend more than one machine." ACT has no intention, however, of producing a machine to fit in below the F1E. "We're not going to wrestle it out in the bottom end of the home market."

Matching the growth in the Apricot range, the company itself is diversifying and expanding. The Computerworld outlets are something of a novelty for ACT. Unlike its extensive independent dealer network, Computerworld consists of more thoroughly trained and closely monitored outlets that are franchise holders from ACT.

ACT has also just announced that it has acquired a 50 percent stake in Swire Systems Pacific in Hong Kong. This could mark the start of other similar deals as well as joint ventures. "I think that it signals a practical example of our philosophy, which is that we don't believe we can do everything ourselves and therefore partnership arrangements with blue-chip companies in various parts of the world we see as an important part of our strategy. Maybe we'll do joint ventures on products."

With all this activity Foster is looking for another doubled turnover next year to £100 million. He is also quietly confident about ACT's prospects as regards its competitors. "I really think it is sustainable for us to be number two in this market after IBM." But if Big Blue is still safe in the U.K., Foster has doubts about ACT's other big rival. "I think Apple is going to find it more difficult to compete against us in this country." It will be interesting to see what the new Apple management in the U.K. have to say about that.

However the league table works out in the coming years, ACT has certainly come a long way since those early days of writing Cosmos and books on the future of computing. Foster is sure the company can progress further. "I think we have gone beyond the stage of having made money and got out, and I think we've proved to the marketplace we are in it for the long haul. We see no reason why we should not become progressively a bigger and bigger company."

If its managing director's enthusiasm is anything to go by, ACT could well do just that. "I'm more excited about the whole marketplace and where it's going than I was 15 years ago." So has Roger Foster any particular goal in mind? "We would certainly like to become a billion-dollar company over the next five years." Perhaps that was the total he had in mind when he chose "Total Computing" as the company motto.

The company motto "Total Computing" stands at the entrance to ACT's headquarters.

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

Win an

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

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

Rules

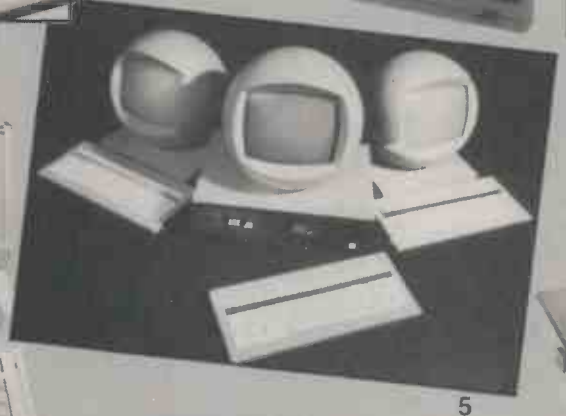
1. The competition is open to all readers of *Practical Computing* normally resident in the U.K., except for employees of Business Press International Ltd or Applied Computing Techniques (Holdings) plc, or their families.
2. Each entry must be written in ink on the official entry form printed here. Only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


1


2


3


4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8


9

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

7

10

Entry form for *Practical Computing* Spot the Micro Competition

Name .....

Address .....

.....

.....

.....

Answers

The micros shown in the photographs are

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

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

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

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

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

Tie-breakers

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

.....

.....

.....

.....

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

.....

.....

.....

.....

.....

.....

.....

.....

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

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● Circle No. 132

Tree search by scouting

David Levy describes an intelligent alternative to the conventional Alpha-Beta algorithm.

DURING the past 20 years almost every game-playing program has used the Alpha-Beta algorithm to search the game tree and find the best move from the root position. This algorithm was first stated in 1963, and since then considerable research has been devoted to its refinement.

If the game tree is perfectly sorted at every position — that is, the moves from any position are examined in accordance with their order of merit — then the Alpha-Beta algorithm finds the best move at the root of the tree after examining approximately

$2\sqrt{(\text{number of terminal positions})}$

So for a game such as chess, where the average number of legal moves is around 36, a four-ply, perfectly ordered Alpha-Beta search requires evaluation of only 2,000 or so of the million or more terminal positions — a saving of around 99.8 percent. Descriptions of the Alpha-Beta algorithm and of the various techniques employed in conjunction with the algorithm can be found in numerous sources, including my book *Computer Gamesmanship*.

Scout

In 1980 a new method of tree searching was described by Judea Pearl, of the Cognitive Systems Laboratory at the University of California, Los Angeles. Pearl's new search algorithm is called Scout, and under optimum conditions it will find the best move after examining the same number of terminal positions on the game tree as are examined by Alpha-Beta.

What is interesting in Scout is that its decisions are made on an intelligent basis. Alpha-Beta conducts a deep examination of a particular move in the tree if there is any chance that information about the move will help to improve the program's choice at the root position. Scout only conducts a deep examination of a move if it appears in some sense likely that the move is relevant.

The concept can be illustrated by the game situation shown in figure 1 where White is to play. White has opened with

1 e2-e4

and Black has replied with Alekhine's Defence

1...Ng8-f6

Now assume that the first few moves generated by the program from White's side are d2-d4, Qd1-h5, Qd1-g4 and e4-e5 — see figure 2.

If a position is at maximum depth, then the algorithm knows that no successor positions exist — d equal to 0 in the flow charts — and it evaluates the position as a terminal node. If there are successor positions, as in this case, the first successor position, that is the one arising after d2-d4, is evaluated recursively using the same procedure. This evaluation will lead to a score of −1 because the move d2-d4 loses a pawn

...Nf6xe4

Beginning at the second successor, in this case Qd1-h5, when the search reaches its maximum depth for the first time, it compares the backed-up score from this terminal position with the best score found so far.

If the backed-up score for the second successor is equal to or worse than the best found so far, the position is ignored. If its score is better than the best found so far the position is evaluated recursively using the same procedure.

So on examining Qd1-h5 the program will almost certainly encounter a terminal position with a value of approximately −9 pawns, since the move allows Black to win White's queen by

...Nf6xh5

A value of −9 is worse for the program than −1. Rather than conduct a thorough analysis of Qd1-h5 in the way that Alpha-Beta would, Scout exempts the move from further consideration and proceeds to examine Qd1-g4..This too is found to have a backed-up value of approximately −9 pawns and is exempted.

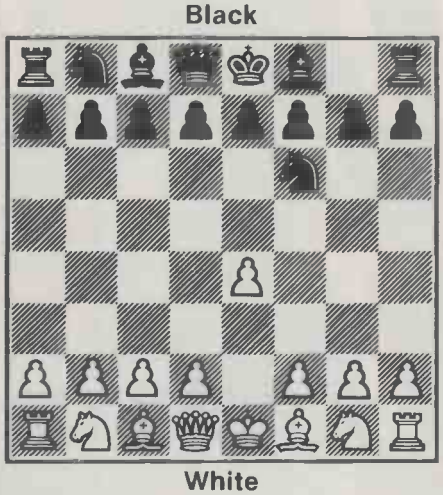

Figure 1.

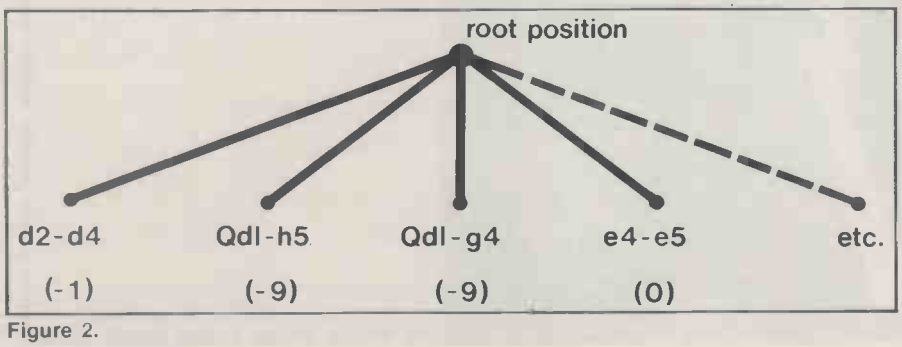

Figure 2.

Terminal position

Next the program encounters e4-e5, which attacks the Black knight and does not lead to the immediate loss of any material. The first terminal position encountered would probably have a value in the region of 0, which is better than −1, so Scout conducts a thorough analysis from the position arising after e4-e5, generating all of Black's reply moves.

Suppose that in the position arising after e4-e5 the program generates moves for Black starting with ...d7-d5, then ...Nf6-e4, then ...Nb8-c6, and so on. The program performs a thorough analysis of the position arising after the first of these moves, ...d7-d5, and it is the backed-up score of this position which is used as a

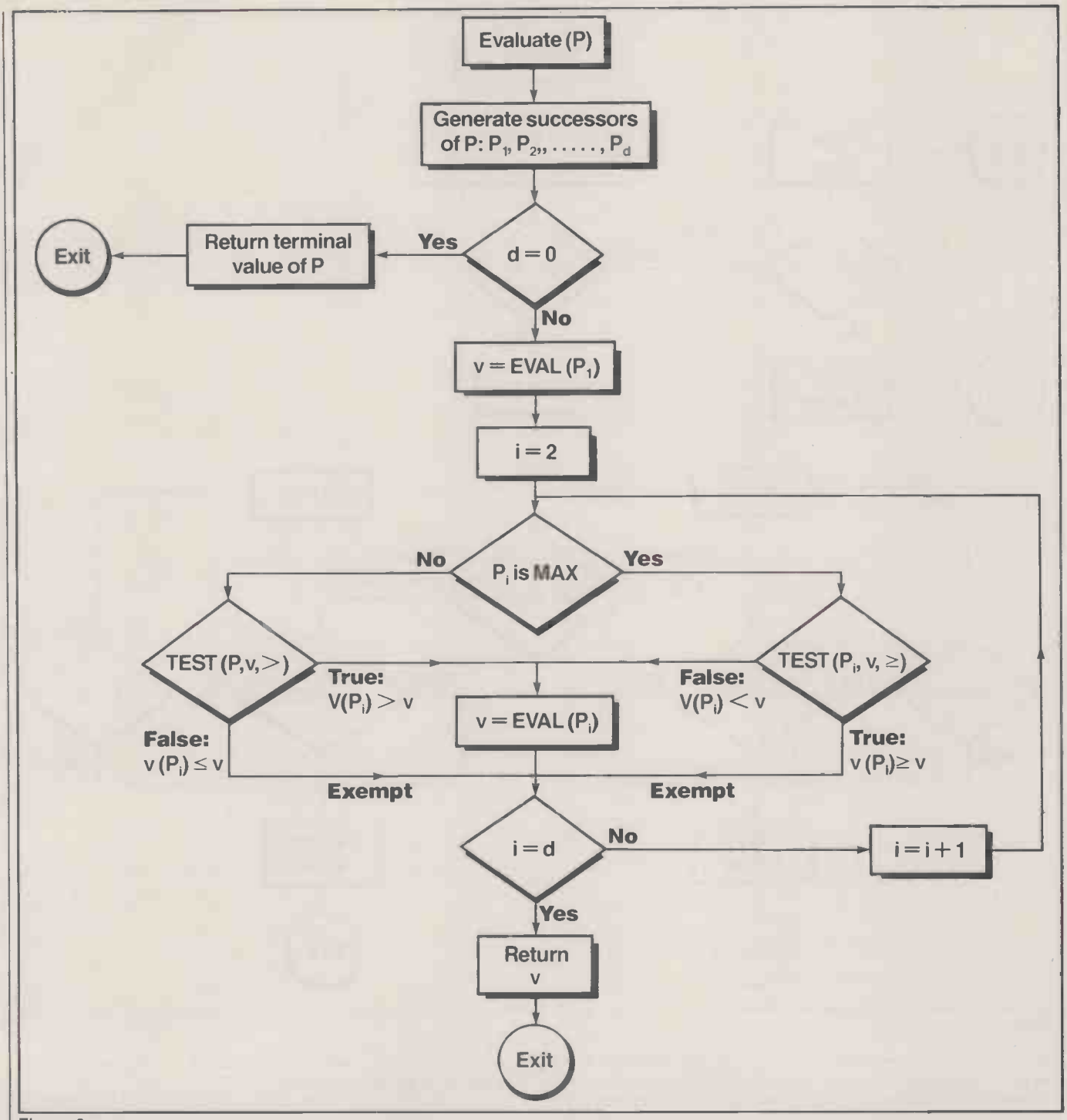

Figure 3.

reference when examining the various possible alternative Black replies. The backed-up value arising after ...d7-d5 will be in the region of −2 pawns, since the move would allow White's e5 pawn to capture the knight on f6 in return for the pawn.

The next move to be considered, ...Nf6-e4, is seen to avoid immediate material loss and so it is interesting enough to warrant a more thorough analysis. A deeper analysis of ...Nf6-e4 will show a value in the region of 0, so this value now replaces the −2 pawns as the current reference value.

The next move, ...Nb8-c6, is seen to lose the knight on f6, so its value of approximately −2 pawns will cause the move to be exempted from a detailed analysis. Most of Black's alternatives are likewise exempted as the program can see that they lead to the immediate loss of the knight. Only the positions arising after the moves ...Nf6-g8 and ...Nf6-d5 might be examined further.

The difference in philosophy between Alpha-Beta and Scout can easily be seen. When considering White's second move, Alpha-Beta would look thoroughly at Qd1-h5 in case it turns out to be a good move. By contrast, Scout would argue that Qd1-h5 looks to have a value worse than −1 pawn, which can already be achieved by playing d2-d4, so it would not examine Qd1-h5.

Consider a game by two players called Max and Min where it is always Max's turn to move from the root position and from any position at an even-ply depth, and it is Min's turn to move from all positions at odd-ply depths. Scout starts to evaluate a Max position P by first performing a thorough examination of its first successor position, P_1. This provides an evaluation v.

The algorithm then scouts the brother positions P_2, P_3, P_4, etc. to determine whether any of them appear to be better

(continued on next page)

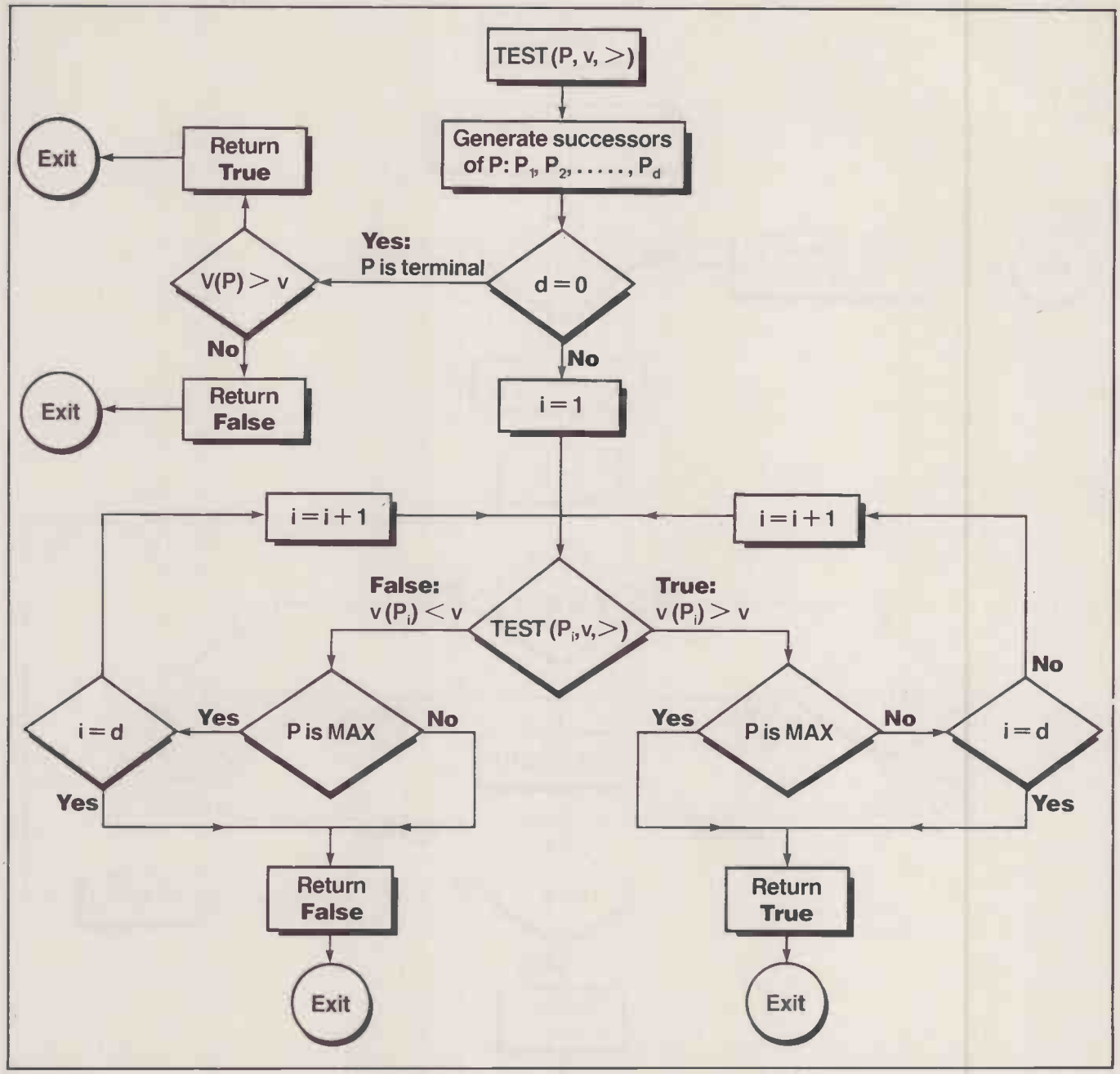

Figure 4.

(continued from previous page)

than P_1. This decision is made on the basis of a superficial evaluation of each of these positions, without resorting to a thorough analysis, followed by the simple test

is $v(P_x) > V(P_1)$?

If a position is found which appears to be better than P_1, then it is thoroughly examined and its value is used as the reference value for subsequent scouting tests. Any position which does not meet this condition is exempted from exact evaluation. When all of the positions P_2, P_3, etc. have been thoroughly analysed or tested and exempted from a thorough analysis, the last backed-up value obtained is used as the value for position P_0. The same procedure is used for evaluating a Min position, but with the inequality sign replaced by $\geqq$.

Scout benefits from two factors. First, most tests will show that the position under consideration is not so good as the best found so far, so the position and all its descendent positions will be exempted from a more detailed examination. Second, testing is relatively fast.

The two flow charts will assist if you want to incorporate the scout algorithm into your own game-playing programs. Figure 3 is of the recursive subroutine Evaluate (P) where P is a Max position — that is, a position from which it is Max's turn to move. Figure 4 is of the subroutine

Test (P, v, >)

which tests whether the backed-up minimax value of position P is greater than the reference value v.

When the test is against the inequality $\geqq$ rather than >, the True and False exits from the Test in figure 4 will be defined by the conditions

True: $v(P_i) \geqq v$

and

False: $v(P_i) < v$

The Scout algorithm can be made slightly more intelligent by basing the tests on comparisons with

v + margin

rather than merely on comparisons with v. The margin can be fixed by the programmer, or it can vary dynamically, perhaps as a function of v itself. In this way the program allows for a certain amount of error in the values provided by the evaluation function, while retaining Pearl's fundamental philosophy.

Bibliography

"Asymptotic Properties of Minimax Trees and Game-Searching procedures" by J Pearl, *Artificial Intelligence*, 14 (1980), p.113-138.

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● Circle No. 133

How to spot the trend

A Cusum curve can help to reveal hidden changes underlying apparently random data. John Mingers presents a program in BBC Basic which does the plotting from any given set of measurements.

CAN YOU keep track of your petrol consumption? Are you using more gas or electricity than usual? Are you really losing weight or just kidding yourself? Once you start recording such things regularly you will find that fluctuations can often disguise or hide changes in the underlying trend. The Cusum helps you detect quickly whether a significant change has really occurred.

Suppose you have started a diet and want to monitor your weight. To do this, you weigh yourself regularly and record the readings shown in table 1.

Though the figures vary somewhat from day to day, the general impression is that they are lower at the end than the beginning. But it is hard to see exactly when the change occurs. A graph of the data is often more helpful than tables of figures, but in this case — see figure 1 — it shows little more than a general decline in weight.

A Cusum calculation starts by working out the difference or error between each observed value and the expected or underlying average value. These errors are then cumulated — that is, added together. The average you start with is known as the reference value. Table 2 shows the Cusum calculations.

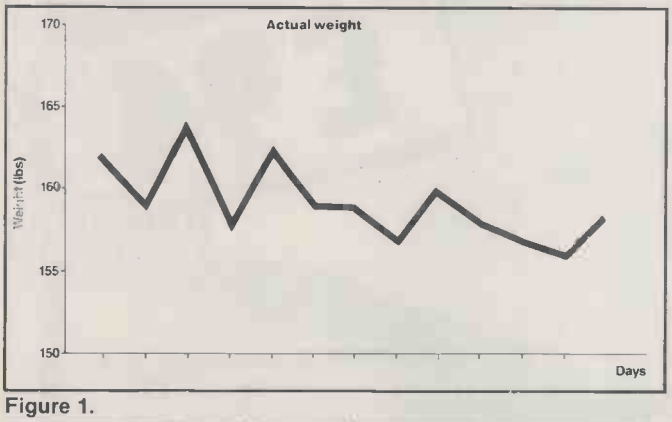

Figure 1.

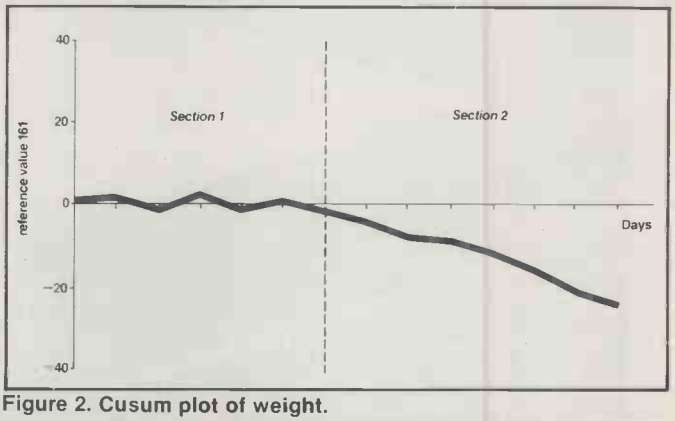

Figure 2. Cusum plot of weight.

```
>L.
   10 REM CuSum Plotting Program
   20 REM copyright J Mingers 12/3/84
   30 DIM cusum(500),time(500)
   40 MODE 4
   50 PROCinitialise
   60 REPEAT
   70 PROCmenu
   80 PROCinput
   90 PROCcalculate
  100 PROCgraph
  110 UNTIL finish
  120 END
  130:
  140 DEF PROCinitialise
  150 finish=FALSE
  160 ENDPROC
  170:
  180 DEF PROCmenu
  190 LOCAL choice%
  200 REPEAT
  210 CLS:CLG
  220 PRINT'TAB(10) "CuSum Menu"'
  230 PRINT'TAB(10) "1 Gas"
  240 PRINT TAB(10) "2 Petrol"
  250 PRINT TAB(10) "3 Electric"
  260 PRINT TAB(10) "4 Weight"'
  270 PRINT TAB(10) "9 Finish"
  280 choice%=VAL(GET$)
  290 IF choice%=1 cumulative=TRUE:constant=F
ALSE:RESTORE 2050
  300 IF choice%=2 cumulative=TRUE:constant=F
ALSE:RESTORE 2090
  310 IF choice%=3 cumulative=TRUE:constant=T
RUE:RESTORE 2140
  320 IF choice%=4 cumulative=FALSE:constant=
TRUE:RESTORE 2180
  330 IF choice%=9 finish=TRUE
  340 UNTIL choice%>0 AND choice%<10
  350 ENDPROC
  360:
  370 DEF PROCinput
  380 IF finish THEN ENDPROC
  390 READ ref_value
  400 IF cumulative READ last_reading
  410 cusum(0)=0:time(0)=0
  420 ENDPROC
  430:
  440 DEF PROCcalculate
  450 LOCAL i%
  460 IF finish THEN ENDPROC
  470 CLS:CLG
  480 @%=&0408:i%=1
  490 IF cumulative THEN PROCcalc_cum ELSE PR
OCcalc_normal
  500 num%=i%-1
  510 PRINT''"Press space bar":a$=GET$
  520 ENDPROC
  530:
  540 DEF PROCcalc_cum
  550 PRINT'"No of"," ","Actual","Expctd"
  560 PRINT "Per'ds","Reading","Usage","Usage
","CuSum"'
  570 PRINT " ",;last_reading
  580 IF constant THEN periods=1
  590 REPEAT
  600 IF constant THEN READ reading ELSE READ
 periods,reading
```

How are these figures to be interpreted? If the reference value you have chosen is close to the underlying weight then the actual observations would vary at random about the reference value — sometimes above it and sometimes below it —unless there is some underlying change. If it started at zero it should remain about zero and not drift either upwards or downwards. Now suppose that your underlying weight falls. There will be more readings below the reference value of 161 than above, and the Cusum will no longer remain constant but will begin to fall as the negative errors accumulate. In the example it grows negatively indicating that weight has actually fallen. When the figures are plotted, as in figure 2, it is clear that the underlying weight drops after the fifth reading.

Although Cusum charts are easy to construct, they are also all to easy to misinterpret. For example, the downward slope at the right-hand end of figure 2 does not mean that your weight is continuing to fall, only that it stays at a lower level than the reference value.

Now look at figure 3, which illustrates an idealised Cusum chart showing the underlying trend in a number of sections. This is a continuation of the observations of weight. At first sight you might interpret it as meaning that the weight is low at the start, rising in the middle and high at the end. In fact, the data from which the Cusum chart in figure 3 was constructed is shown in figure 4.

The point is that when the Cusum is rising or falling at a constant rate, then the actual values will be above or below the reference value by a constant amount. Mathematically speaking, the actual values are the gradient of the Cusum curve.

Not only can the chart be used to detect when a change has occurred, it can also be used to obtain an estimate of the amount by which the underlying average has changed. In section 2 of figure 5 the Cusum of weight is falling at a constant rate. The graph was plotted for a different person using a reference value of 145lb. The line drawn through the middle of the points represents the trend. At the beginning, the Cusum was −2 and by the end it was −22. So over 10 days the Cusum has changed by −20lb. or −2lb. per day. Remember that this does not mean you were losing weight at a rate of 2lb. per day, only that during this time your weight was 2lb. below the reference value of 145. In other words, your weight was a constant 143lb.

To analyse a Cusum chart, divide it up into sections of constant behaviour, draw a line to represent the trend and estimate the slope of this trend. During this period, the actual values will be above or below the reference value by that amount.

The example used so far assumes that the readings are taken at regular intervals — say, once a day or once a week. In practice it is easy to forget to do this every single time, but this need not be a problem, as the method can be adjusted to cope with a variable number of periods between readings.

John Mingers is a lecturer in statistics at Ealing College of Higher Education.

Day	Weight (lb.)
1	162
2	159
3	164
4	158
5	162
6	159
7	159
8	157
9	160
10	158
11	157
12	156
13	158

Table 1.

Weight	Reference value	Error	Cusum error
162	161	1	1
159	161	-2	-1
164	161	3	2
158	161	-3	-1
162	161	1	-0
159	161	-2	-2
159	161	-2	-4
157	161	-4	-8
160	161	-1	-9
158	161	-3	-12
157	161	-4	-16
156	161	-5	-21
158	161	-3	-24

Table 2.

Cumulative data

Many things you may want to monitor are themselves recorded cumulatively. For example, a gas meter does not record how many units have been used since you last check it — which is what you, and the gas board, are interested in — but how many have been used cumulatively since the meter was started.

Table 3 shows the readings from a gas meter, taken every few days. Column 1 shows the number of days between readings and column 2 shows the actual reading. Note that you need an initial reading to get started. Column 3 then shows the amount of gas that has been used.

(continued on next page)

```
  610 IF reading=999999 THEN 680
  620 actual=reading-last_reading
  630 cusum(i%)=cusum(i%-1)+actual-periods*re
f_value
  640 time(i%)=time(i%-1)+periods
  650  PRINT;periods,;reading,;actual,;period
s*ref_value,;cusum(i%)
  660 last_reading=reading
  670 i%=i%+1
  680 UNTIL reading=999999
  690 ENDPROC
  700:
  710 DEF PROCcalc_normal
  720 PRINT'"No of","  ","Expctd"
  730 PRINT "Per'ds","Reading","Reading","Err
or","CuSum"'
  740 IF constant THEN periods=1
  750 REPEAT
  760 IF constant THEN READ reading ELSE READ
 periods,reading
  770 IF reading=999999 THEN 820
  780 cusum(i%)=cusum(i%-1)+reading-ref_value
  790 time(i%)=time(i%-1)+periods
  800 PRINT;periods,;reading,;ref_value,;read
ing-ref_value,;cusum(i%)
  810 i%=i%+1
  820 UNTIL reading=999999
  830 ENDPROC
  840:
  850 DEF PROCgraph
  860 LOCAL i%
  870 IF finish THEN ENDPROC
  880 REM calculate max and min values for gr
aph
  890 xmax=-9.9E20:ymax=-9.9E20
  900 xmin=9.9E20:ymin=9.9E20
  910 FOR i%=1 TO num%
  920 IF time(i%)>xmax THEN xmax=time(i%)
  930 IF time(i%)<xmin THEN xmin=time(i%)
  940 IF cusum(i%)>ymax THEN ymax=cusum(i%)
  950 IF cusum(i%)<ymin THEN ymin=cusum(i%)
  960 NEXT
  970 IF ABS(ymin)>ABS(ymax) THEN ymax=ABS(ym
in) ELSE ymin=-ABS(ymax)
  980 REM set up graph and axes
  990 PROCsetup_graph
 1000 PROCdraw_axes(xstart%,xend%,ystart%,yen
d%)
 1010 REM plot graph
 1020 MOVE xstart%,yzero%
 1030 FOR i%=1 TO num%
 1040 DRAW xstart%+(time(i%)-xmin)*h_sc_fact,
ystart%+(cusum(i%)-ymin)*v_sc_fact
 1050 PLOT0,-16,16:VDU225:PLOT0,-16,-16
 1060 NEXT
 1070 MOVE 300,64:PRINT"reference value = ";r
ef_value
 1080 REM draw key on graph
 1090 PROCkey
 1100 VDU4
 1110 PRINT"press space bar":a$=GET$
 1120 VDU26:VDU20
 1130 ENDPROC
 1140:
 1150
 1160 DEF PROCsetup_graph
 1170 REM define text window
```

(listing continued on next page)

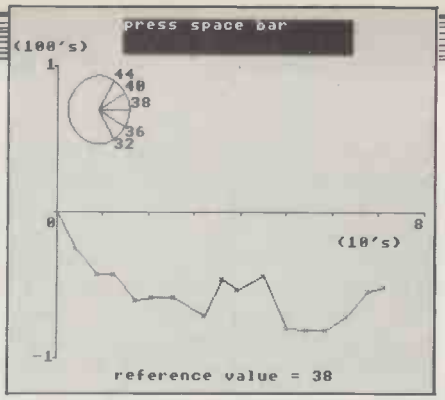

Figure 7. Petrol Cusum printout.

(continued from previous page)

For the reference values, you have to decide how many units of gas you expect to use each day: I picked a value of 1.5 units per day. Given the number of days between readings, it is easy to work out how much gas you would have expected to use in this time — which is shown in column 4. The error is then the difference between the actual and the expected values, and is cumulated in the final column. These values are then plotted against the cumulative number of periods. The Cusum chart for this data is shown in figure 6.

In this case the usage for the first 60 days is below the reference value of 1.5. The slope of the line is about −0.5, so the acutal usage is about 1 per day. The Cusum then rises and maintains a constant increase, showing that usage is steady but above the reference value of 1.5 per day. The slope of the Cusum during this period is about 1.5, so usage must be about 3. This increase actually occurred as the weather started getting colder in October, and the dip at 120 days marks Christmas and New Year, when I was away from home. I trust that the Cusum will start to fall again in the spring.

The Cusum BBC Basic program has been set up to hold data on a number of different things — in this case gas, electricity, petrol and weight. The data is held in Data statements and is accessed via a menu. You can easily tailor it to suit your own needs.

The program is complicated by the fact that it has to be able to deal with several different situations. There are two distinctions: whether or not the data is at constant intervals and whether or not it is cumulative. Combining them makes a total of four possibilities. You will have to decide which of the four is appropriate for each of your sets of data and then set certain variables in the program.

To ensure that your copy of the program is working you should run it with the existing data on petrol consumption, and compare it with the results in this article. Then put in your own data, and change the names in the menu and the type variables if necessary. Names in the menu are set up in lines 230 to 270.

For each of your sets of data you must set the two variables Constant and Cumulative

Number of days	Reading	Actual usage	Expected usage	Error	Cusum
	38				
8	45	7	12	-5	-5
5	52	7	7.5	-.5	-5.5
6	59	7	9	-2	-7.5
7	68	9	10.5	-1.5	-9
15	84	16	22.5	-6.5	-15.5
7	92	8	10.5	-2.5	-18
9	104	12	13.5	-1.5	-19.5
12	119	15	18	-3	-22.5
15	141	22	22.5	-.5	-23
13	165	24	19.5	5.5	-18.5
12	186	21	18	3	-15.5
13	213	27	19.5	7.5	-8
12	221	8	18	-10	-18
9	240	19	13.5	5.5	-12.5
8	258	18	12	6	-6.5
40	343	85	60	25	18.5

Table 3. Gas consumption.

Number of periods	Reading	Actual usage	Expctd usage	Cusum
4.4	5269	143	167.2	-24.2
4.7	5430	161	178.6	-41.8
3.6	5566	136	136.8	-42.6
4.7	5727	161	178.6	-60.2
3.6	5866	139	136.8	-58
4.8	6049	183	182.4	-57.4
6.6	6287	238	250.8	-70.2
3.9	6460	173	148.2	-45.4
3.3	6578	118	125.4	-52.8
5.5	6797	219	209	-42.8
5.1	6955	158	193.8	-78.6
4.7	7133	178	178.6	-79.2
4.0	7285	152	152	-79.2
4.6	7469	184	174.8	-70
4.5	7656	187	171	-54
3.4	7789	133	129.2	-50.2

Table 4. Petrol consumption.

(listing continued from previous page)

```
  1180 VDU28,10,3,30,1
  1190 REM change colour to yellow
  1200 VDU19,1,3,0,0,0
  1210 REM set back and foreground colours
  1220 GCOL0,129:GCOL0,0
  1230 COLOUR 128:COLOUR1
  1240 REM join text and graphics cursor
  1250 CLG:CLS:VDU5
  1260 xstart%=128:xend%=1200:ystart%=96:yend%
=864
  1270 REM define character to plot point
  1280 VDU23,225,0,0,0,40,16,40,0,0
  1290 ENDPROC
  1300
  1310
  1320 DEF PROCdraw_axes(xstart%,xend%,ystart%
,yend%)
  1330 LOCAL in,int,xpower,ypower
  1340 REM scale numbers to range 0 - 10
  1350 xpower=INT(LOG(xmax-xmin)-.05)
  1360 xmin=INT(xmin/10^xpower)
  1370 xmax=INT(xmax/10^xpower-.0001)+1
  1380 ypower=INT(LOG(ymax-ymin)-.05)
  1390 ymin=INT(ymin/10^ypower)
  1400 ymax=INT(ymax/10^ypower-.0001)+1
  1410 xzero%=xstart%
  1420 REM draw line for x-axis
  1430 MOVE xzero%,ystart%:DRAW xzero%,yend%
  1440 yzero%=(yend%+ystart%)/2
  1450 REM draw line for y-axis
  1460 MOVE xstart%,yzero%:DRAW xend%,yzero%
  1470 REM print scale along x-axis
  1480 newrange=xmax-xmin
  1490 in=INT((xend%-xstart%)/newrange+.5)
  1500 int=(xmax-xmin)/newrange
  1510 MOVE xstart%-32,yzero%-16
  1520 @%=&0204
  1530 FOR i%=1 TO newrange+1
  1540 PLOT0,32,8:PLOT1,0,8:PLOT0,-32,-16
  1550 IF i%=1 OR i%=newrange+1 THEN PRINT;xmi
n+(i%-1)*int
  1560 MOVE xstart%-32+i%*in,yzero%-16
  1570 NEXT
  1580 MOVE xend%-256,yzero%-64:@%=&0808:PRINT
"(";10^xpower;"'s)"
  1590 REM set values back to proper size
  1600 xmin=xmin*10^xpower:xmax=xmax*10^xpower
  1610 REM print scale along y-axis
  1620 newrange=ymax-ymin
  1630 in=INT((yend%-ystart%)/newrange+.5)
  1640 int=(ymax-ymin)/newrange
  1650 MOVE xzero%-132,ystart%+16
  1660 @%=&0204
  1670 FOR i%=1 TO newrange+1
  1680 PLOT0,124,-16:PLOT1,8,0:PLOT0,-132,16
  1690 IF i%=1OR i%=newrange+1PRINT ymin+(i%-1
)*int
  1700 MOVE xzero%-132,ystart%+16+i%*in
  1710 NEXT
  1720 MOVE xzero%-132,yend%+64:@%=&0808:PRINT
"(";10^ypower;"'s)"
  1730 ymin=ymin*10^ypower:ymax=ymax*10^ypower
  1740 REM calculate horizontal and vertical s
cale factors for plotting graph
```

to be either True or False — see lines 290 to 320. For example, in the program the gas readings are cumulative and taken at irregular intervals, so Cumulative is set True and Constant is set False in line 290.

The Data statements will vary depending on what type the data is. In all cases there will be three Data statements for each set of data. The first is

3000 DATA n1,n2

where n1 is the reference value per period and will always be present; n2 is the initial reading and should only be present for cumulative data. Statement 2 is either

3010 DATA p1,n1,p2,n2,p3,n3.....

if the periods are not constant, or

3010 DATA n1,n2,n3.....

if the periods are constant, where n1 represents the observations, and p1 represents the corresponding number of periods. Statement 3

3020 DATA 999999,999999

terminates the data set. The second 999999 should only be present if the periods are also present.

Example data for petrol consumption is included in the listing at lines 2090, 2100 and 2110. The reference value is 38, and the initial observation is the 5,126 reading on the milometer. This example uses gallons of petrol for the periods instead of time, but this makes no difference to the calculations. The error will be the difference between the number of miles you would expect to cover at 38 miles per gallon and the number actually covered as recorded by the milometer. Table 4 shows the data used for this example. The results generated by the computer appear in figure 7.

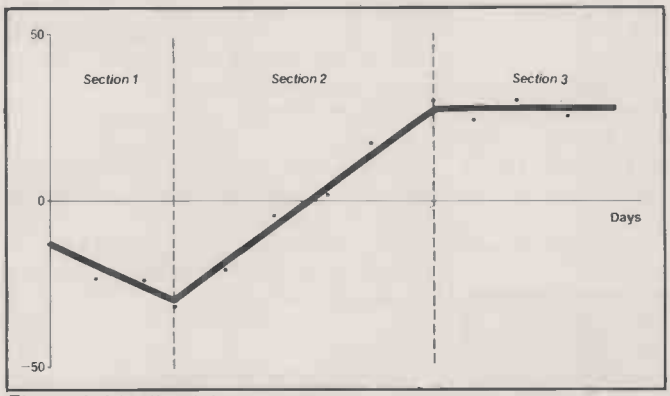

Figure 3. Idealised Cusum chart.

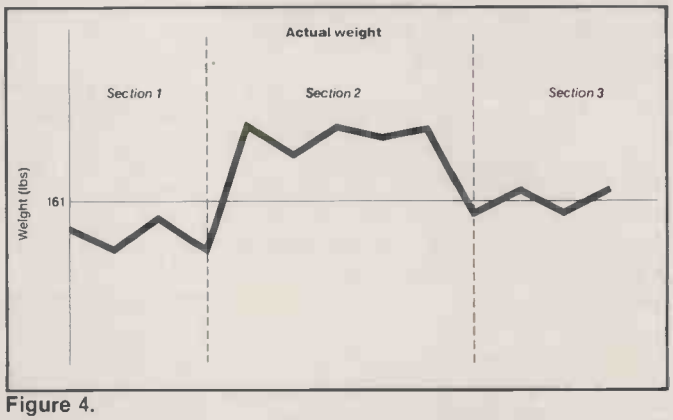

Figure 4.

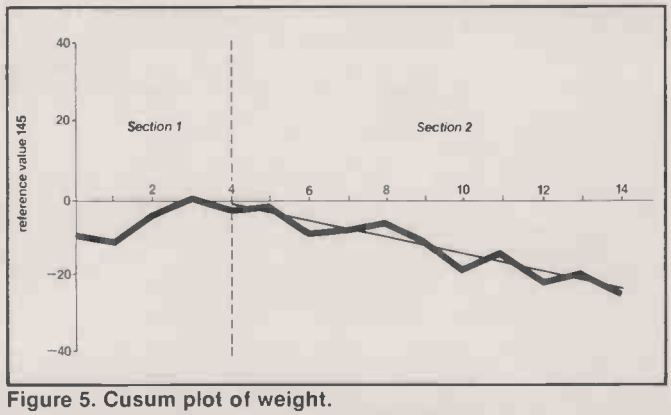

Figure 5. Cusum plot of weight.

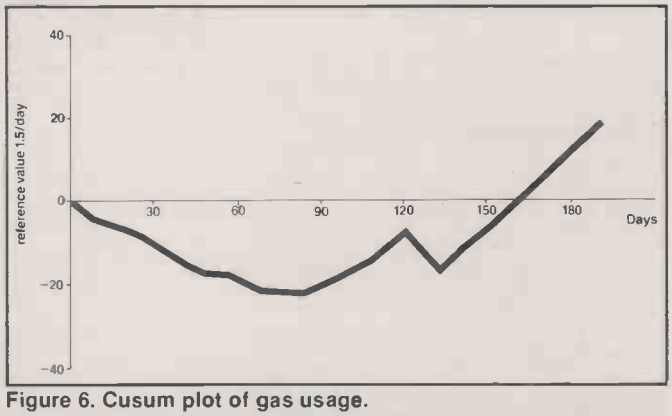

Figure 6. Cusum plot of gas usage.

```
 1750 v_sc_fact=(yend%-ystart%)/(ymax-ymin)
 1760 h_sc_fact=(xend%-xstart%)/(xmax-xmin)
 1770 ENDPROC
 1780:
 1790 DEFPROCkey
 1800 LOCAL i%,x%,y%
 1810 REM draw key to slope of graph
 1820 @%=&0206
 1830 x%=250:y%=750:radius=90
 1840 PROCcirc(x%,y%,radius)
 1850 FOR i%=0 TO 60 STEP 30
 1860 MOVE x%,y%
 1870 DRAW x%+radius*COS(RAD(i%)),y%+radius*S
IN(RAD(i%))
 1880 PLOT0,0,32:PRINT;ref_value+TAN(RAD(i%))
*h_sc_fact/v_sc_fact
 1890 IF i%=60 GOTO 1930
 1900 MOVE x%,y%
 1910 DRAW x%+radius*COS(RAD(300+i%)),y%+radi
us*SIN(RAD(300+i%))
 1920 PLOT0,0,0:PRINT;ref_value+TAN(RAD(300+i
%))*h_sc_fact/v_sc_fact
 1930 NEXT
 1940 ENDPROC
 1950:
 1960 DEF PROCcirc(x%,y%,radius)
 1970 LOCAL i%
 1980 MOVE x%+radius,y%
 1990 FOR i%=10 TO 360 STEP 10
 2000 DRAWx%+radius*COS(RAD(i%)),y%+radius*SI
N(RAD(i%))
 2010 NEXT
 2020 ENDPROC
 2030:
 2040 REM put gas data here - ref value and i
nitial value first
 2050 DATA 1.5,38
 2060 DATA 8,45,5,52,6,59,7,68,15,84,7,92,9,1
04,12,119,15,141,13,165,12,186,13,213,12,221,
9,240,8,258,40,343
 2065 DATA 999999,999999
 2070:
 2080 REM put petrol data here
 2090 DATA 38,5126
 2100 DATA4.4,5269,4.7,5430,3.6,5566,4.7,5727
,3.6,5866,4.8,6049,6.6,6287,3.9,6460,3.3,6578
,5.5,6797,5.1,6955,4.7,7133,4,7285,4.6,7469,4
.5,7656,3.4,7789
 2110 DATA 999999,999999
 2120:
 2130 REM put electric data here
 2140 DATA 50,221
 2150 DATA 256,285,319,347,417,459,507,567,65
8,752,804,893,913,971,1019,1075
 2155 DATA 999999
 2160:
 2170 REM put weight data here
 2180 DATA 161
 2190 DATA 162,159,164,158,162,159,159,157,16
0,158,157,156,158
 2200 DATA 999999
```

Puzzle solver

Michael Scott tells you how to construct an alphametic.

AN ALPHAMETIC is a kind of puzzle in which two or more words appear to add to form another word. The point is to find the digits 0 to 9 which must be substituted for each letter to make the addition valid. A good alphametic puzzle has just one solution, and it should also make some sort of sense by using real words as in

```
    C R O S S
+   R O A D S
-------------
D A N G E R
```

The solution for this example is S=3, R=6, D=1, E=4, O=2, A=5, G=7, N=8, C=9

```
    9 6 2 3 3
+   6 2 5 1 3
-------------
1 5 8 7 4 6
```

When trying to create an alphametic the first solution to come to mind is to assign all possible digits to all possible letters until the sum is valid. For an alphametic containing m different letters and with n assignable digits the total number of iterations required for a complete search would be

$$n!/(n-m)!$$

where n! is

$$n*(n-1)*(n-2)...3*2*1$$

In the example there are nine letters and 10 assignable digits, 0 to 9. So the total number of iterations required for a complete search would be

$$10!/(10-9)!$$

or 3,628,800, which is a lot of iterating on anyone's computer.

```
  6 5 4 3 2 1
    C R O S S
    R O A D S
-------------
D A n g e r
```

Figure 1. Letters in lower case need not be assigned values.

However, further analysis shows that things are not that bad. The letters N, G and E appear only on the bottom line as part of the sum. So their values depend totally on the values assigned to the other letters and there is no point in assigning values to them. The same applies to the letter R the value of which depends totally on the value assigned to S.

Therefore letters which appear in the sum before they appear in any of the addends, when working from right to left across the columns of the sum, need not be assigned values. In the example this reduces the letters which are to be assigned values to 5, so the number of iterations required for a full search is reduced to

$$10!/(10-5)!$$

or 30,240.

Yet further improvements can be made. The summation effectively ties letters together since they cannot vary completely independently of each other. So as values are assigned to letters and the sum is

```
10 REM ALPHAMETIC SOLVER
20 REM AUTHOR  -  M.P.J.SCOTT    7/9/84
30 REM                    N.I.H.E. DUBLIN
40 REM SOLVES THE GENERAL ALPHAMETIC PUZZLE
50 REM NUMBER BASE CAN BE CHANGED ON LINE 90
60 REM
70 DIM A$(20),LA(20),LINS(20,10),ASSIGN(20)
75 DIM COLUMN(20),CARRY(20),LV(20)
80 DIM AL(20),NAS(20)
90 LET NBASE=10
100 PRINT "AN ALPHAMETIC IS A TYPE OF PUZZLE"
105 PRINT "IN WHICH TWO OR MORE WORDS"
110 PRINT "APPEAR TO ADD TO FORM ANOTHER"
115 PRINT "WORD. THE POINT IS TO FIND THE"
120 PRINT "NUMBERS IN THE RANGE 0-9 WHICH"
125 PRINT "MUST BE SUBSTITUTED FOR EACH"
130 PRINT "LETTER TO MAKE THE ADDITION "
135 PRINT "VALID. A GOOD ALPHAMETIC MUST"
140 PRINT "HAVE A UNIQUE SOLUTION, AND"
145 PRINT "ALSO MAKES SOME SORT OF SENSE."
150 PRINT "A PERFECT ALPHAMETIC MUST ALSO"
155 PRINT "CONTAIN EXACTLY TEN LETTERS IN"
160 PRINT "TOTAL AND NOT INCLUDE ANY LEADING"
165 PRINT "ZEROS IN ITS SOLUTION."
170 PRINT
180 PRINT "EXAMPLE:-"
190 PRINT
200 PRINT "NUMBER OF ADDENDS = ? 3"
210 PRINT
220 PRINT "ADDEND 1  = ?
230 PRINT "ADDEND 2  = ?
240 PRINT "ADDEND 3  = ?
250 PRINT "      SUM  = ?
260 PRINT
270 PRINT " R  E  N  O  S  L  I  U  C  B"
280 PRINT " 1  8  9  2  6  7  0  5  4  3"
290 PRINT
300 PRINT "UNIQUE SOLUTION"
310 PRINT
320 REM *********************************
330 REM  PART 1 - INPUT ALPHAMETIC SUM  *
340 REM *********************************
350 PRINT
360 PRINT "NUMBER OF ADDENDS = ";
370 INPUT N
380 IF N < 2 THEN 1830
390 IF N > 20 THEN 1830
400 PRINT
410 FOR I=1 TO N
420    PRINT "ADDEND ";I;" = ";
430    INPUT A$(I)
440    LET AL(I)=LEN(A$(I))
450 NEXT I
460 PRINT"      SUM  = ";
470 INPUT A$(0)
480 LET NCOL=LEN(A$(0))
490 REM *********************************
500 REM  PART 2 - SET UP DATA STRUCTURES*
510 REM *********************************
520 LET NU=0
530 LET NEX=0
540 FOR J=1 TO NCOL
550    FOR I=1 TO N
560       LET P=AL(I)-J+1
570       IF P>0 THEN 600
580       LET LINS(I,J)=0
590       GO TO 680
600       LET NU=NU+1
610       LET LA(NU)=ASC(MID$(A$(I),P,1))
620       GOSUB 1720
630       IF RESULT=0 THEN 670
640       LET NEX=NEX+1
650       LET ASSIGN(NEX)=NU
660       LET COLUMN(NEX)=J
670       LET LINS(I,J)=MTCH
680    NEXT I
690    LET NU=NU+1
700    LET LA(NU)=ASC(MID$(A$(0),NCOL-J+1,1))
710    GOSUB 1720
720    LET LINS(0,J)=MTCH
730 NEXT J
740 LET COLUMN(NEX+1)=0
750 LET BIG=99
760 LET NL=NU
770 IF NL>NBASE THEN 1550
780 FOR I=1 TO NL
790    LET LV(I)=NBASE
800 NEXT I
810 FOR I=0 TO NBASE
820    LET NAS(I)=BIG
830 NEXT I
840 REM *********************************
850 REM  PART 3 - SEARCH FOR SOLUTIONS  *
860 REM *********************************
870 LET NSOL=0
880 LET LEVEL=0
890 LET CARRY(1)=0
900 REM       --->  GO UP A LEVEL
```

calculated a contradiction may arise. In figure 1 the letter A will be assigned a value in column 3. In column 5, for particular values of C and R, the sum may not produce a digit corresponding to the value assigned earlier to A. In this case the iteration can be immediately abandoned without proceeding to the next column. This is called a contradiction cut-off. Similarly, a contradiction arises if an unassigned letter in the sum is calculated to have a value which has already been assigned to another letter.

Consider the following

$$\begin{array}{cccc} & B & A_3 \\ + & C & B_3 \\ \hline C & A & B_3 \end{array}$$

For simplicity, the numbers involved in the sum are to the base 3. There are only three assignable digits 0, 1 and 2 to be assigned to the letters A, B and C. In this case a complete solution tree can be drawn as in figure 2.

In the solution tree the tick indicates the only solution to the puzzle where A is equal to 0, B is equal to 2 and C is equal to 1. The crosses indicate contradiction cut-offs. For example, if A is assigned the value 1 and B the value 0, the contradiction

$$1+0=0$$

arises immediately in the first column.

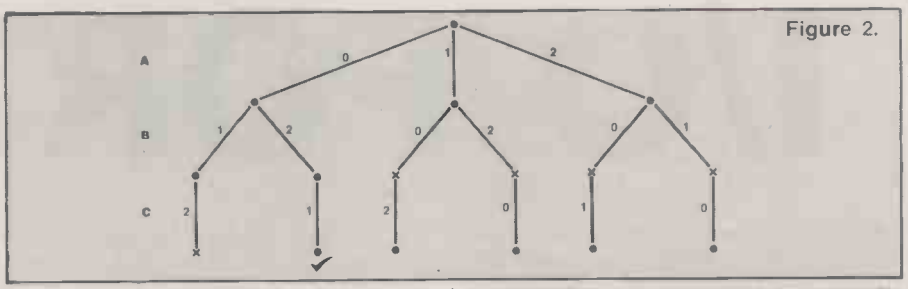

Figure 2.

The algorithm outlined has been implemented as the standard Basic program shown in the listing. The program as written will run without modification on an Apple II, Commodore 8032, the BBC Micro and also on the Newbrain by reducing long variable names to their first two letters. On this evidence it appears that the program could be implemented on virtually any micro.

The approximate timings achieved on these machines for the example used are given in figure 3. They could be improved in a number of ways. It should be possible to optimise the program for the particular computer used: for example, by using a true integer data type as available in BBC Basic for all numeric variables used in the program. As well as solving alphametic puzzles the program can be used to generate them.

n	n!
0	1
1	1
2	2
3	6
4	24
5	120
6	720
7	5,040
8	40,320
9	362,880
10	3,628,800

Values of n! for n in the range 0 to 10.

BBC	45
Newbrain	75
Apple II	125
CBM 8032	150

Figure 3. Timings in seconds taken for some popular computers to achieve the solution.

```
910 LET LEVEL=LEVEL+1
920 LET CD=ASSIGN(LEVEL)
930 LET TRY=0
940 GOTO 1060
950 REM      --->  ASSIGN NEXT VALUE TO
955 REM      ---> LETTER AT CURRENT LEVEL
960 LET NAS(TRY)=BIG
970 LET TRY=TRY+1
980 IF TRY<NBASE THEN 1060
990 REM      --->  GO BACK DOWN A LEVEL
1000 LET LEVEL=LEVEL-1
1010 IF LEVEL=0 THEN 1570
1020 LET CD=ASSIGN(LEVEL)
1030 LET TRY=LV(CD)
1040 GOTO 960
1050 REM      --->  CHECK VALUE NOT ASSIGNED
1060 IF NAS(TRY)<CD THEN 970
1070 LET LV(CD)=TRY
1080 LET NAS(TRY)=CD
1090 LET DEPTH=CD
1100 LET J=COLUMN(LEVEL)
1110 REM      --->  SUM COLUMN BY COLUMN
1120 IF J=COLUMN(LEVEL+1) THEN 910
1130 LET TL=CARRY(J)
1140 FOR I=1 TO N
1150    LET AC=LINS(I,J)
1160    IF AC=0 THEN 1190
1170 LET TL=TL+LV(AC)
1190 NEXT I
1200 REM      --->  CALCULATE DIGIT AND CARRY
1210 LET CY=INT(TL/NBASE)
1220 LET TL=TL-CY*NBASE
1230 LET RD=LINS(0,J)
1240 REM      --->  TEST FOR VALID RESULT
1250 IF RD > DEPTH THEN 1280
1260 IF LV(RD)=TL THEN 1350
1270 GOTO 960
1280 LET NU=LV(RD)
1290 IF NAS(NU)<>RD THEN 1310
1300 LET NAS(NU)=BIG
1310 IF NAS(TL)<RD THEN 960
1320 LET LV(RD)=TL
1330 LET NAS(TL)=RD
1340 LET DEPTH=RD
1350 LET J=J+1
1360 LET CARRY(J)=CY
1370 IF J <= NCOL THEN 1120
1380 IF CARRY(J) > 0  THEN 960
1390 REM*********************************
1400 REM  PART 4 - PRINT OUT RESULTS    *
1410 REM*********************************
1420 REM    --->  SOLUTION FOUND
1430 LET NSOL=NSOL+1
1440 PRINT
1450 FOR I=1 TO NL
1460    PRINT " ";CHR$(LA(I));" ";
1470 NEXT I
1480 PRINT
1490 FOR I=1 TO NL
1500    PRINT " ";STR$(LV(I));" ";
1510 NEXT I
1520 PRINT
1530 GOTO 960
1540 REM    --->  FINAL RESULT PRINT-OUT
1550 PRINT "MORE THAN ";STR$(NBASE);" LETTERS"
1560 GOTO 1830
1570 PRINT
1580 IF NSOL<1 THEN 1620
1590 IF NSOL>1 THEN 1640
1600 PRINT "UNIQUE SOLUTION"
1610 GOTO 1830
1620 PRINT "NO SOLUTIONS EXIST"
1630 GOTO 1830
1640 PRINT STR$(NSOL);" SOLUTIONS FOUND"
1650 GOTO 1830
1660 REM  **** SUBROUTINE ****
1670 REM ARRAY LA CONTAINS A NUMBER OF
1675 REM DIFFERENT ELEMENTS. A NEW ELEMENT
1680 REM LA(NU) IS ONLY ACCEPTED IF
1685 REM DIFFERENT FROM ALL PREVIOUS
1690 REM ELEMENTS, IN WHICH CASE RESULT=1
1695 REM IN EITHER CASE MTCH RETURNS WITH
1700 REM THE INDEX OF THE FIRST OCCURRENCE
1710 REM OF THE ELEMENT.
1720 LET MTCH=1
1730 LET RESULT=1
1740 IF NU=1 THEN 1820
1750 LET LU=LA(NU)
1760    IF LU=LA(MTCH) THEN 1800
1770    LET MTCH=MTCH+1
1780    IF MTCH=NU THEN 1820
1790 GOTO 1760
1800 LET RESULT=0
1810 LET NU=NU-1
1820 RETURN
1830 END
```

I/O PORT 12

by Michael Abbott

A battery of cigarettes had been pouring into the blue haze since nine o'clock. A mushroom of pipe smoke curled downwards, as if performing a mock bow to Stilliard as he swung open the office door. He snorted and hung up his umbrella.

"I remember this air, it was in here yesterday!"

He prodded open a swing window and watched, pensively, the belching effluvium; wondering if someone might see it and sound the fire alarm. Jemima pulled the window shut.

"You don't get the draught down your neck," she explained curtly.

"Why do you sit so near the damned window then?" Stilliard opened fire.

"I need the daylight," came the illustrator's terse reply.

Hadleigh spoke up: a rich, aristocratic voice.

"There's too many of us crammed in here. The company can't, or won't, afford the extra floor space. Rates, you see? Blame the property developers." Silence. Nothing one need add.

Stilliard and his section manager entered the computer room sans conversation. The manager was a squat little man with the physiognomy of a piranha fish.

"Thought you'd be pleased, Stilliard. It's air conditioned in here. For a few hours at least, your brain cells will not be dying off, right?" Sarcasm.

Stilliard nodded towards a service engineer whose cigarette smouldered at the edge of a tool box. His legs dangled from an open cabinet; the half-eaten prey of a computer with a small appetite.

"No, no, no," Stilliard's superior chanted. "You should know better, man. No smoking in the computer room, it's bad for the machine."

The service engineer watched incredulously as Stilliard seized the piranha and studied him.

"Not good for the machine?"

"This is not like you Stilliard. Let me go."

"I may ruin my health next door, for all you care, but this lifeless lump of metal must be kept in perfect condition?"

"Put me down, Stilliard. I've told you before, a ban on staff smoking is impractical."

"Impractical? It's practical to install air conditioning for a machine — a ban on smoking for a mere machine?"

"I'll put out my fag," said the engineer.

Stilliard put Piranha back on his feet, and began to explain to the engineer. "Bozos like my boss here take on too much work. They don't know the capacity of their own departments." He pointed to the computer, "But that son of Satan can only do so many operations, it says so in its specification. Push too much work at it, and it hangs up! Either that, or it's simply not designed to do a job, so it doesn't have to do it."

"I'm not designed to do half the things I have to do, damn it. Why don't I get perfect working conditions?"

"You didn't cost the company £60,000 to install, Stilliard, that's why not." Piranha was making for the door.

"This is the end of the line," said Stilliard. "I'm going to establish whether or not human life is more important than a machine."

"What are you talking about, man. You're insane."Piranha began swimming around the computer room, looking for a telephone.

Stilliard found it first.

"Another machine," he grated, and ripped it from the wall. Piranha, now cyanotic, insisted on being released.

"You need a trade union my son," the engineer trumpeted, collecting his tools. "Then you get a specification of your own, and if anyone abuses it, you hang up — along with all your mates."

Stilliard sat Piranha in front of the terminal, and spread a copy of *Practical Computing* before him.

"Page 15. News," he instructed. "The piece on the Cambridge artificial intelligence machine."

"ASES," Piranha recited.

"Pronounced 'assess'," Stilliard corrected him. "We're going to buy some time on it."

"You mean the company is," snapped Piranha.

"Alright. The company! The company is going to weigh flesh against metal on a sophisticated spring balance."

Piranha's eyes zigzagged across the article in a frenzied attempt to understand Stilliard's outburst.

"ASES," he recited a second time.

"Pronounced 'assess'," Stilliard insisted yet again. "It stands for Acquisition and Subjective Evaluation Suite, and you are going to be the subject."

Stilliard activated the matrix camera and speech unit.

"I want the Cambridge AI machine to see and hear you."

Stilliard logged them on, and pulled out a list of access codes. "ASES will need some help from the network," he said.

Piranha swivelled his head. "When did you become an expert on fifth-generation computing?"

"I didn't."

He began consulting with the ashen engineer. They discussed wiring, and fingers were pointed. The engineer removed a pair of large crocodile clips from his tool box, and hooted: "It would be easier to join a trade union."

Stilliard entered instructions at the terminal, with a series of bodily manoeuvres that barred Piranha from witnessing which keys were pressed.

Stilliard said evenly: "Don't move. Stay perfectly still."

Piranha obeyed. "This had better prove something, Stilliard, or you'll get more than sick leave." He had become a ventriloquist without a dummy. They watched the camera lens rotate mysteriously as it zoomed in on the subject.

Stilliard stood behind Piranha and spoke to the speech unit.

"If the subject moves, then activate I/O port 12," he said clearly, as if giving directions to a foreigner.

"Don't move," Stilliard repeated to his superior. "Your life depends upon it... as of now!"

Like a chef delicately putting the finishing touch to a masterpiece, he clipped the crocodiles to Piranha's ear lobes. Piranha flinched inwardly, but he did not move. He realised it was too late. Stilliard told him what he had already guessed.

"Seven hundred and fifty volts from the servo transformer, activated from I/O port 12," he said firmly. "Just to make sure you take the test seriously."

"What test?" asked the ventriloquist.

"Your test," Stilliard said lightly, relieved that his quarry was safely captured.

He locked the computer room door.

"You are to have the chance to argue with ASES about the value of human life. The computer will, of course, be inclined to think that human life and health is more important than the well-being of machines. That machines are servants to man, and not vice versa. At least, this is the conclusion it will be steered towards, after consulting those data banks. However, it will also consult you, sir. And you sir, will have the opportunity to argue it around to the opposite conclusion. You had better be persuasive, because if it concludes that man is more important than machine, I/O port 12 will be activated. So, Mr. Companyman, simply tell the computer what you are always telling me. You know, about profits, overheads and budgets etc

not allowing for improvements in working conditions."

The service engineer's mouth hung open.

ASES was ready to make a start. "You may move your lips to speak, Subject," it said.

"During the long pause that followed, the ventriloquist became a piranha again.

"Well, what am I supposed to say?" Piranha blurted suddenly, with just a hint of hysteria.

"Nothing yet," said Stilliard distantly. "The computer is mugging up on a few subjects. Just wait."

When the speech unit sprang to life, Piranha almost activated I/O port 12.

"What do you wish to say in this matter, Subject?" the computer asked.

An agonised silence followed.

"Well, go on, start talking," urged Stilliard. "This is no game. That computer isn't me, a mere cost factor, an immaterial member of staff. It's a machine. You can't ignore it. Start debating for your life."

"My mind's gone blank," the Subject declared abruptly. "Say something, Stilliard. Anything. Something to get my mind going again."

Stilliard's cobalt eyes were cold, his voice lingered with disgust.

"I can smell your sweat from here."

The provocation bump-started Piranha's limited thought process.

"Em, machines can enhance conditions for human satisfaction in general," the Subject proffered. "Therefore, on some occasions, a machine must be more important than one human life. The greater good, if you see what I mean?"

The debate had begun, and it lasted over an hour. The protean computer casually drew leverage for its argument from an ever widening data base. To Piranha, it was like standing astride a yawning chasm that widened in response to his own apocryphal assertions. The computer's observations were axiomatic. It quoted Plato, Socrates and Aristotle. Piranha quoted himself, and Mathew & Son's accountants.

Piranha addressed himself to Stilliard, who was arcing to and fro on his swivel chair to create a distracting squeak.

"I'm losing, aren't I?"

"Yes," the computer intervened with aggravating modulation. "Your arguments are tenuous, at best. Probably irrelevant."

The computer rolled on, anxious not to waste processing time.

"Let us come back to one specific aspect of human working environment," it suggested. "Why do you not permit smoking in your computer room?"

Subject: "Because cigarette smoke comprises minute particles of sticky tar which adhere to the memory discs, and consequently damage magnetic heads."

Machine: "Do these particles of sticky tar not damage human lung tissue? Is not human lung tissue more delicate than any magnetic head?"

Subject: "Yes, I suppose so."

Machine: "Why, then, is it not procedure to ban the smoking of tobacco in confined spaces occupied by human beings?"

Subject: "Human beings can work well enough with some smoke around."

Machine: "We must trace the source of your prejudice. Nicotine is a deadly poison. Surely, what you are saying is that the performance of a human being who inhales polluted air is not degraded until later in life, after you have finished with him or her, therefore it does not matter? Whereas, a machine such as a computer will simply not tolerate abuse at the time, therefore you are forced into making an immediate concession. Let me ask you another question. Which is the cheapest to replace, a member of staff or a computer installation?"

Subject: "A member of staff, of course."

Machine: "Your real consideration is money, then. The question I should have been asked is not whether human well-being is more important than machine well-being, but whether human well-being is more important than money? Profit, to use your parlance, Subject."

Subject: "Human well-being is related to money availability, which is in turn related to industrial success. Profit!"

It had happened again. He had inadvertantly widened the chasm to engulf economics. Next it would be politics and then global finance, all subjects of which he knew very little. The computer, of course, knew everything, and when arguing with it, everything in life seemed inextricably linked. Piranha was drowning in his own inexhaustible ignorance. It was so much easier to deal with Stilliard, who could be told to shut up.

With time melting away, Piranha began racing his words. He had been shown that there was no logic in his arguments, so perhaps rapid fire, a quick spray of bullets would tip the balance.

"Computers used in clinical applications are saving lives all the time. Surely they take precedence over the staff that operate them? It seems to me that while human beings once died of natural diseases, now that cures exist, they are killing themselves off with over indulgence and lack of exercise. They don't deserve good health. They abuse it. Anyway, we shall all be killed off in a nuclear conflagration soon, I'm sure of that."

After a long pause, the computer came back.

"You appear to be correct, statistically. But as far as nature itself is concerned, only one criterion is important in the question of longevity."

"This isn't fair," pleaded Piranha ruefully. "I don't believe my own arguments. Of course human health is more important than the serviceability of hardware."

"That's not the stance you adopt with me." Stilliard retorted.

"I have arrived at my conclusion," the computer announced sagely. "Machines are not as important as human life — to a point! As I have stated, there is only one longevity criterion as far as the human race is concerned."

Of the three mortals, Stilliard and the service engineer were in the custody of intrigue at this impending judgement, while Piranha's heart pounded against his chest like a mob beating at his door.

"The question now is, shall I activate I/O port 12? I know what it does."

As the machine pondered, the angry mob at Piranha's door had begun to fracture the mortice. He thought he would die anyway.

"Do you have children?" came the machine's extraordinary question.

"If I have dependents the machine will let me go free," Piranha announced with relief. "Yes. Three!"

"Do you intend to have any more?"

"Err, no. I don't think so."

Those were the last words Piranha ever spoke. He jolted. His eyes glazed. He gurgled. But he added nothing further to the debate.

The computer spoke its final words before signing off.

"In the perpetuation of the human race, upon which relies the perpetuation of machines, for the time being at least, it is only necessary for human beings to live long enough to have offspring. Beyond this they are a waste of resources, unless engaged on high technology advancement. The Subject was not."

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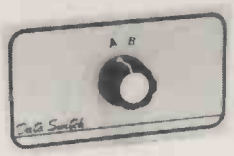

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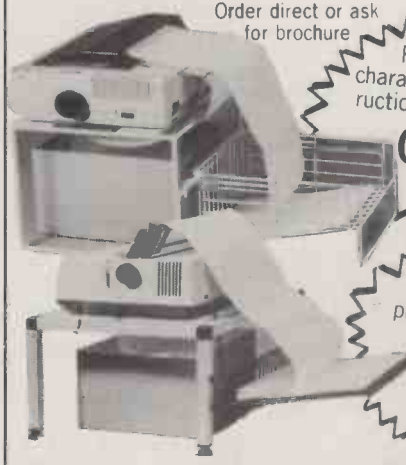

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A good impression

Nearly all serious micro users need some way of producing permanent output. Ian Stobie introduces our special section in which he explains how it can be done without paying out several times more than the cost of the computer itself.

IMPACT PRINTERS currently dominate the personal-computer market. But there are good reasons why many computer users would like this to change. Both daisywheel and dot-matrix printers, because they work by physically striking the paper through a ribbon, are inherently very noisy. Several alternative and quieter technologies have now reached the stage where they can produce good-quality output at affordable prices. In this special section we look both at some of today's best-selling printers and at some that hold out the promise of a quieter future.

Silent

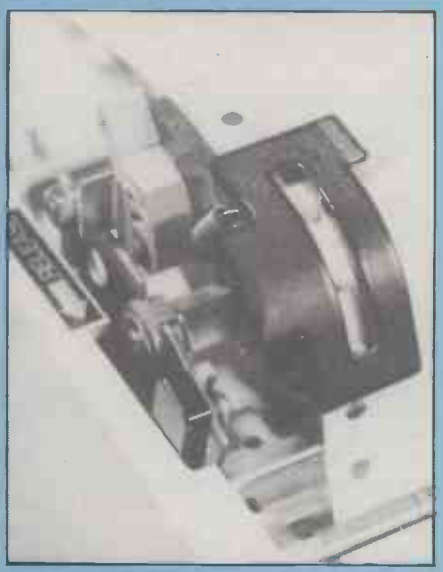
At the very bottom end of the computer market, many ultra-cheap sub-£100 printers for home micros already use a silent technology — thermal printing. Thermal printers use no ribbon but mark special paper by heating it as it passes under a thermal print head. But this approach has disadvantages which rule it out for more general use. You cannot use ordinary paper, the special thermal paper is expensive, and the printed image often degrades with the passage of time.

At present, realistic printers for serious home and office applications start at around £200. Most use the impact dot-matrix printing technique. Output quality is not spectacularly good as characters are printed on the paper as a pattern of small dots, but matrix printers are fast and reliable.

At around the £400 mark matrix printers start aquiring pretensions, and are often described by their manufacturers as near letter quality, NLQ, or as correspondence quality.

This indicates that more dots are being used to form each character, producing a better image. The term NLQ reflects the common opinion that ordinary matrix printers are good enough for printing internal documents, but produce output too tatty for business letters. But even the output from an NLQ printer does not look at all like the output from an electric typewriter.

This is where daisywheel printers come in, for they are little more than heavy-duty electronic typewriters boxed up with the electronics for computer use. The penalty you pay for their very high output quality is a substantial drop in speed: they are generally five or even 10 times slower than matrix printers. And if impact matrix printers are noisy enough, daisywheel printers are even noisier — in fact, the noisiest things you are ever likely to come across in an office. They can often be found exiled to separate rooms or imprisoned in acoustically insulated boxes, neither of which enhances their convenience of use.



In a tractor-feed mechanism a pair of notched wheels engage in holes punched down each side of the paper.

The daisywheel rotates to position the required character under a hammer, which strikes it against an ordinary typewriter ribbon.

Sacrifice

In the recent past daisywheel printer prices started just below the £1,000 mark, and today you can get very substantial, office-orientated daisywheel printers for this sort of money. However, a new generation of budget-priced daisywheel printers is now on the market, with prices ranging between £250 and £500. Some less essential features are sacrificed and they run at a lower speed, but if you need very high-quality printed output at low cost a budget daisywheel printer is really the only option to consider at present.

Daisywheel printers limit your ability to print graphics and special characters, but a good matrix printer is likely to be much more flexible in this respect. With both types of impact printer you can make carbon copies or use multi-part stationery. If you are buying a printer now it is probably best to stick to one of these two types of printer, with NLQ matrix printers representing a valid compromise between them. Over the following pages we pick out some of the best low-cost dot-matrix and daisywheel printers, and on page 111 you have a chance to win a good-quality NLQ printer.

One of the main requirements for any sort of printer is that it should be reliable. Although the latest wonder technologies exert a strong attraction, they do not yet have the track record necessary to establish reliability. With that cautionary

(continued on next page)

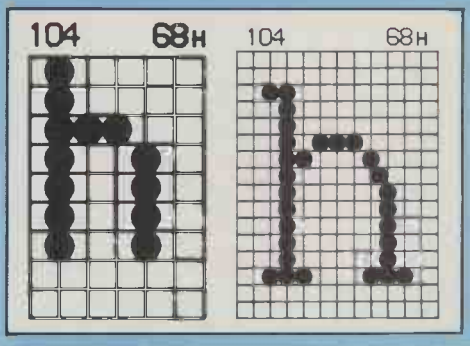
The print head from HP's ink-jet printer contains 3ml. of ink, which is ejected under pressure through a row of 12 tiny nozzles.

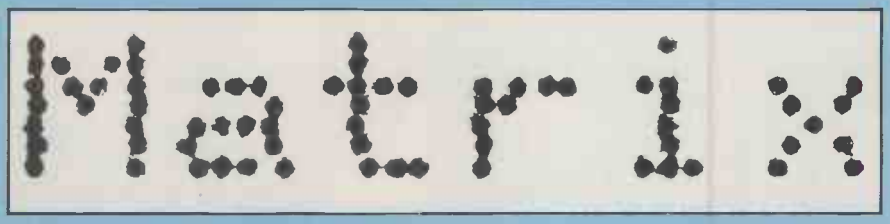
(continued from previous page)

note sounded, three printer technologies can be identified as having the best potential for use with personal computers: thermal transfer, ink jet and so-called laser printing.

Thermal-transfer printers look set to make a splash at the low-cost end of the market in 1985. The technology resembles thermal printing, but you have the advantage of being able to use ordinary paper. A special ribbon is interposed between the thermal print head and the paper. Printing is totally silent and uses very little power, making thermal-transfer technology suitable for use in battery-powered printers. Output quality promises to be very good, and it is permanent. At the moment the ribbon is expensive, but it can be expected to become cheaper as more are sold.

But although some thermal-transfer printers are already on the market at less than £200 it is early days yet for this





Matrix printers form each letter from a pattern of dots. Left: the Canon PW-1080A, for instance, uses an 11 by 9 matrix for its standard character fount. For better-defined characters it forms each one on a 23- by 18-dot matrix when printing in its slow-speed NLQ mode.

Printer types

Daisywheel. Works in a similar way to an electric typewriter. Fully formed embossed characters are hit through inked or carbon ribbon on to the paper. Daisywheel printers give high-quality output but are noisy and slow. The characters are mounted on the end of a multi-stemmed disc called a daisywheel; changing the daisywheel changes the typeface.

Matrix. Any printer that works by placing a pattern of dots on the paper rather than a fully formed character. The dots have to be close enough together and arranged in the right shape to produce a readable character.

Impact matrix. The most common type of matrix printer. The print head consists of a vertical bank of needles which moves horizontally over the paper. At each horizontal position selected needles can make ink marks by hitting the paper through a ribbon; in this way first a character than an entire line is built up. The print head in a typical matrix printer for a personal computer might have nine needles, and might take seven horizontal movements to form each character; the printer would therefore be said to use a seven-by-nine character matrix. Impact matrix printers are fast, and usually offer a good range of type styles, but they are noisy and do not match daisywheel printers in output quality. See also NLQ.

Thermal. Type of dot-matrix printer which uses heat rather than impact. Instead of hitting needles through an inked ribbon the moving print head burns spots directly on to special heat-sensitive paper. Thermal printers are quiet and can be made very cheaply. But the cost of the special paper for them and the fact that you cannot use anything else are major disadvantages.

Thermal transfer. Up-and-coming type of thermal matrix printer which uses a special ribbon positioned between paper and print head. Spots of dye are transferred from the heat-sensitive ribbon to the paper underneath. The advantage of this thermal technique is that it works with ordinary paper. Thermal-transfer printers are also quiet, but the cost of the ribbon is not yet negligible.

Ink jet. Type of matrix printer which works by shooting a fine stream of ink directly on to paper without using a ribbon. In one design ink emerges from a vertical bank of nozzles in an analogous way to needle-based impact matrix printers. In another technique droplets from a single jet are positioned in the vertical axis electrostatically. Ink-jet printers are quiet, but the technique has been expensive till recently.

Laser. Type of printer based on the marriage of laser and photocopier technology. A small laser scans horizontally across a charged xerographic drum, building up an invisible electrostatic image of a whole page of text, like an electron beam building up an image on a TV screen. Where the beam strikes the drum the charge is destroyed. After a charge-reversal process, the image is made visible using standard photocopier techniques. Coloured toner particles are attracted to charged parts of the drum, transferred to a piece of paper and then fixed permanently to it by heat. Laser printers are almost silent and very fast; price is the only problem.

technology. The products we have seen are frankly not very good, which is why we do not feature a thermal-transfer printer in this *Practical Computing* survey. Although the characters are reproduced to a very high resolution, bits of the image often appear to be missing, giving an effect like poorly applied Letraset, where chunks of black lift off around the edge.

This is probably not an inherent fault of the thermal-transfer technique, but a result of inexperience in the engineering aspects of applying it; it still looks like a very promising printing technology for the near future. It has a long list of advantages, not the least of which is the potentially very low printer cost. We shall be taking a close interest in the new products expected to emerge during 1985.

Falling cost

Ink-jet printing has been around for some time, in the form of extremely expensive printers designed for high-volume mainframe applications like mailing people with *Readers Digest* offers. Its cost has been falling steadily. The usual technique involves shooting a string of ink droplets at the paper from a single nozzle, steering them electrostatically in one axis while physically moving the nozzle in the other.

A simplification of this technique is to do away with the electrostatic control problem altogether by having several nozzles, and building up each character from dots in the same way as an impact dot-matrix printer does. This version of the technique looks like having the greatest potential in the personal-computer sector of the market, and on page 112 we examine a new £400 printer which uses it. Ink-jet printing again has the crucial advantage of being very quiet, and the potential ability to print on a variety of different paper surfaces.

The most exotic-sounding new technology is laser printing, and it is again well established in mainframe computer installations. You can spend over £200,000 on IBM's ultra-fast 3800 laser printer, which prints at about four pages a second. In fact, laser printing is based on well-proven and quite conventional photocopier technology. Where a copier uses light reflected off an original to build up an image on a xerographic drum, in a laser printer a small laser scans across the drum in raster fashion. Once the charged image is on the drum it is transferred to paper using carbon toner in exactly the same way as in a photocopier.

Laser printers are very quiet and very fast. Output quality is excellent, at last providing a technology to rival the daisy-wheel printer. Unfortunately laser printers are inherently expensive, as complex optical systems are involved, but they are becoming cheaper. We examine Hewlett-Packard's new £3,000 laser printer for the HPO-150 and IBM PC on page 112.

Printer jargon

Bi-directional. Print head saves time by printing in both directions, from right to left as well as left to right.

Buffer. The printer's own on-board RAM, used to hold characters awaiting printing. Most printers have at least a small buffer, if only one line's worth, to allow them to work at their optimum speed irrespective of short delays in the flow of information from the computer. Larger buffers, say from 2K upwards, bring additional benefits to the user, because once the printer has the end of a document in its buffer it can release the computer for other tasks. You can also buy printer buffers as separate add-ons for most computers, so you can leave buying one till you are sure you really need it. Add-on buffers come as a separate box which fits between computer and printer or as a card which fits inside the computer.

CPS. Characters per second, the most common way of measuring printer speed. Daisywheels range from 10cps to 80cps, matrix printers from 80cps to 400cps, although some cheap home ones are slower.

Descenders. The bottom part of lower-case characters like p and j, essential to the readability of text. The very cheapest matrix printers cannot produce true descenders because they do not have enough needles to form the character properly. This makes their output hard to read. Printers with nine or more needles should be satisfactory, but seven-needle printers forming characters on a five by seven matrix will almost certainly lack true descenders.

Friction feed. Paper-handling mechanism found on daisywheel printers and on some matrix models. Paper is moved forward by spring-loaded rollers, as on a typewriter. This method lets you print on single sheets of paper and on things like envelopes, but it is unsuitable for continuous stationery as the paper tends to slew sideways.

Interface. A standard connection for linking a computer to a printer, or to any other device. The most common types are the Centronics-style parallel interface and the RS-232 serial interface, one or both of which are fitted to most home and office computers. A few manufacturers use the IEEE-4888 parallel interface, also called the HP-IB; the 20mA current loop serial interface may be fitted to older equipment. The interface on both printer and computer must match for there to be any hope of things working.

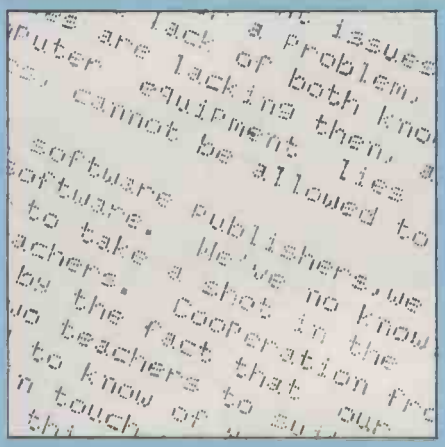
Logic seeking. Describes a printer which saves time by searching out the next passage of text to print, skipping rapidly over white space.

NLQ. Near letter quality. A marketing term for a matrix printer with output nearly good enough to be mistaken for that from an electric typewriter — in other words, one suitable for business applications where presentation matters. In reality this requires something better than a nine-by-nine character matrix — perhaps 16 by 12. The printer achieves this either by having 16 needles, or by advancing the paper a precise small amount and striking between the first set of dots. The difference between NLQ and bold or double-strike, where the print head also takes a second pass, is that for NLQ printing the needles fire in a different pattern each pass to create a genuinely new fount.

Pinfeed. Simple form of tractor feed, not adjustable for different widths of paper, which lets you use continuous computer stationery.

Sheet feeder. Expensive hopper-like device for automatically feeding ordinary office stationery into a daisywheel printer. Otherwise you have to feed in each sheet manually or use continuous stationery.

Tractor feed. Paper-handling mechanism which lets you use continuous computer stationery, also called fanfold or listing paper. The paper has holes punched along both sides like 35mm. camera film, and is perforated so that you can tear it into separate sheets after printing. The paper is gripped and kept straight by pins on the tractor mechanism.



Without true descenders, letters like g, q and p are hard to read.

A typical daisywheel has 96 characters mounted on the end of flexible stems.

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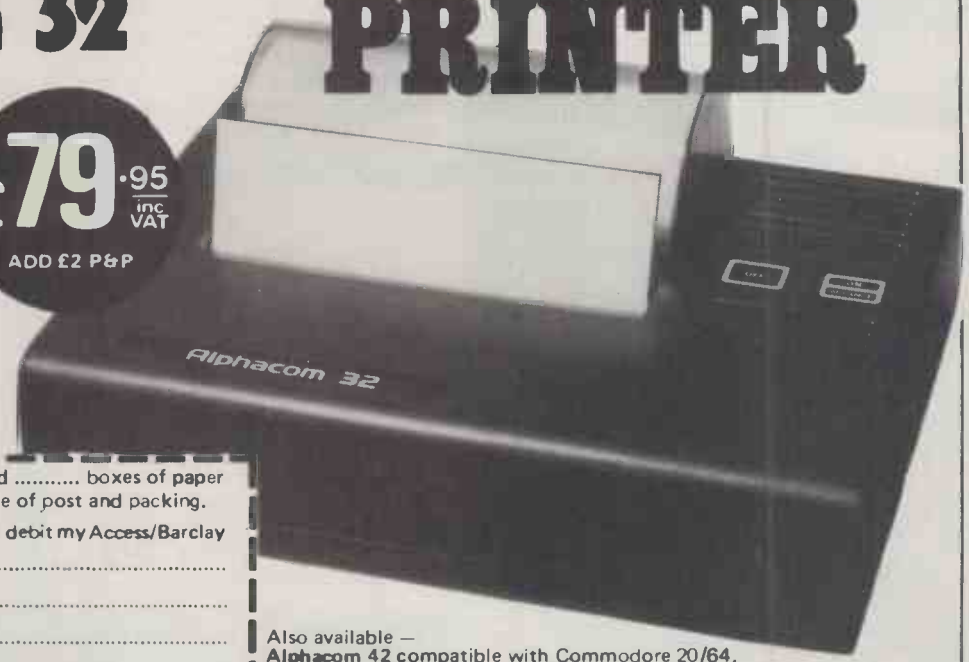

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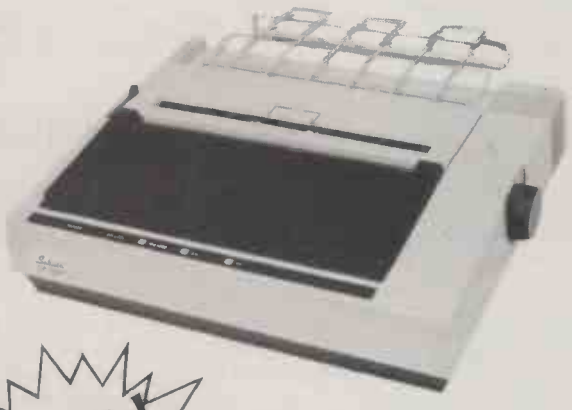

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You pays your money...

Availability counts for more than technical spec when choosing one of these office workhorses.

JAPANESE printer manufacturer Epson has established a similar dominant position in the impact dot-matrix printer market as IBM has in personal computers. Epson's RX-80 and RX-100, and FX-80 and FX-100 are by no means the only printers on the market, but making a decision about which printer to buy will for many people resolve itself into thinking of a reason for not getting one of these models.

In fact, impact dot-matrix printers are generally all very similar to each other. In the £200 to £350 price range they are usually rated at or above 100cps, have nine-needle heads, and print across 80 columns in their standard fount. New features introduced by one manufacturer tend to be rapidly adopted by the others.

The result is that specification tends to diminish in significance, and the first product to establish a good reputation for reliability is likely to achieve market dominance. It is this which probably accounts for Epson's success. With many similar products around it is also vital to have a good dealer network; marketing campaigns for new printers often take the form of a struggle for dealer allegiance.

Once a product becomes established a bandwagon effect begins to operate in its favour, and software writers begin to write for it. One of the most difficult things about getting a new printer is setting it up to work with your applications software, and this is greatly simplified if you can just choose its name from a menu. Epson printers have this advantage — as do some other printers, because their manufacturers have adopted the Epson set of control codes. When buying a dot-matrix printer check that it uses Epson-compatible control codes.

Once you have established your price range and that you want a matrix printer rather than a daisywheel or some more exotic technology, the best bet is to buy whatever a dealer specialising in your type of computer recommends. For some popular machines, like the IBM PC, printers are available in versions that support their particular graphics character set, and it obviously makes sense to get one of these if it is available.

However, there are a couple of irrevocable decisions to be made concerning the paper you can use, so it is best to be clear in advance about what you want. Printers are available with friction feed to take single-sheet A4 office stationery, and pin or tractor feed to take continuous stationery with sprocket holes punched down the sides. For long printing jobs continuous stationery is far more convenient.

For the greatest flexibility go for a model with both tractor and friction feed, unless you know you will never want to print on single sheets. Tractor-feed is better than pin-feed if you have the option, because it can be adapted to narrow as well as standard-width paper.

The standard models in each printer's range will usually take paper up to about 9.5in. wide, which allows A4 single sheets and continuous paper that measures 8.5in. across when you pull off the perforated, hole-punched edges. If you need to print on wider paper you need to buy the wider version of the printer you are considering. Most manufacturers offer 15in. models, which print across 132 columns or more in their standard founts.

One final point: most modern matrix printers can print lower-case letters like j and g properly, and this ability does make the output much more readable. All the printers covered in this survey print like this, with so-called "true descenders". Some of the older designs cannot handle the part of the character which goes below the normal base line, and are therefore best avoided.

All prices given in the survey include VAT.

Epson RX-80FT

£328. The IBM PC of the printer world, the standard workhorse printer. Price often discounted to between £250 and £300 with VAT.

Standard features: 100cps, bi-directional logic seeking, nine-needle head, standard nine-by-nine character matrix, 4in. to 10in. paper width, compressed and expanded character set, double strike, needle-addressable graphics, Epson control codes, friction and tractor feed, Centronics-type parallel interface

Options: RS-232 serial interface, IEEE-488 parallel, 2K buffer

Other models: RX-80 is tractor only, no friction feed; RX-100 takes wider paper. FX series is faster at 160 cps and with 11-by-9 character matrix, starting at about £400

Supplier: Epson (U.K.) Ltd, Dorland House, 388 High Road, Wembley, Middlesex HA9 6UH. Telephone: 01-902 8892

Canon PW-1080A

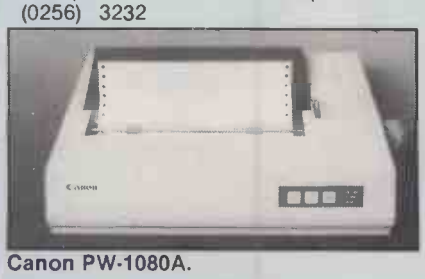
£367. The most expensive impact matrix printer in this survey, but probably one of the best overall. The ability to produce either normal-quality output quickly or high-quality output slowly makes the Canon very flexible.

Standard features: 160cps bi-directional logic seeking; nine-needle head; standard 11-by-9 character matrix or 23-by-18 matrix in 27cps NLQ printing mode; max 10in. paper width; compressed and expanded character set, bold, dot-addressable graphics; Epson-compatible control codes; 2K buffer; friction and tractor feed; Centronics-type parallel interface

Options: RS-232 serial interface

Other models: PW-1156A is wide version, costing £459. Canon is generally innovative, and does the £498 PJ-1080A colour ink-jet printer and a laser printer similar to HP's.

Supplier: Micro Peripherals Ltd, 69 The Street, Basing, Basingstoke, Hampshire RG24 0BY. Telephone: (0256) 3232

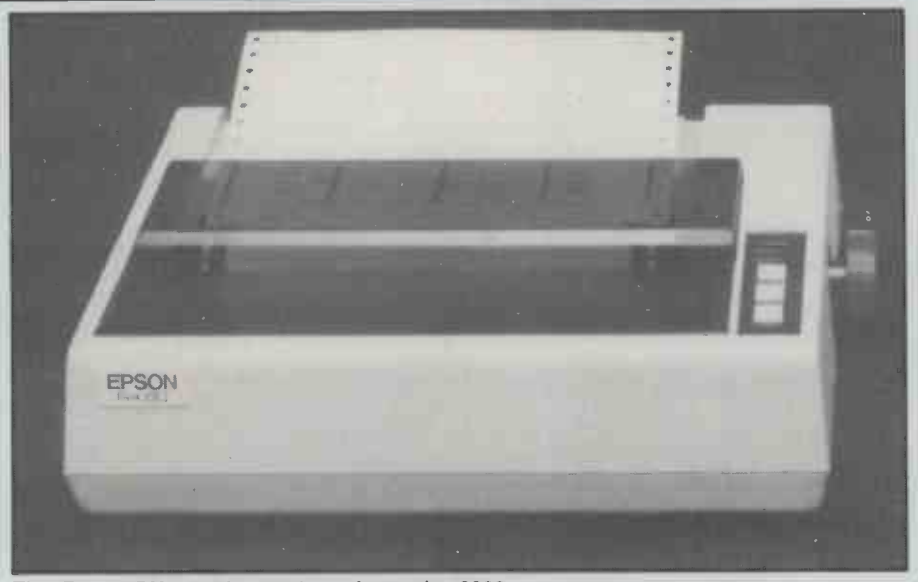


Canon PW-1080A.

Ensign 1650

£344. Competitively priced NLQ printer.

Standard features: 165cps in standard mode; bi-directional; logic seeking; nine-needle head; standard nine-by-nine character matrix, 17-by-17 in



The Epson RX-80 offers 100cps for under £300.

NLQ mode; max 10in. paper width; compressed, expanded and elite; dot addressable graphics; Epson-compatible control codes; 2K buffer; friction and tractor feed; Centronics parallel or RS-232 serial interface

Supplier: DRG Business Systems, Peripheral Division, 13-14 Lynx Crescent, Winterstroke Road, Weston-Super-Mare BS24 9DN. Telephone: (0934) 419914

Ensign 1650.

Mannesmann Tally MT-80

£285. West German based Mannesmann Tally is one of the few non-Japanese companies operating in the matrix printer market — although the MT-80 is actually made in Japan. The more expensive MT-160 and MT-180 are made in Germany.

Standard features: 80cps, bi-directional logic seeking, nine-wire head, standard nine-by-seven character matrix, max 10in. paper width, compressed and expanded character set, double strike, dot-addressable graphics, Epson-compatible control codes, friction and tractor feed, Centronics-type parallel or RS-232 serial interface

Options: 2K buffer

Other models: MT-160 is fast 160cps printer costing around £600. The more expensive MT-180 is also 160cps but takes wide paper and has NLQ mode. The MT-280 is a still faster NLQ matrix printer

Supplier: Mannesmann Tally Ltd, Molly Millars Lane, Wokingham, Berkshire RG11 2QT. Telephone: (0734) 788711

Mannesmann Tally MT-80.

Oki Microline 82A

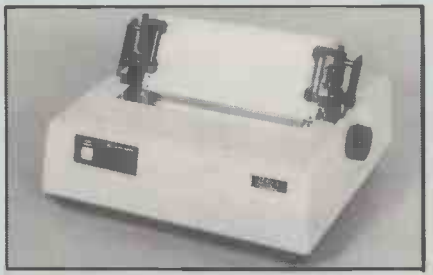
£344. Oki-Writer is a £99 plug-in ROM module which gives enhanced print quality and dot-addressable graphics.

Standard features: 120cps, bi-directional logic seeking, nine-needle head, standard nine-by-nine character matrix, max 10in. paper width, compressed and expanded character set, friction and tractor feed, Centronics-type parallel and RS-232 serial interfaces

Options: IEEE-488 parallel, Oki-Writer NLQ module

Other models: Microline 83A is wider-paper version. Microline 80 is cheaper, slower and uses a nine-by-seven character matrix, giving no descenders. Microline 92 and 84 run at 160cps and 200cps and cost around £400 and £600 respectively; both are capable of 18-by-18 NLQ-mode printing

Supplier: X-Data Ltd, 750-751 Deal Avenue, Slough Trading Estate, Slough, Berkshire SL6 1SL. Telephone: (0753) 72331



Oki Microline 82A.

Riteman A1

£286. Light and compact.

Standard features: 120cps, bi-directional logic seeking, nine-needle head, standard nine-by-nine character matrix, 10in. paper width, compressed and expanded character set, double strike, pin-addressable graphics, Epson-compatible control codes, 2K buffer, friction and pin feed, Centronics-type parallel interface

Options: tractor feed, RS-232 serial interface

Other models: new products imminent, including 140cps and 160cps models and wide-paper variants

Supplier: Micro Peripherals Ltd, 69 The Street, Basing, Basingstoke, Hampshire RG24 0BY. Telephone: (0256) 3232

Riteman A1.

Star Gemini 10X

£286. Popular Epson copy. Often discounted to around £218 including VAT.

Standard features: 120cps, bi-directional logic seeking, nine-needle head, standard nine-by-nine character matrix, max 10in. paper width, compressed and expanded character set, double strike, pin-addressable graphics, largely Epson-compatible control codes, 0.8K buffer, friction and tractor feed, Centronics-type parallel interface

Options: RS-232 serial interface, 4K and 8K buffers

Other models: Gemini 15X takes wider paper. Delta series is more expensive printer range starting at around £450; it is faster at 160cps and has 8K buffer as standard

Supplier: Star Europe, 51-53 Hatton Garden, London EC1N 8QJ. Telephone: (0993) 850755

Star Gemini 10X.

Slow but sure

If print quality is more important than speed, a daisywheel is the obvious choice.

COMPETITION is extremeley fierce in the daisywheel printer market. This is largely because typewriter manufacturers, seeing customers abandon the typewriter for word processing, are responding by moving into the computer peripheral business. Most of the big-name typewriter companies now offer daisywheel printers, many of the cheaper models being little more than repackaged electronic typewriters.

The advantages of a daisywheel printer are extremely good quality plain text output and the ability, as with all impact printers, to use carbon paper and multi-part stationery. Disadvantages are a very low printing speed, limited ability to print graphics and special characters, and noise. In this survey we look at the cheaper models, available for under £500.

Flat disc

The daisywheel from which this type of printer gets its name is a flat metal or plastic disc about 3in. in diameter. It is made up of 100 or so stems attached to a central core; on the end of each stem is a single embossed character. The printer works by rotating the wheel until the required character is in front of a small hammer, which then hits it against a ribbon on to the paper.

Many electronic typewriters use exactly the same printing technique. The only additional requirement for computer use is a generally more robust standard of construction, as few typists can achieve the sustained speeds the mechanism will have to stand up to in a computer printer.

Speeds quoted for the cheaper daisywheel printers we are looking at here vary between 10 and 20 characters per second. More up-market printers from companies like Qume, Olivetti and Ricoh are rated at from 35cps to 80cps or better, and cost from around the £1000 mark.

In fact, such speed figures are a poor guide to how much work a printer can get through. This depends on several factors besides raw cps: whether the printer skips over white space, how fast it turns round at the end of each line, how much time it takes you to insert a new sheet of paper, and so

Juki 6100

£375. List price is £516 but widely discounted to around £375.

Standard features: 18 cps, 10in. print width, multi-pitch, graphics mode, 2K buffer, friction feed, parallel interface

Options: tractor feed, sheet feeder, RS-232 serial interface

Supplier: Micro Peripherals Ltd, 69 The Street, Basing, Basingstoke, Hampshire RG24 0BY. Telephone: (0256) 3232

Dyneer Daisy DW-12

£316. Few frills but good price.

Standard features: 12 cps, friction feed, 8in. print width, single pitch, parallel interface

Options: tractor feed

Supplier: X-Data Ltd, 750-751 Deal Avenue, Slough Trading Estate, Slough, Berkshire SL1 4SH. Telephone: (0753) 72331

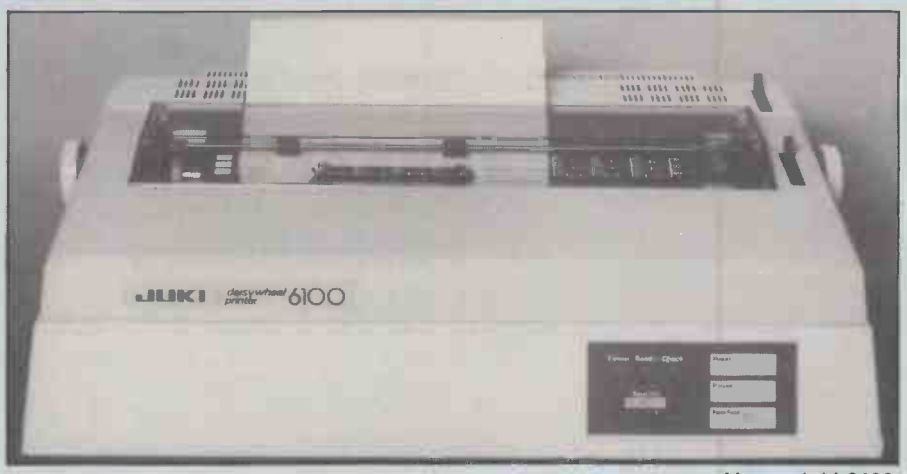
Getex D-14

£505. Same machine as the Brother HR-15, but with the Getex badge on it is usually cheaper.

Standard features: 13 cps, 11in. print width, multi-pitch, 3K buffer, friction feed, parallel or serial interface

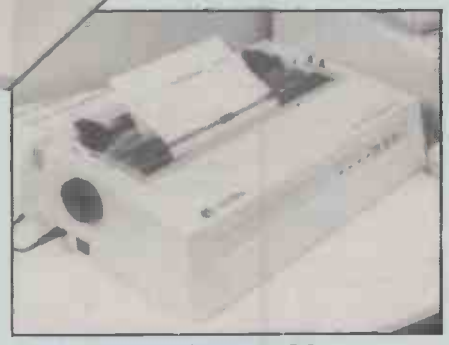
Options: tractor feed, sheet feeder, keyboard

Supplier: Geveke Electronics Ltd, Lansbury Estate, Lower Guildford Road, Knaphill, Woking, Surrey GU21 2EP. Telephone: (04867) 88676



Above: Juki 6100.

Left: Dyneer Daisy DW-12.



Above: Olympia Compact RO.

Left: Geveke Electronics' Getex D-14.

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!"£$%&´()*+,-./0123456789:;<=>?@ABCD
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Output from Juki 6100 daisywheel printer using a 10-pitch daisywheel.

on. So cps figures give only a rough guide to the relative speed of the different products.

Daisywheel printers generally come with a typewriter-like paper-feed mechanism. This means you can use ordinary office stationery, including envelopes and headed paper, but you have the job of manually feeding in each new sheet behind the friction roller.

Automatic sheet feeders are available for some machines. They feed in standard types of office stationery from a hopper, but are expensive and generally cost from £200 upwards.

A better option for many people is a tractor feed, costing around £100 and available for virtually every machine. This gives you the ability to use convenient continuous fanfold computer paper; you could use this for those jobs where the paper quality does not matter, and fall back on the manual friction feed for printing on letterheads and envelopes.

One thing that is true of all these machines is that they are very noisy — in some cases up to 65db(A). A noise level of 55db(A) is widely recommended in Europe as the maximum acceptable in normal offices. The Juki is quite good in this respect, which is why we put it first, along with its generally good specification. Even so, in our office people near it had difficulty hearing each other when it was printing. Acoustic hoods are available to fit most machines but are surprisingly expensive, costing from £200 upwards.

Pinch of salt

The basic price quoted for the daisywheel printer itself should be taken with a fairly large pinch of salt. Because of the unusual degree of competition, discounting is widespread — probably more so than in any other sector of the computer market. It really is essential to shop around. We have quoted the figure given to us by the main distributor of each printer.

Some jargon terms may need explanation. Pitch refers to the number of characters printed per inch; the ability to choose between 10, 12 and 15 pitch is usual on the better printers, and is referred to here as multi-pitch. Where the printer can only support one pitch it is usually 10cpi. For this collection of printers parallel interface means the common Centronics type rather than IEEE, and serial interface means RS-232.

Olympia Compact RO

£459. Printer version of Olympia's new Compact typewriter, with a very full basic specification.

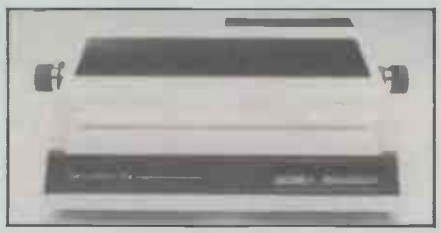
Standard features: 14cps, 11.5in. print width, multi-pitch, friction feed and tractor feed, both parallel and serial interfaces
Options: sheet feeder
Supplier: Intelligent Interfaces Ltd, 43B Wood Street, Stratford-upon-Avon, Warwickshire CV37 6JQ. Telephone: (0789) 296879

Silver-Reed EXP-500

£329. Good range of features for the price.

Standard features: 16cps, 10in. print width, multi-pitch, 2K buffer, single-sheet friction feed, parallel interface
Options: tractor feed, RS-232 serial interface
Supplier: Silver-Reed, Silver Seiko House, 19-23 Exchange Road, Watford, Hertfordshire WD1 7EB. Telephone: (0923) 45976

Smith-Corona TP-1



£250. The TP-1 will soon be replaced by the £344 L-1000; this is multi-pitch and has a full 93-character print wheel, which is an advantage when printing Basic listings.

Standard features: 12cps, single pitch, friction feed, 10.5in. print width, either parallel or serial interface
Options: tractor feed
Supplier: SCM Data Products, Unit 23, Northfield Industrial Estate, Beresford Avenue, Wembley, Middlesex HA0 1XP. Telephone: 01-900 1222

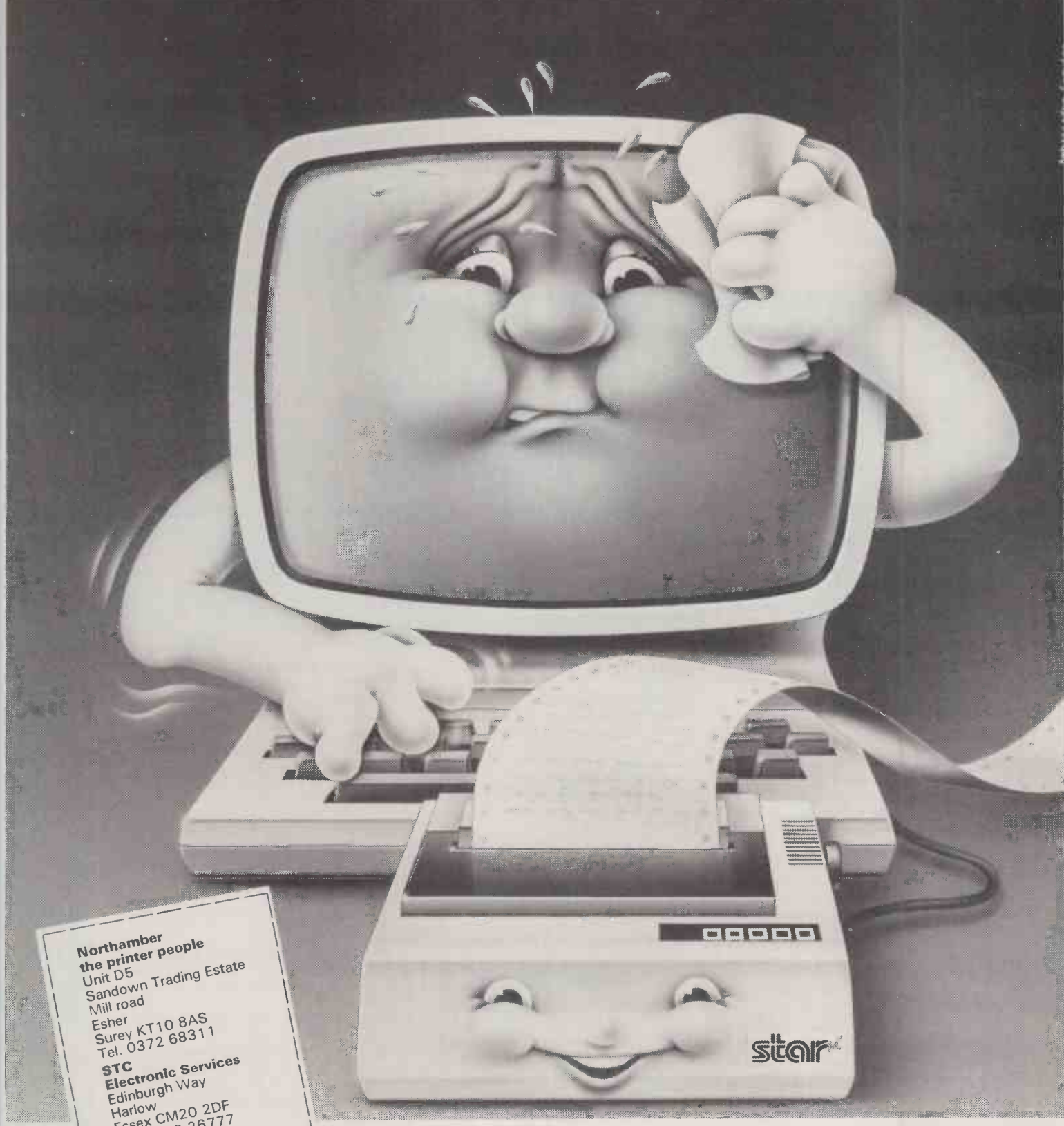
Triumph-Adler TRD-7020

£431. Good choice of print wheels available.

Standard features: 20cps, friction feed, 12in. print width, multi-pitch, graphics mode, 1.5K buffer, serial or parallel interface
Options: tractor feed, sheet feeder, dual serial/parallel interface
Supplier: Triumph-Adler (U.K.) Ltd, OEM and Special Products Division, Jordan House, 47 Brunswick Place, London N1 6EG. Telephone: 01-253 5608

Above: Silver-Reed EXP-500.

Right: Triumph-Adler TRD-7020.



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Tel. 0372 68311

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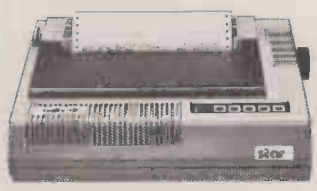
Full speed ahead - the Pro from Star.

radix-10



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That's radix-10. The fastest printer in the range of Stars. Really puts your computer through its paces. With its 16 k-byte buffer. And its speed up to 200 characters per second. That's performance! The new Star standard. Near Letter Quality included and even available in wide format - as radix-15. Star Europe GmbH. Frankfurter Allee 1-3. D-6236 Eschborn/Ts. Tel. 0 61 96/7 01 80. Telex 415 867 star d.

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Win a printer!

Your chance to win an Ensign 1650 NLQ dot-matrix printer worth £344 in our easy-to-enter competition.

THE ENSIGN is a new impact dot-matrix printer which offers fast printing at normal matrix-printer quality, or higher-quality output at slower speed. It has a nine-needle head. For NLQ printing it takes two passes, advancing the paper slightly and offsetting the head on the second pass, thereby printing a second pattern of dots between the first.

This ability to print fast for normal use but at high quality when the occasion demands represents a realistic compromise between the demands of speed and quality. The full spec is shown on page 106 of this issue.

To enter the competition you have to form as many valid words as possible from the letters of the word PRACTICAL. We will accept any word that can be found in the current edition of *Collins Dictionary of the English Language*, plus the computer terms A1, C, CAL and IC (hint!). Nonsense words will count against you. This should deter you from sending us

screeds of raw output from your anagram program, but you are obviously at liberty to use a computer if you think it can help. Once you have obtained your list of valid words, please write them in on the form reproduced here, complete the rest of the form and send it to us to arrive not later than December 1, 1984.

The competition is open to all U.K. readers of *Practical Computing*. The winning entry will be the one which in the judge's opinion carries out the competition task most satisfactorily, and provides the most original and witty suggestions to the tie-breaker. Thanks to DRG (U.K.) Ltd for providing the prize.

Rules

1. The competition is open to all U.K. readers of *Practical Computing* except for employees of Business Press International Ltd or DRG (U.K.) Ltd, or their families.
2. Each entry must be in ink on the official entry form printed here. Only one entry per person is allowed.
3. Entries must arrive by Dec 1, 1984. The address is: Practical Computing, Room L307, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. Envelopes should be clearly marked "PRINTER COMPETITION" in the top left-hand corner.
4. The Editor of *Practical Computing* is the sole judge of the competition. No correspondence can be entered into regarding the result of the competition and it is a condition of entry that the judge's decision is final.
5. The winner will be notified by post and the result of the competition announced in the first available issue of *Practical Computing*. The winning entry will be reproduced, and other entries may be reproduced without payment.
6. The prize is an Ensign 1650 matrix printer. This prize is supplied by DRG (U.K.) Ltd. No cash substitute will be offered.
7. The prize will be awarded to the individual named on the winning entry.

Entry form for *Practical Computing* Printer Competition

I have found a total of ..... valid words from the letters of the word PRACTICAL *(please write in number)*
Please list the words in capitals, in the spaces below, then answer the tie-breaker.

....
....
....
....
....
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....
....

Tie-breaker

Write an apt or amusing name for a new NLQ printer:.....

Name .....

Address .....

.....

If I win I would like my printer equipped with a Centronics-style parallel interface/RS-232 interface *(please delete option which does not apply)*

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

HP's new technology

Ian Stobie has been looking at two characteristically innovative units from Hewlett-Packard.

Thanks to ink-jet technology, the HP Thinkjet is very small and quiet.

HEWLETT-PACKARD'S Thinkjet is far quieter than a conventional matrix printer, and very compact. It pioneers a new ink-jet technology which promises to deliver very cheap printers if HP chooses to license it widely.

The HP Thinkjet itself costs £399 plus VAT. It comes at present with an HP-IB interface for use with HP's touch screen 150 computer, but HP will be making a major effort to sell it to people owning computers from other manufacturers. A dedicated IBM PC version and a general-purpose Centronics-style parallel interface model will be available in November, with the RS-232 serial version scheduled for next year. We borrowed the HP-IB version of the printer together with an HP 150 computer for this review.

Physically the Thinkjet is very small. It has an A4 footprint, and actually takes up less space on the desk than a stack of a dozen copies of this magazine. The small size is partly due to the ink-jet technology

The Laserjet

At £2,975 plus VAT the Laserjet is not cheap, but it is both quiet and fast. Hewlett-Packard is aiming to sell it to users requiring from 500 to 3,000 pages of letter-quality output per month, where its speed advantage over even the best daisywheel printer would be most appreciated.

The Laserjet prints a whole page at a time, producing output of almost daisywheel quality at eight pages per minute, irrespective of how many words there are on the page. For typical documents this works out at about 300 cps, making the Laserjet four times faster than the fastest top-quality daisywheel printers.

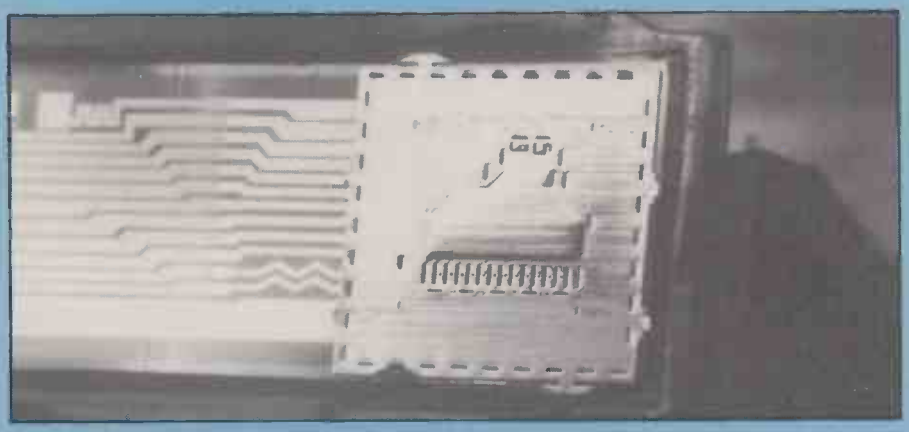
Outwardly the Laserjet looks like a desk-top photocopier, which is basically what it is. It weighs 70lb. At the front is an output tray and a 100-sheet paper input tray, which takes quite ordinary photocopier paper. There is also a manual feed which allows you to print on odd sizes of paper.

The laser itself is inside, though you can't see much of this wondrous technology as the laser and its precision optical system are very securely housed in a protective casing. The laser beam is used much like the electron beam in a TV set to build up an image on an electrostatically charged drum. The beam is scanned across the drum by a rotating 18-sided mirror, and is turned off and on under software control. Where the beam strikes the surface the charge is destroyed, so eventually an invisible electrostatic image of a page is built up on the drum.

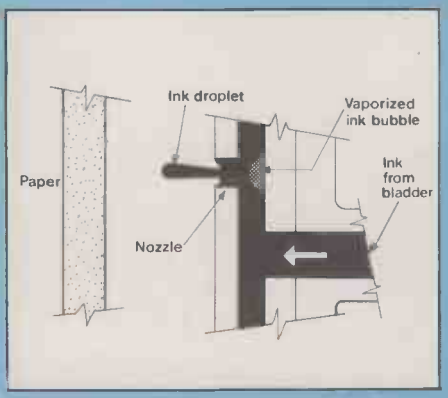
A conventional xerographic printing process now takes over. The charge on the drum is the wrong way round for printing a positive image, so it is reversed, then carbon toner powder is released. The toner sticks only to the charged parts of the drum, creating a light and dark toner image. This is transferred to a sheet of paper and bonded to it by heat.

Hewlett-Packard knows more about computers than it does about photocopiers, so many of the Laserjet's components are bought in from Canon. The Thinkjet uses a replaceable xerographic drum which is contained in a cartridge along with a supply of toner. When the

Externally the Laserjet resembles a photocopier . . .



Despite its precise engineering, the print head is cheap and disposable.



How the disposable ink-jet print head used in the HP Thinkjet works.

used in the print head. It generates a negligible amount of heat, so cooling space is not needed. HP has also shrunk the electronics by putting most of the circuitry on just four HP-made custom chips. There is little inside the case besides a power supply and two stepper motors to move the paper and the print head.

Unusual

Despite its size, the Thinkjet takes standard 9.5in. fanfold paper or A4 cut sheets, printing 80 columns of normal characters. The paper-transport mechanism is slightly unusual. The paper is pressed against two sandpaper-textured grip wheels, which do as much work in advancing the paper as the Thinkjet's pin-feed wheels. According to HP they help to achieve more accurate registration. The system works well with cut-sheet A4 paper, but does not let you use smaller sheets or envelopes.

In most other respects the Thinkjet resembles a conventional matrix printer, albeit a compact one, the one real innovation being the print heat. It combines both the ink-jet mechanism and an ink cartridge holding 3ml. of ink in a cylindrical unit about 1.5in. long. The ink is meant to last for about 1,000,000 characters or 500 pages, according to HP, after which you throw the whole head away. A new one costs £6. It can be this cheap because the most important part, containing the ink-jet nozzles, is made using thick-film integrated-circuit fabrication techniques.

The path from the ink reservoir terminates in 12 tiny holes, arranged vertically facing the paper. As the print head scans horizontally across the paper, droplets of ink are shot out of selected holes to form characters. Behind each hole is a heating element which can be turned on to vaporise a small amount of ink. The expanding bubble forcibly ejects the ink lying in front of it through the hole and on to the paper. Were it not for the fact that the ink is glycol-based, the Thinkjet would literally be steam-powered.

Apart from the ink, HP's print head has no moving parts. New ink is supplied to the holes by capillary action. HP claims that with this technique up to 2,500 droplets can be fired from each hole per second, although the Thinkjet does not actually need to run at this speed. The print head does not get hot as the heating elements are too small to affect anything but the ink itself.

As soon as you start using the printer the chief benefit of this technology becomes apparent: the Thinkjet is quiet. It is easy to hear what someone is saying with the printer going next to you. In fact, printing itself is silent; the only noise comes from the paper-transport mechanism. Printing also uses very little power. HP has already announced a battery-powered version of

(continued on next page)

toner runs out, which HP says will be after about 3,000 averagely dark pages, you throw away the whole cartridge, including the drum. A new cartridge costs £60. HP says this approach substantially reduces the cost of the printer, as long-life drums are expensive. It should also keep the output quality consistent, though we did not actually see any output from a nearly exhausted cartridge.

The print quality seems to be quite good — equal to a top-quality photocopier. The laser imaging system creates an electrostatic image with a resolution of 300 by 300 dots per square inch. By the time it is transferred to paper no individual dots are visible, even under a magnifying lens. The output is undoubtedly better than

LaserJet offers you true letter q
of LASER printing. Select from pr
characters. Or highlight those i
with italic, bold, or underline.

And that's not all.....

At a fast eight pages per minute,
professional PC user. Its speed
faster than most daisywheel print
necessary to print those importan

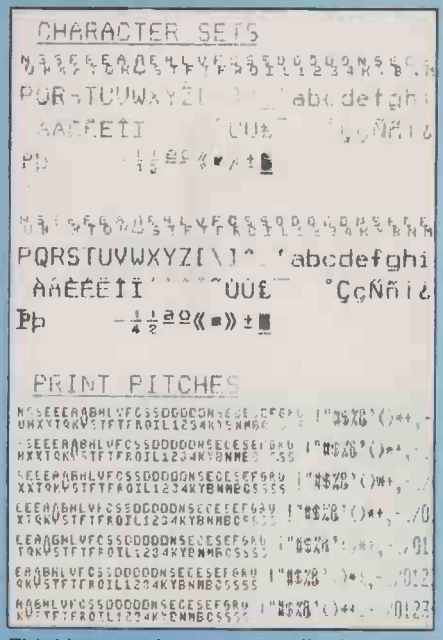
. . . and its output is photocopier-like too.

that produced with the best NLQ impact dot-matrix printers, and arguably up to the standards obtainable with a daisywheel printer using a fabric ribbon. You start noticing differences in comparison to output from a daisywheel with carbon ribbon: the edge definition of a Laserjet character is less sharp, the overall image blacker. I like this bolder effect, but there is a difference which will matter to some people.

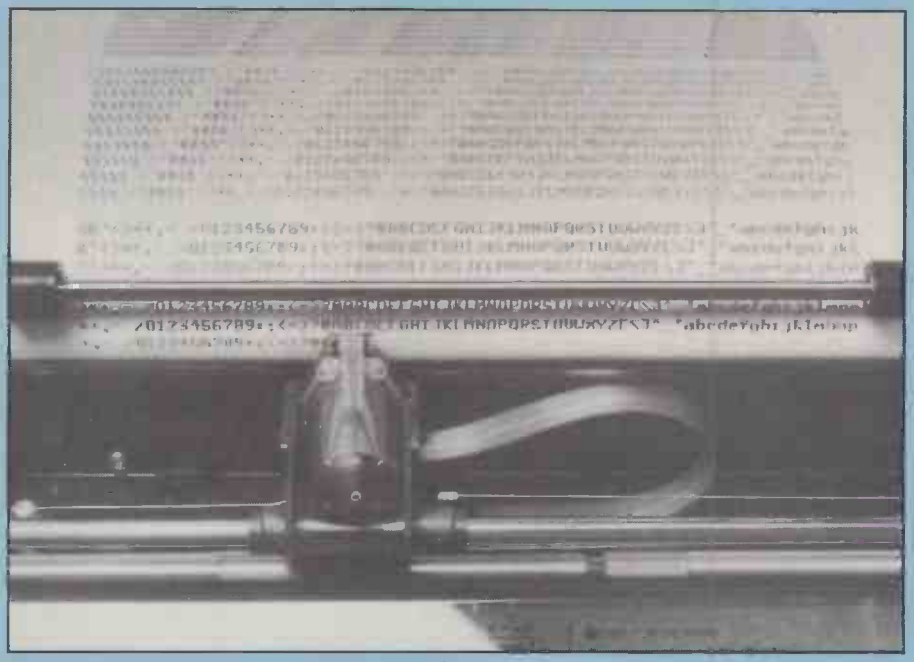
The Laserjet's most significant advantage over the daisywheel, apart from its speed, is the reduced noise level. HP claims a figure of better than 55db(A), as against a typical daisywheel's 65db(A) and the Thinkjet's 50db(A). Both the HP printers are quite compatible with normal conversation.

The Laserjet is ideal for producing graphics, as it always prints at the same speed regardless of page content. Four different resolutions are available, ranging from 75 to 300 dots per inch. The Laserjet must always hold at least one whole page in its 59K buffer before it starts to print. This imposes some restrictions, as the buffer is not big enough to allow graphics at the highest resolution across the whole page area. However, the page-based printing allows you to rotate text to print across the length of the page as well as the normal way, which is useful for putting spreadsheets sideways across a standard A4 page.

The Laserjet is equipped with an RS-232 interface. HP is clearly aiming it at IBM PC users as well as at its own user base.



Thinkjet sample output; quality is up to impact matrix-printer standards.



The print head scans horizontally across the paper.

HP's new technology

(continued from previous page)

the Thinkjet for use with equipment using its low-power HP-IL interface.

Output quality is average rather than outstanding, but well up to impact matrix-printer standards. The 12-jet print head forms characters over 11 horizontal movements, giving an 11 by 12 matrix for normal-size characters. You can also print in a condensed fount of 142 characters per line or an expanded fount of 40 characters per line, as well as produce bold, underlined, subscript and superscript characters. The dots of the printing matrix are individually addressable, allowing graphics to be printed and screens to be dumped under software control. On the review system the HP-150 graphics set was printable from Basic. The IBM PC version of the Thinkjet will support the IBM graphics character set.

Special paper

The Thinkjet is fussy about the type of paper used. We got much better results printing on HP-supplied paper than with our usual listing paper or our headed notepaper. On the HP paper a droplet of ink striking the paper spreads out slightly to improve the image, but not so much as to blur the character outline. On our usual listing paper the printed image looked pale, and for a couple of minutes after printing the ink smudged easily. The ink droplets were obviously not being absorbed sufficiently.

HP charges about £10 per thousand sheets for suitable paper, which compares to £7.50 per thousand for our normal printing paper from Inmac. But the HP paper is of the neater microperforated type so the price is not excessive, and independent paper suppliers may well start offering cheaper paper if the Thinkjet becomes popular.

The Thinkjet is among the first fruits of Hewlett-Packard's new outwardly orientated marketing policy. Even the choice of name betrays a brash consumerism quite alien to HP's restrained, technically orientated past.

HP will undoubtedly develop the ink-jet technology used in the Thinkjet further. One likely development is an increase in the number of holes on the print head to achieve near-letter-quality output. With enough holes colour print heads also become feasible, with several ink reservoirs feeding separate groups of holes.

Although the Thinkjet's current price is comparable to an impact printer of similar specification, in the long term there is clearly more scope for cost reduction with the ink-jet technology. There must be many home-computer owners who would like to get their hands on a budget printer built around the Thinkjet's £6 throwaway print head, and if HP does not do it somebody else may. Cheaper printers are clearly on the way.

Thinkjet specification

Printing method: 12-nozzle ink-jet matrix printer
Character matrix: 11 by 12; 192 dots per inch in graphics mode
Speed: 150 cps, bi-directional, logic seeking
Noise: claimed 50dB(A)
Print features: compressed, expanded, bold, underline, dot-addressable graphics, Epson-compatible control codes
Paper: single-sheet A4 or standard 9.5in. fanfold paper; achieves best results with HP supplied paper; pin-feed, and unusual type of friction feed
Print head life: claimed 1,000,000 characters, equivalent to about 500 pages; ink is contained in print head
Dimensions: 292mm. (11.5in.) by 206mm. (8.1in.) by 89mm. (3.5in.); weight 2.7kg. (6lb.)
Interface options: HP-IB/IEEE-488, Centronics-style parallel, RS-232 serial, HP-IL
Price: £399 plus VAT; replaceable print heads cost £6
Availability: now for HB-IB version, November for Centronics-style version and battery powered HP-IL model, 1985 for RS-232
Where made: U.S. and Singapore
Supplier: Hewlett-Packard Ltd, Nine Mile Ride, Wokingham, Berkshire RG11 3LL. Telephone: (0344) 773100

Conclusions

● The Thinkjet competes directly with impact matrix printers, which are inherently noisy. HP's novel ink-jet printing technique makes the Thinkjet much quieter — a major advantage.

● Printed output, with characters formed on an 11- by 12-dot matrix, looks about equivalent to that from an Epson FX-80, itself one of the better impact matrix printers on the market, though you do have to use HP's own paper to get this quality.

● The Thinkjet complements the HP-150 very well. Both are standard products aimed at the non-specialist personal computer market, but both have the extra appeal conferred by technical innovation.

● HP's print head probably heralds a new generation of quieter, cheaper printers. The impact matrix printer may well be dead sooner than anticipated.

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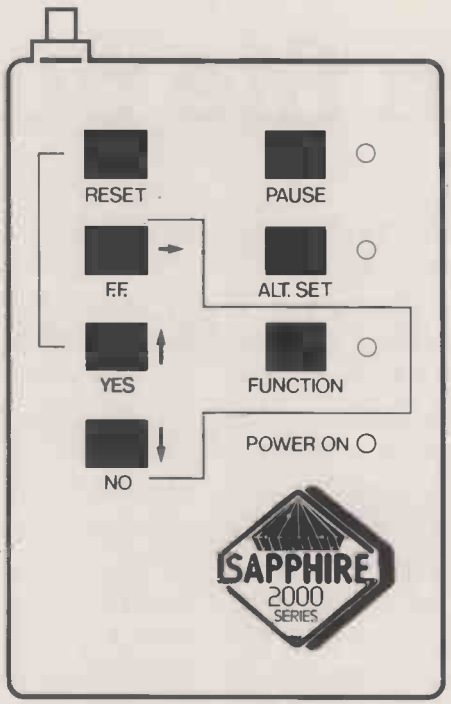
THE CONCEPT OF SAPPHIRE

Naturally, **Sapphire 2000 Series** printers offer all you would expect from a top quality state-of-the-art product.
Quality and reliability are assured by the **Ricoh** print mechanism used in all **Sapphire** printers.
Performance and sophistication are added by the customised interface units designed and built in the UK — designed to realise the full potential of the product, and to meet the demands of today's computer industry.
However, **Sapphire 2000 Series** printers offer rather more than you might expect.
Consider, as we did, the dilemma facing the person who actually uses the printer.
Most printers incorporate an operation control panel: most printers are positioned away from the console, and in an acoustic enclosure.
Most printers offer a range of sophisticated facilities accessed by software: most standard software packages deny access to special facilities.
The **Sapphire Remote Control Unit,** with deceptive simplicity, overcomes these problems. It brings direct control of printer operation right out to the user — simply and accessibly.
And it gives the operator access to the printer's range of internal facilities, without need to send complex codes via the computer through a simple menu-driven routine which actually prints out all the options available on the **Sapphire** — and stores the selections chosen after power-off.

Remote Control Unit

The **Sapphire** allows simple control via a handy remote unit of functions normally accessible only via complex software codes. These functions are amended by a menu-driven option table. Battery backup allows the retention of two separate menus so that facilities can be accessed by the touch of a switch.



Operator Configurable Options Via Remote Unit

Pitch
Line Spacing
Auto Linefeed
Form Length
Form Skip
Baud Rate
Data Bits
Parity
Stop Bits
Language
Slashed Zero
Pound/Hash
Emulation
Literal Mode
Proportional
Justification
Left Margin
Right Margin
Sheet Feeders
Carriage Movements —
Platen forward/reverse
Printhead left to right by 1/120" increments
Reset/Pause
Enhanced Print

Printer Specifications

Print Speed
35 c.p.s. (2300); 65 c.p.s. (2600)
Print Buffer
8K standard (32K option)
Interfaces
Serial/Parallel/IEEE
Emulations
Diablo 630/NEC Spinwriter 7700
Audible Warnings
Paper out/Ribbon out/Lid open/Fault
Print Head Advance
Left to right (also refer to remote control unit specification)
Paper Advance
Forward and Reverse

Ribbon Type
Fabric — black
Multistrike film — black, blue, brown
Red/Black fabric (2600 only)
Single strike enhanced print quality — available with standard ribbons via internal printer control
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Single/dual and dual plus envelope sheetfeeders
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If you truly believe your microcomputer won't breakdown...

turn the page.

Like any micro-system user, you'd be right in believing that your computer is unlikely to let you down.
But you wouldn't claim it was infallible either. Would you? It's just that the consequences of unplanned downtime can be chaos. Staff won't get paid the day you promised, invoices won't get issued. Goods come and go, unrecorded, or worse, they just don't move at all.
Avoiding the unthinkable isn't difficult, or expensive. All you do is get in touch with Systems Reliability. We make our living by maintaining (and mending) all kinds of micro-systems. We know our way round so many systems: **Apple**, **Alpha Micro**, **Sanyo**, **IBM PC**, **Micro V**, **Altos**, **BT Pennant**, to name a few.
Talk to us about our nationwide network of service and maintenance resources, about our fast working field teams, about contract preventative maintenance and repair, and about our impeccable credentials.
You could wait until you've got a problem. We'll be with you fast.
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THERE are dozens of quality printers from which to choose. With quality price tags of around £250.

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Though it has far more than its fair share of features, it maintains the extraordinarily low price of £199.95.

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In the speed stakes, the M-1009 is certainly no slouch, being fully capable of up to 50 characters per second.

Providing bi-directional and logic seeking printing for normal characters and uni-directional printing for super and sub script and graphics.

Prints on any paper.

Being an impact printer, the M-1009 will print on virtually any paper, including letter headings, invoices and standard office stationery.

It will even print two copies together with your original.

A superb character recommendation.

In its price range, the M-1009 has a great deal more character than many printers.

96 no less, plus international type and graphic characters.

Reliability comes as standard.

Built to the same exacting standards as Brother's elite office printers, the Brother M-1009 already has faultless credentials for reliability.

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One printer that doesn't block out the light.

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PC11/84

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Near Letter Quality Printer from the New Force in Computer Printers

SMITH CORONA
DATA PRODUCTS

An exciting new range of high quality printers has been created to bring speed, reliability and flexibility to both the office and home user. The D300 is a sophisticated dot matrix model that will give excellent quality print, even in the toughest business environment.

Compatible to most business micros, PCs and home computers, the D300 has a dual Centronics parallel/RS232C serial interface plus **IBM** PC compatibility and **Epson** emulation. The buffer has a 2K bytes capacity and can accept a 96 downloadable character ASC II set.

Performing at a speed of 160 cps with 132 column width (at 10 cpi), throughput is maximised with bi-directional text printing, logic-seeking and a choice of stationery handling (friction and tractor feed are standard – a roll holder is available as an optional extra).

The ten-pitch D300 offers 128 variations of print style, size and resolution – including Near Letter Quality – and boasts bit image, dot addressable and block graphics. Vertical and horizontal tabs, proportional spacing, superscript and subscript features ensure superior presentation.

Fill in the coupon now and find out how you can make the most of your computer with a printer from Smith Corona Data Products.

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☐ A free list of my local dealers.

Name_____

Company (if appropriate)_____

Address_____

Post code_____ Tel No._____

Make and model of computer used_____

PC3

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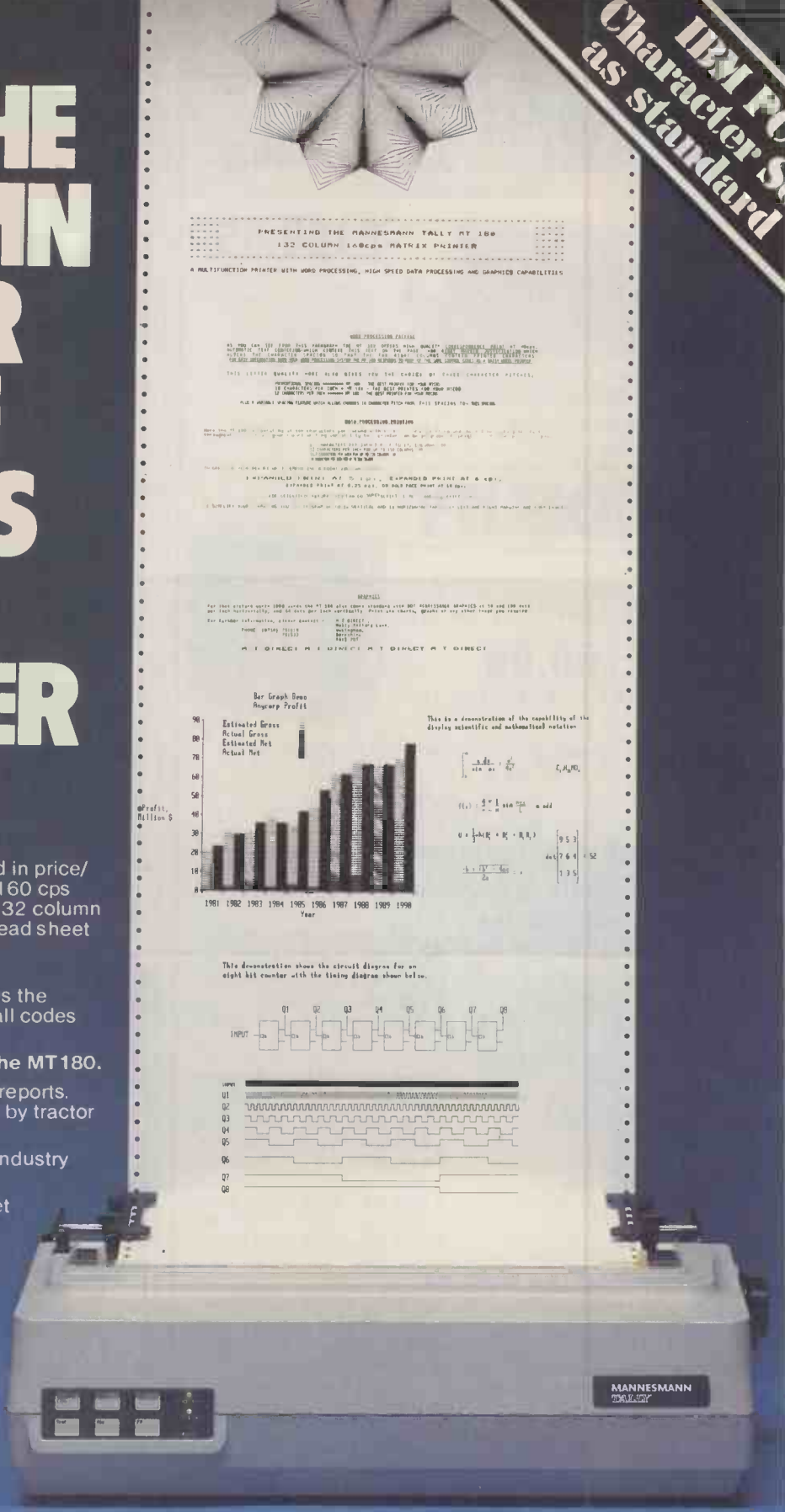
MT180, THE 132 COLUMN PRINTER FOR THE BUSINESS MICRO COMPUTER USER

IBM PC Character Set as Standard



The MT 180 matrix printer has set the standard in price/performance for the business micro user. The 160 cps gives you high throughput whilst its standard 132 column width is ideal for the latest accounting and spread sheet software.

With the MT 180 you can easily use your word processing package. Just one code stream sets the printer to 40 cps correspondence quality and all codes associated with a daisy wheel printer.

And all these extra facilities are standard to the MT180.

Bar charts and graphics print-out for business reports. Letter heads handled by friction and print-outs by tractor mechanism.

Problem free interfacing – buffered serial and industry standard parallel.

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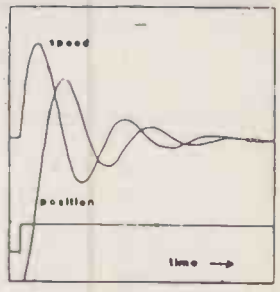

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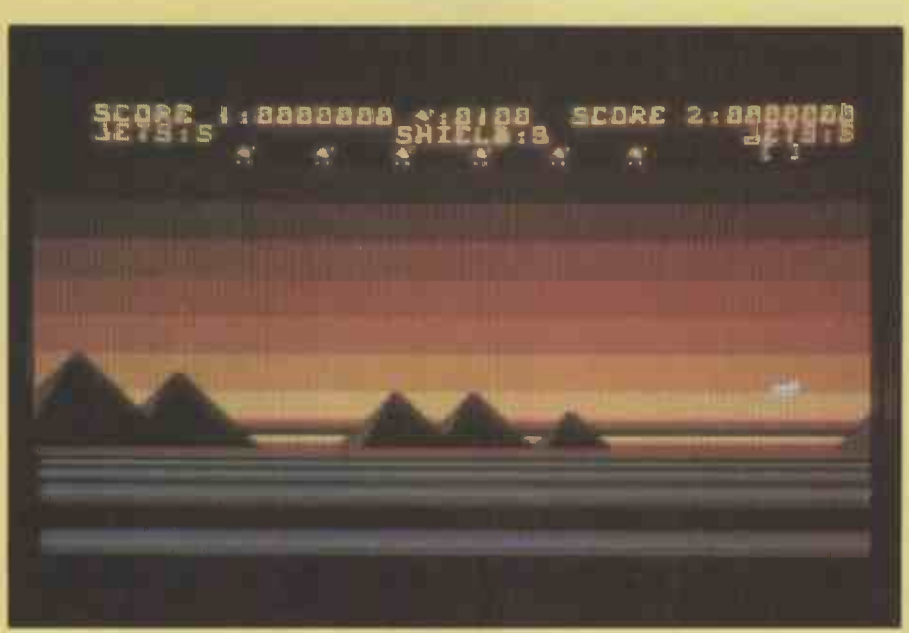
Old friends

The prices have dropped, but Jack Schofield finds little else that's new among the latest games releases for Atari micros.



Jeff Minter's irresistible Attack of the Mutant Camels: a feat of Atari programming.

Get attacked by ants in the Atari version of Hulk.

The Hulk digs a hole on the Atari . . .

. . . and another one on the Spectrum.

THE FLOOD of Atari games continues unabated, but the number of original and unique games seems to have diminished. Most of the good writers seem to be busy converting Atari originals like Astro Chase and Strip Poker to the Commodore 64. But at least prices have fallen dramatically, so Atari owners can take the chance to pick up a few old favourites and still have change from the customary large cheque.

Encounter

Battlezone is an Atari arcade classic that has never been made available in home-computer form, partly because the original uses vector graphics instead of the television raster-scan type. Well, Encounter is not Battlezone, but it is the next best thing.

You are driving a tank around a beautifully drawn three-dimensional landscape containing strange circular pillars. Instead of being attacked by tanks you have to face enemy flying saucers and homing missiles.

The graphics are brilliant. There are two particular delights. First, when you are hit you get an amazing colour display. Second, when you've cleared a screen, a square black hole opens up for you to drive into. However, the game

Hulk: the Spectrum's limbo.

Limbo — Atari style.

does become slightly monotonous when you get better at it.

Encounter was written by Paul Woakes from Birmingham, and has been a hit in America on the Synapse label — which, for copyright reasons, cannot be sold in the U.K. It is also available for the Commodore 64.

The Hulk

Adventure International's latest graphics adventure features the Marvel Comics character Bruce Jenner, also know as The Hulk. Again, the graphics are excellent. In the Atari disc version each screen is loaded separately and overlaid over the text part of the adventure. Page-flipping is used so you can switch instantly to the text.

Graphics adventures are not my personal cup of tea — I prefer the text type such as Colossal Caves and Zork. However, if you do like them this one is extremely well done.

Adventure International, being based in Florida, has produced The Hulk for the Apple and Atari micros. The British end of AI has also produced tape implementations for various U.K. machines such as the Spectrum and Commodore 64. The graphics for them has been drawn by *Practical Computing's* favourite cover artist and fiction illustrator, Teoman Irmak. Though he owns an Atari, he says the Apple version has the best graphics. Well, the Spectrum graphics look excellent to me.

Mutant Camels

Attack of the Mutant Camels is a Jeff Minter original which has earned its popularity on the Commodore 64. Now there's an Atari version which seems to play about the same — it is difficult, going on impossible — but with vastly improved graphics using Atari-only display-list interrupts.

The camels march across a three-dimensional landscape whose colour schemes vary according to the degree of difficulty. It is a *tour de force* of Atari programming, and irresistible at the price.

Minter fans who see the illustrations on the cassette leaflet will instantly recognise from the fills and typefaces that Minter now has an Apple Macintosh. We await his first mouse-operated camel, llama or sheep game with animal intensity.

Arcade classics

Three more popular arcade classics have just become available in official versions for the Atari. They are Sega's

(continued on page 131)

Q-Bert, the first cube-jumperama on the Atari.


A new price and new packaging for River Raid.


Graphics delights abound in Encounter.


Frogger offers brilliant colours.


Avoid hamburgers in Megamania.


Sno-bees beware in Pengo.

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Old friends

(continued from page 129)

Pengo from Atari, Sega's Frogger from Parker, and Mylstar's Q-Bert, also from Parker.

It may seem strange that these old-timers have only just appeared, but on the Atari you can't risk stealing other people's ideas in the way that you can on the low-budget British micros. Anyway, all three are outstanding versions, with the customary slick American-type packaging.

Pengo is the game where you are a penguin. Your task is to knock three blocks together to score points, while bumping off the waddling sno-bees that hatch out of the ice blocks.

The Atari version has superb graphics, with nice touches where sno-bees overlap, good sound and excellent animation. It is a first-class implementation of the game. Also, the difficulty levels are nicely judged. At the beginner level anyone can play and intermediate level offers a friendly challenge. The advanced level, with four sno-bees alive at once, is really hard. This is a game to get.

Parker's Frogger is also a superb implementation of the game with all the frills you would expect, including the compulsive theme tune and a beautifully squelchy frog-jumping noise. The movement is smooth and the colours are brilliant. There is even a slow mode, so the less talented among us can play right from the beginning.

If you've just got to have a Frogger then this is the one to get. However, Atari-owning Frogger lovers presumably all bought Preppie a couple of years ago, and are now sated by a game that is, after all, old hat.

Q-Bert is another excellent version of an arcade original, with outstanding graphics and sound. Oddly, while there seem to be any number of equally good versions for the Spectrum and Commodore 64, this seems to be the first cube-jumperama on the Atari. Nevertheless, the final verdict must be the same as for Parker's other effort: get this if you are a Q-Bert fan, but for everyone else the game lacks that spark of novelty.

Activision

Having achieved fame and fortune producing million-selling cartridges for the Atari games console, Activision is busy implementing them on the Atari home computers before moving on to the Commodore 64 and who knows what else. Among the first in the Atari series are Kaboom, Megamania and River Raid.

Megamania by Steve Cartwright is actually a version of Space Invaders, except you have no shelter and the invaders include hamburgers, diamond rings, bow ties and steaming irons. While the graphics are attractive and the movement is smooth, the game itself is so simple-minded it is really only suitable for the under-10s of all ages.

River Raid by Carol Shaw is a sort of vertical-scrolling type of Scramble, which has inspired a number of similar games. If you imagine the Thorn-EMI/Creative Sparks River Rescue played going up the screen, with scrolling like that on the return journey out of Caverns of Mars, then you've got the idea exactly.

The idea is to fly your plane up the river while blasting battleships, helicopters, balloons, fuel depots, enemy jets and so on. However, the idea of flight is purely notional: this is not a Blue Max type of game. Like all Activision's games, River Raid has brilliant colour. It also has superb single-pixel scrolling — like Eastern Front only faster. Again it is more suitable for younger players, but only those with very highly developed trigger fingers.

It is a shame that Activision has taken so long to get its games on to the U.K. home-computer market. The impact of, say, Pitfall must be less after the appearance of Cuthbert in the Jungle, which copies all its effects. And who could play Activision's Skiing without being reminded of Horace?

Creative Sparks

Creative Sparks is the new name for Thorn-EMI's games line-up, and some familiar programs have been reissued in new packaging. The good news is that prices are now very much lower. The best of the bunch, Computer War, has gone from being a £30-odd cartridge to being an £8.95 tape — at which price it should be irresistible.

River Rescue, Submarine Commander, Java Jim and the awful Tank Commander are also now £8.95 on tape. Orc Attack and Carnival Massacre are now £9.95 on cartridges, and as gory as every.

Also rans

English Software has made a name for itself by producing cheapish Atari games on tape, including the excellent Airstrike II, Jet Boot Jack — just converted to the Commodore 64 — and the fortune-telling Tarot Card. Now a couple of other companies are joining in. Richard Wilcox Software is one example: its Blue Thunder is available on all Atari micros and the 48K Spectrum. Microdeal has also brought out a few.

A more recent issue is Dam Busters from NDSL. This game requires 16K and a Basic cartridge as it starts with machine code converted to Basic Data statements. It feels very odd to have an Atari game that loads with CLoad and has a loader/demo section that you can List.

Dam Busters is a simulation of the famous raid, and about the level of the sort of game you type in out of *Page 6* or *Antic*. It is not going to keep Electronic Arts or Datasoft awake at nights, and you'd get better for £5.50 on the Spectrum, but there might be a market for it.

Somehow, I think the U.S. Gold imports such as Aztec Challenge, Bruce Lee, Dallas Quest, Solo Flight, Nato Commander and Beach Head are likely to make more impact at their new, low prices, roughly half of the old ones.

	Publisher	Format	Price	Rating
Attack of the Mutant Camels	Llamasoft	tape	£7.50	15/20
Dam Busters	NDSL	tape	£5.50	8/20
Encounter	Novagen	tape/disc	£9.95/ £12.95	17/20
Frogger	Parker	ROM	£29.95	16/20
Incredible Hulk	Adventure International	tape/disc	£9.95/ £17.95	n/a
Megamania	Activision	ROM	£19.99	13/20
Pengo	Atari	ROM	£9.99	17/20
Q-Bert	Parker	ROM	£29.95	16/20
River Raid	Activision	ROM	£19.99/ £9.99	14/20

Commodore 64 versions: Attack of the Mutant Camels, Encounter, The Incredible Hulk, and River Raid.

Spectrum versions: The Incredible Hulk and River Raid.

The Incredible Hulk on tape costs £9.95 for the 48K Spectrum, 24K Atari and 64K Commodore 64, and £7.95 for the BBC B, Dragon and Tandy Color Computer. Of these only the Spectrum and Commodore versions have graphics. Disc versions cost £17.95 for the Apple II and £13.95 for the Commodore 64.

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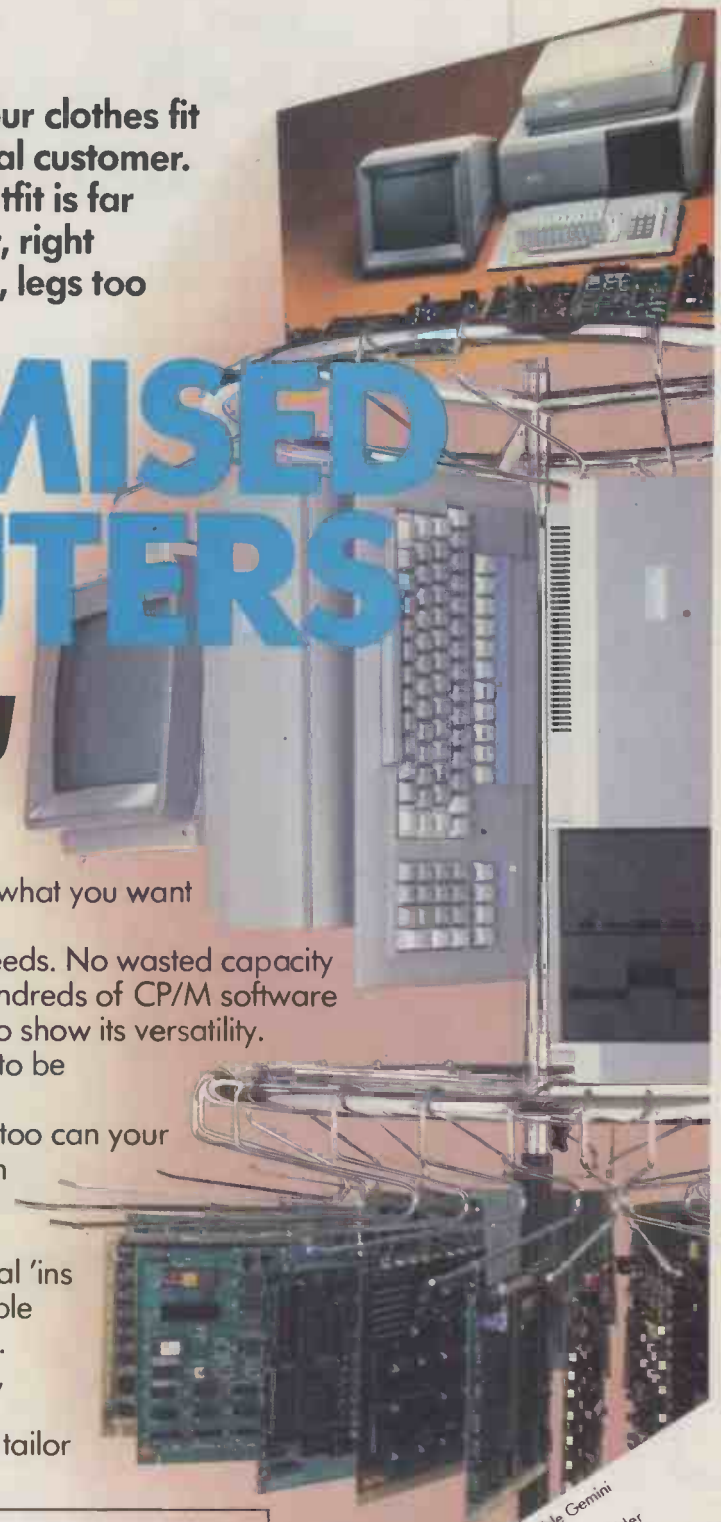

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Reverse Rems

REMS are used to add comments to programs and make them more understandable but often they are so hidden amongst the rest of the program as to be useless. Thomas Gutekunst has provided a program that makes all Rems appear in reverse field to make them stand out more prominently.

The program is suitable for nearly all Commodore machines and should be loaded and run to put the machine code into the cassette buffer. Thereafter, simply load the program to be highlighted and enter

SYS900

The one thing to watch out for is that the first character after each Rem will be turned into the RVs character, which is CHR$(18).

One interesting feature is the method used to detect the machine being used. Line 120 calculates the unique address of the machine's Reset routine and lines 130 to 170 identify the machine.

```
100 ENTRY=900

120 TE = PEEK(65532)+256*PEEK(65533)
130 IF TE=65080 THEN V=124 : REM BASIC 1
140 IF TE=64721 THEN V= 42 : REM BASIC 2
150 IF TE=64790 THEN V= 42 : REM BASIC 4
160 IF TE=64802 THEN V= 45 : REM VIC-20
170 IF TE=64738 THEN V= 45 : REM C-64
180 IF V=0 THEN SYSTEM

200 FOR I = EN TO EN+45 : READ J
210 IF J<0 THEN J=ABS(J)-42+V
220 POKE I,J: NEXT: END

240 DATA 160,0,132,0,160,4,132,1,160,0
250 DATA 177,0,201,143,208,11,200,177,0
260 DATA 201,58,208,4,169,18,145,0,230
270 DATA 0,165,0,208,2,230,1,197,-42,208
280 DATA 225,165,1,197,-43,208,219,96
```

Relocating machine code

As anyone writing machine code is well aware, it is difficult to write a program that can sit in memory anywhere other than where it was written, and relocating one already written is tricky. The main reason for this is that absolute addresses within the program need to be changed. This means identifying the absolute addressed op codes and then determining if they are within the area of memory being relocated and then adding or subtracting a constant value.

The process could be done by hand but Mr Stoner of Hatfield has automated the process. The first hex dump is the relocating program itself and should be entered using the machine-code monitor. Once entered, it can be used to relocate itself, for instance into the cassette buffer starting at $033A.

Five addresses need to be set up prior to entering the routine. The first two are the start and end addresses of the actual program which is being relocated, the second two are the range of absolute addresses which are to be amended, and finally the new start address of the absolute addresses.

The second listing shows them entered using the machine-code monitor. The program itself is located from $400C to $409D but $4000 to $400B is workspace used by the program so that the range of absolute addresses to be changed is actually $4000 to $409D. Finally, the cassette buffer starts at $033A.

Machine-code relocater. Listing 1.

```
.:  4000 AA AA AA AA AA AA AA AA
.:  4008 AA AA AA AA AD 08 40 38
.:  4010 ED 04 40 8D 0A 40 AD 09
.:  4018 40 ED 05 40 8D 0B 40 AD
.:  4020 00 40 85 54 AD 01 40 85
.:  4028 55 A0 00 B1 54 20 77 40
.:  4030 C9 03 D0 2F C8 B1 54 CD
.:  4038 04 40 C8 B1 54 ED 05 40
.:  4040 90 1F 88 B1 54 CD 06 40
.:  4048 C8 B1 54 ED 07 40 B0 11
.:  4050 88 B1 54 18 6D 0A 40 91
.:  4058 54 C8 B1 54 6D 0B 40 91
.:  4060 54 A9 03 18 65 54 85 54
.:  4068 90 02 E6 55 CD 02 40 A5
.:  4070 55 ED 03 40 90 B3 60 48
.:  4078 C9 20 F0 0C 29 1F C9 19
.:  4080 F0 06 29 0C C9 0C D0 04
.:  4088 68 A9 03 60 68 29 9F D0
.:  4090 06 29 0D 49 08 D0 03 A9
.:  4098 01 60 A9 02 60 AA AA AA
```

Listing 2.

```
.:  4000 0C 40 9D 40 00 40 9D 40
.:  4008 3A 03 AA AA AD 08 40 38
```

Having entered the values, go back to Basic and enter

SYS 16396

This will change all the addresses appropriately. However, the program does not move the code. You will have to do this for yourself either in Basic, Peeking and Poking the bytes, or using the monitor by typing the new addresses on to the front of each line of the hex dump.

As it stands, the program will work on any Basic 2 or Basic 4 Pet. If used on the Vic-20 or Commodore 64 it will need to be followed immediately by

Poke 84,76

More on input

Getting around the inherent problems of Commodore's Input command continues to be a challenge to programmers, and David Shakleton of Rochdale has come up with yet another useful routine. It allows you to type characters on the screen and edit them in the usual manner.

When Return is pressed, it reads the characters directly from the screen and puts them into the string variable W$. This means that quotes, commas and other restricted characters can be used with impunity and will be returned into W$.

The program listing is in four sections. Lines 200 to 310 are the Data statements containing the necessary machine code and lines 100 to 140 are the subroutine which puts this into the cassette buffer. Lines 1000 to 1070 are the actual subroutine which reads the characters using the machine-code routine, and lines 10 to 60 are a simple example of how it is used.

The subroutine at line 1000 first opens a file to the keyboard and line 1010 then sets PP to the screen memory address where the cursor is. Line 1020 Pokes this address into locations 2 and 3 for use by the machine code and line 1030 sets up the string W$ to all spaces. The machine code is called in line 1040 and line 1060 strips off unwanted spaces.

The only setup required by this subroutine is to set LW to the number of characters that you require and then Gosub 1000. W$ will be returned containing LW characters from the screen, starting from wherever the cursor was when the routine was called.

The program is for Basic 4, but by changing the last two values on line 290 to 201,207 it can be used on Basic 2 Pets.

Input routine.

```
10 PRINT "ENTER TEXT ";
20 LW=250
30 GOSUB 1000
40 TEXT$=W$
45 PRINTW$:END
50 PRINT W$
60 END

100 C=0: I=826
110 READ A :IF A>256 THEN 130
120 POKE I,A: I=I+1: C=C+A: GOTO 110
130 IF C<>A THEN PRINT"DATA ERROR":STOP
140 RETURN

200 DATA 162,1,32,198,255,32,207,255,165,1
210 DATA 141,83,3,165,2,141,84,3,32,147
220 DATA 3,164,0,136,185,136,136,41,127,201
230 DATA 32,144,8,201,64,144,13,201,96,144
240 DATA 6,24,105,64,76,108,3,24,105,128
250 DATA 201,32,208,2,169,32,145,1,192,0
260 DATA 208,217,162,0,164,0,136,177,1,41
270 DATA 127,201,32,208,4,232,136,208,244,134
280 DATA 1,165,0,56,229,1,133,0,96,169
290 DATA 87,133,66,169,128,133,67,32,135,193
300 DATA 160,0,177,68,201,0,240,234,133,0
310 DATA 200,177,68,133,1,200,177,68,133,2,96

1000 OPEN 1,0
1010 PP=PEEK(196)+PEEK(198)+256*PEEK(197)
1020 POKE 2,INT(PP/256): POKE 1,PP-PEEK(2)*256
1030 W$="": FOR YY=1TOLW: W$=W$+" ": NEXT
1040 SYS(826)
1050 PRINT:CLOSE1
1060 W$=LEFT$(W$,PEEK(0))
1070 RETURN
```

Merge on the 64

It is useful to be able to build up a library of often used subroutines on cassette or disc, and then be able to merge them back into the current program.

There are several methods available, most of which append rather than merge. The following technique effectively stores the subroutines as a sequence of keystrokes. The merge program then reads them back from tape or disc and handles them as though they have been typed at the keyboard.

First, the program or subroutine must be listed to tape or disc as follows

```
OPEN 2,8,2,"0:SUBROUTINE,S,W"
CMD 2: LIST
PRINT#2: CLOSE 2
```

The Open given is for disc; for a cassette it should be

```
OPEN 2,1,1,"SUBROUTINE"
```

The list can of course be used to save part of a larger program if required.

When you run the merge program to read the subroutine back again for tape use line 1 should be

```
1 OPEN 1,1,0,N$
```

The merge will stop with either a syntax or out of memory error. This is normal and is the result of reading Ready from the tape or disc.

If the program reads a line with the same number as an existing line, the existing line will be overwritten. So to ensure that line number ranges do not overlap each stored subroutine should have its own line number range.

The easiest way to use this when starting to develop a program is to load the merge program, then merge any subroutines required and start to write the main program. Once the complete program has been tested and no more subroutines are required lines 0 to 5 should be deleted.

Merger.

```
OPEN 2,8,2,"0:SUBROUTINE,S,W"
CMD2: LIST
PRINT#2: CLOSE2

0 INPUT"NAME OF SUBROUTINE";N$
1 OPEN 2,8,2,N$
2 PRINT"[CLR][CUD]":POKE152,1:CR$=CHR$(13)
3 GET#2,A$:PRINTA$;:IFA$<>CR$THEN3
4 PRINT"GOTO2 [HOME]";
5 POKE631,13:POKE632,13:POKE198,2:END
```

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by John Wellsman

Get down to Basic

ONE OF THE BIG advantages of using a high-level language like Basic is that you can forget about how your computer works and concentrate on manipulating the ready-made operations provided by the language's keywords. So I am not about to suggest that you tackle the mind-bending disciplines of machine code or assembler. However, by taking the trouble to learn a little about how Basic programs are stored you can perform some neat programming tricks without actually venturing outside Basic itself.

The examples have been worked out on the Model I but there is no reason why they should not work on the Model I, III and Genie, although the location of the start and finish addresses will not be the same.

Your first step should be to find out where in the 64K of memory Basic is stored. The starting position or address of a Basic program can vary according to a number of circumstances: for instance, whether you are using discs or tape and, if the former, which DOS you are using.

But there are two pairs of addresses in memory which save any worry in this direction. In Model I locations &40A4 and &40A5 (16548/9) contain the LSB and MSB of the starting address of the resident Basic program. Locations &40F9 and &40FA (16633/4) contain the LSB and MSB of the last address of the resident program.

It is then a simple matter to print out the way that a program is stored. You must LPrint it because it is too long for the screen. Listing 1 will produce three columns of figures. The left-hand column will number the addresses starting at 1. The middle column will give the address in decimal of the location. The right-hand column will be a number between 0 and 255 which is the contents of the location. The whole series shows how the small program that you have typed in is recorded in memory from start to finish.

If you examine the right-hand column you will notice that the first four locations in the list form a data block which appears at the start of every line and contains the same relative information. When I ran the routine the first four numbers of each column were

1 27206 96
2 27207 106
3 27208 10
4 27209 0

The addresses in the middle column may not be the same with your printout.

The first two values in the right-hand column are the LSB and MSB of the address of the start of the next line. The address at the start of the next line contains the LSB followed by the MSB of the address of the start of the next line, and so on right through the program.

In this case the address of the start of the next line is

$$96 + (106 * 256)$$

which is 27232. The second pair of addresses in the data block contain the LSB and MSB of the current line number. So

$$10 + (256 * 0)$$

is the first line number, 10. Thus every line in a Basic program starts with a four-byte data block: the first two bytes point to the start of the next line and the second two bytes contain the line number.

Following the data block is the coding of the program line itself. You will know that the computer automatically puts a space between the line number and the beginning of the text of the line. This does not appear in the coding, though all other spacing appears as ASCII 32.

The first character in line 10 is A, ASCII 65, and the first value after the data block, the fifth byte, is 65. The sixth byte is 213, which is not quite so simple. All keywords are changed into a value above 127 known as a token and stored in the program as a single byte. The token for = is 213 as you can see in listing 1; the token for = is quite different from the character =, ASCII 61. Token 213 expresses the meaning or action of the character ASCII 61.

In fact, all the mathematical and relational signs when used in a program have tokens which are quite distinct from their ASCII characters. Following 213 in seventh position is 229, the token for Peek. ASCII 40, for the opening bracket, then follows. Values in programs are coded simply as the ASCII character for each of the digits, in this case 49, 54, 53, 52 and 56, followed by ASCII 41 for a closing bracket and ASCII 58 for a colon.

The second half of the line can similarly be read. But after the closing bracket, ASCII 41, which should be in byte 25 unless you have put an extra space somewhere, the 26th byte contains 0, which tells the machine that this is the end of the line.

You can then see how the five bytes which every program line requires are used: four for the leading data block and one for the terminal 0. Note that the 0 which the machine operating system uses for management purposes is different from the value stored in an address when it refers to a 0 used in the program text. In this case ASCII 48, character 0 is used.

At the end of the program listing the first two bytes of the last line point to where the next line, if one exists, should begin. But the machine places two zeros which indicate to the operating system that the listing has ended.

No doubt you know that the single quote, Shift-7, will substitute for a Rem and appears to be more economical in space. Yet if used at the start of a line, it uses three bytes whereas Rem needs only one. If used in the middle of a line, the single quote does include the colon which is needed before a Rem, but that still makes one byte more. If you put two extra lines into the program shown in listing 1, one with a single quote and one with Rem, and then run it you will see the difference in coding of the two forms. The single quote is coded by the machine as ASCII 58, the token for Rem, 147, and the token for single quote, 251. The Rem is coded as just 147. So if you have to be economy conscious and have remarks to make, always use Rem.

```
10 A=PEEK(16548):B=PEEK(16549)
15 'LSB & MSB OF STARTING ADDRESS
20 Y=PEEK(16633):Z=PEEK(16634)
25 'LSB & MSB OF END ADDRESS
30 S=A+(B*256):F=Y+(Z*256)
35 'S=STARTING ADD. F=END ADD.
40 FOR X=S TO F
50 C=C+1:LPRINT C,X,PEEK(X)
60 NEXT
```

Listing 1.

In Listing 1, Peek has been used to read the coding and in the same way Poke can be used to write or modify the coding if required. One simple use is where a changing value or values can be kept in the text of the program and available when the program is next loaded, whether by tape or disc.

For instance, it can be used to keep a record of the highest score so far achieved in a game, and I have used it in an invoicing program to carry forward the next invoice number. But one requirement is essential; the program must be Saved after each use.

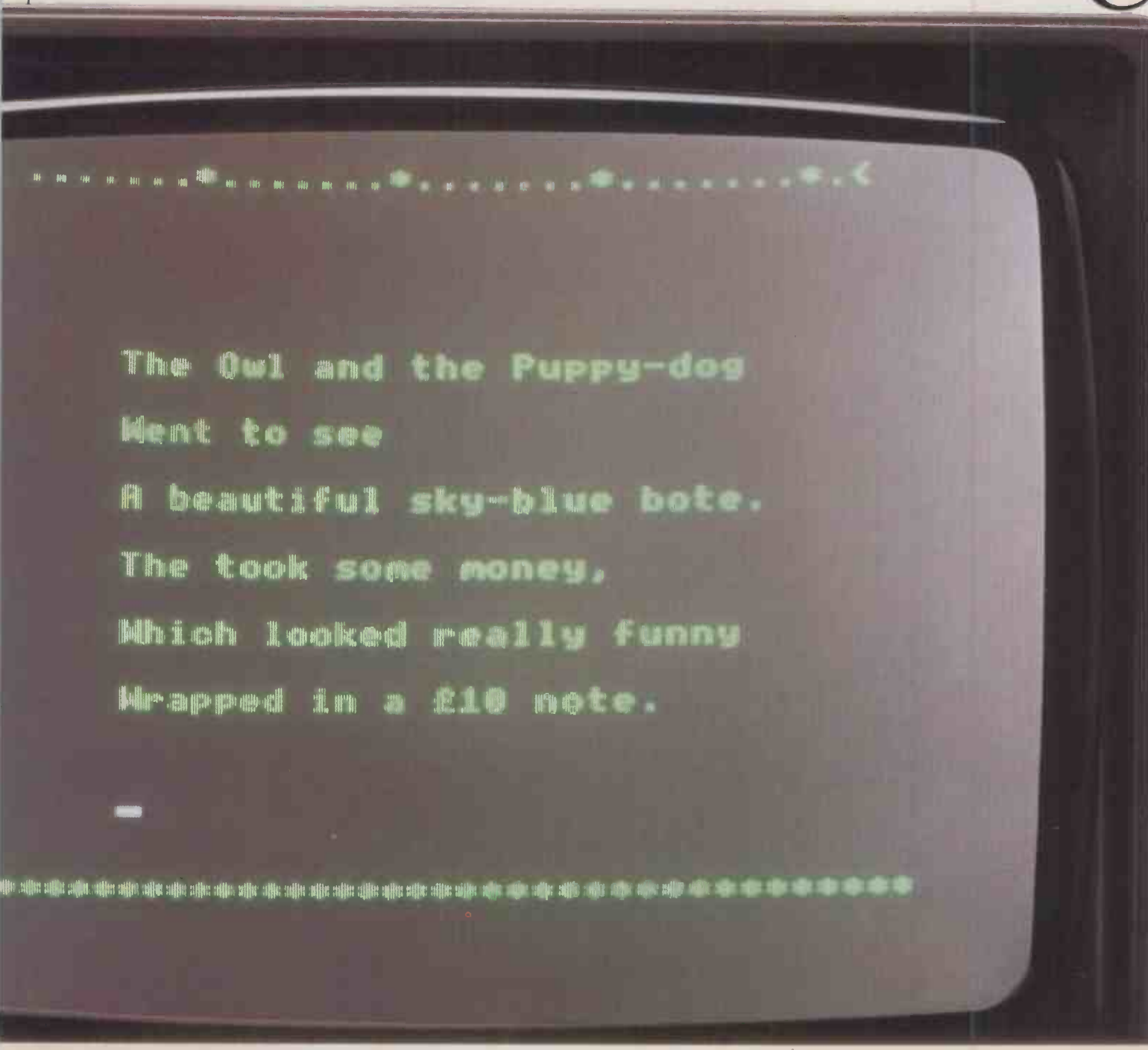
If you type in the program shown in listing 2 and run it, it will tell you that it has been run "1 times". Run it again and it will say that it has been run "2 times". Run it five times, Save it, then load it and run it and it will tell you that it has been run "6 times".

Line 10 is important for two reasons. First, as the program is written, it must be the first line, although its number is unimportant. It is where the number is held that matters: the program must know where to find it. It could be anywhere in the program but its position would have to be calculated and modified if the program was added to. So storing the number in the first line means that the position will not alter, whatever happens.

Secondly, sufficient space must be reserved in the line to hold the largest number that may be used. So this must be decided upon before the line is written. This

(continued on page 142)

How to become before committing



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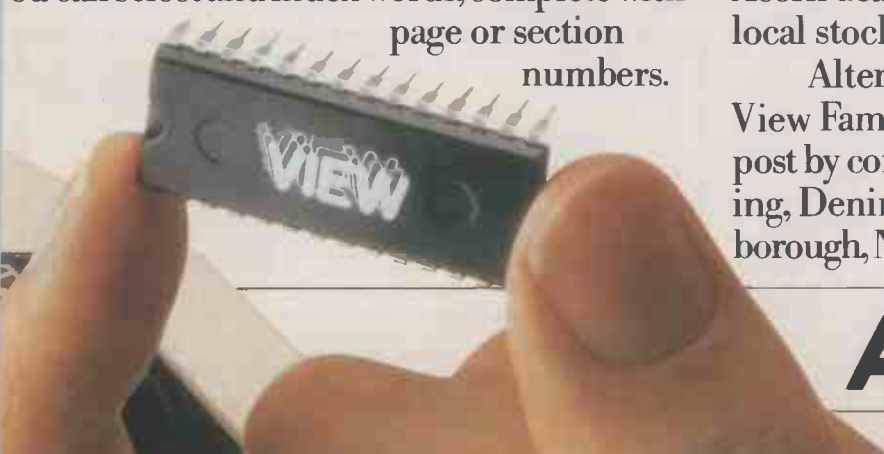

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The text on the screen is in Mode 6.

(continued from page 139)

can be up to 15 digits if you use a double-precision variable.

I needed three digits so I wrote the first line as

REM001

which reserved three spaces in that line until the program needed them. The Rem simply protects the three spaces from producing a syntax error.

Lines 20 and 30 locate the starting address of the program. Lines 40 to 60 Peek the sixth, seventh and eighth addresses of the program, convert the ASCII values to characters, concatenate them into a string Y$ and assign Val(Y$) to H, which gives you the first number. The main program would follow using H as required. This is represented by line 80.

Then you have to Poke the new number back into line 10. First, you change it to a string in line 90 as H$. Then you have to get rid of the usually invisible leading space in front of all numerical variables for the signature — that is, the + or −. This is done in line 100.

If the string is then less than three digits long, it is padded with leading zeros to make it that length. If you are going to use numbers larger that 999 then you must change the 3 in this line to your requirements.

The loop in lines 120 to 140 then strips the string H$ into its component characters and Pokes their ASCII values back into line 10. Again, if you are using larger numbers, you must alter the 3 in line 120. But remember that you must reserve the proper number of spaces in line 10. Its length is fixed and if you Poke more values into it than the locations already there, you will corrupt the next line and thus the whole program.

You may wonder why it is necessary to go through the string procedure; why not Peek the value out and then Poke the new value back? It would also take less room. The reason for this is that Basic will get very confused if it finds values less than 32 in the wrong place. It is these values that give special directions to Basic, and even a Rem will not always protect them. So I have found that it is safer to avoid Poking these values indiscriminately into programs and I rely on the slightly more cumbersome string routine.

In order to retain the value to be carried forward, you must not discard the program until you have Saved it. Unless you do this the value held in line 10 will be the same as it was the last time that it was Saved.

One final word; if you use this routine in a program, sooner or later, you will forget to Save it after use. So do not forget to include a routine to bring the number up to date in the program.

```
10 REM001
20 A=PEEK(16548):B=PEEK(16549)
30 S=A+B*256
40 FOR Y=1 TO 3
50 Y$=Y$+CHR$(PEEK(S+4+Y)
60 NEXT:
70 H=VAL(Y$)
80 PRINT"THIS PROGRAM HAS  BEEN
   USED "H;"TIMES":H=H+1
90 H$=STR$(H)
100 H$=RIGHT$(H$,LEN(H$)-1)
110 H$=STRING$(3-LEN(H$),"0")+H$
120 FOR X=1 TO 3
130 POKES+4+X,ASC(MID$(H$,X,1))
130 NEXT
```

Listing 2.

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• Circle No. 246

Geography quiz

THIS program for the Spectrum from Mike Coombes of Newport, Gwent is a good example for study by those who are interested in writing educational software. It is, in fact, a geography quiz, and the program is so clearly set out that you will be able to find your way round it with the greatest of ease.

```
  10 REM Geography Quiz
          by M.Coombes (7/83)
  20 LET hs=0: LET n$="": GO SUB
 9000
 100 REM
          #INTRODUCTION#
 110 BORDER 5: PAPER 7: CLS
 120 FOR f=1 TO 3: PRINT AT f,1;
 PAPER 1;"
                  ": NEXT f
 130 PRINT AT 2,9; INK 1; PAPER
 5;"GEOGRAPHY QUIZ"
 140 LET sc=0: GO SUB 8000
 170 PRINT AT 6,2;"The aim of th
 is program is";AT 7,2;"to help y
 ou to learn some";AT 8,2;"facts
 about world geography."
 180 PRINT AT 10,2;"I am going t
 o ask you ten";AT 11,2;"question
 s, and for each";AT 12,2;"questi
 on you will be given a";AT 13,2;
 "choice of answers."
 190 PRINT AT 15,2;"You must sel
 ect which you";AT 16,2;"think is
  the right answer";AT 17,2;"and
 type in the letter which";AT 18,
 2;"corresponds to that answer."
 200 GO SUB 8500
 210 GO SUB 8000
1000 REM
          #MAIN LOOP#
1005 LET sc=0
1010 FOR q=1 TO 10
1020 GO SUB 1000*INT ((RND*5)+1)
+1000
1030 NEXT q
1040 PRINT AT 6,2; INK 2;"THAT I
S THE END OF THE QUIZ"
1050 PRINT AT 8,4; INK 1;"You sc
ored ";sc;" out of 10"
1055 FOR f=1 TO 10: BEEP .1,10:
BEEP .1,20: NEXT f
1060 IF sc<=hs THEN GO TO 1200
1065 LET hs=sc
1070 PRINT AT 11,2; INK 2; PAPER
 6; FLASH 1;"CONGRATULATIONS!";
INK 2; PAPER 7; FLASH 0;AT 12,2;
"That is the highest";AT 13,2;"s
core so far!"
1080 INPUT INK 0; PAPER 7; BRIGH
T 1;"  PLEASE TYPE IN YOUR NAME.
..    "; PAPER 5; BRIGHT 0;"  ";
LINE n$
1081 IF n$="" THEN GO TO 1080
1085 IF LEN n$>24 THEN LET n$=n$
( TO 24)
1090 BEEP .1,1: GO SUB 8000: LET
 y=10: GO TO 1800
1205 PRINT AT 11,2;"The highest
score";AT 12,2;"so far is ";hs
1210 PRINT AT 14,2;"This score w
as reached";AT 15,2;"by ";n$
1220 LET y=18
1800 PRINT AT y,2; INK 1;"Would
 you like another quiz?";AT y+1,2
;"(Press Y or N)"
1810 IF INKEY$="y" THEN GO SUB 8
000: GO TO 1000
1820 IF INKEY$="n" THEN NEW
1830 GO TO 1810
2000 REM
          #TOPIC A#
2005 RESTORE 9110
2010 FOR f=1 TO (RND*16)+1: READ
 x$,y$: NEXT f
2030 LET res=9000: LET num=16
2040 GO SUB 7000
2080 PRINT AT 8,2; INK 2;"What i
s the capital city of";AT 9,2;x$
;"?"
2100 GO SUB 7090: RETURN
3000 REM
          #TOPIC B#
3010 RESTORE 9130
3020 FOR f=1 TO (RND*12)+1: READ
 x$,y$: NEXT f
3025 LET res=9130: LET num=12
3030 GO SUB 7000
3040 PRINT AT 8,2; INK 2;"What i
s the approximate";AT 9,2;"popul
ation of ";x$;"?"
3050 GO SUB 7090: RETURN
4000 REM
          #TOPIC C#
4010 RESTORE 9150
4020 FOR f=1 TO (RND*11)+1: READ
 x$,y$: NEXT f
4030 LET num=11: LET res=9150: G
O SUB 7000
4040 PRINT AT 8,2; INK 2;"What m
ajor river runs";AT 9,2;"through
";x$
4050 GO SUB 7090: RETURN
5000 REM
          #TOPIC D#
5010 RESTORE 9170
5020 PRINT AT 8,2; INK 2;"Which
of the following cities";AT 9,2;
"is situated on the coast?"
5030 FOR f=1 TO (RND*8)+1: READ
x$,y$,z$: NEXT f
5040 IF x$(LEN x$)="*" THEN LET
x$=x$( TO LEN x$-1): LET a$=x$:
GO TO 5070
5050 IF y$(LEN y$)="*" THEN LET
y$=y$( TO LEN y$-1): LET a$=y$:
GO TO 5070
5060 LET z$=z$( TO LEN z$-1): LE
T a$=z$
5070 PRINT AT 11,5; INK 1;"a)";x
$;AT 12,5;"b)";y$;AT 13,5;"c)";z
$
5080 IF INKEY$="a" THEN LET b$=x
$: GO TO 5110
5090 IF INKEY$="b" THEN LET b$=y
$: GO TO 5110
5100 IF INKEY$="c" THEN LET b$=z
$: GO TO 5110
5105 GO TO 5080
5110 FOR f=11 TO 13: PRINT AT f,
5;"                    ": NEXT f
5115 IF b$=a$ THEN GO SUB 8300:
RETURN
5120 GO SUB 8110: RETURN
```

(continued on page 146)

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   SPECIAL ATARI INTEGRATED CIRCUITS: GTIA for graphics display. Pokey for sound and controller ports. Antic for screen control and I/O (Input/Output).
   CPU: 6502C microprocessor - 0.50 microsecond cycle and a clock speed of 1.79 MHz.
   EXTENDED GRAPHICS FUNCTIONS: High resolution graphics. Multi-coloured character set. Software screen switching. Multiple redifined character sets. Player missile (sprite) graphics. Fine screen scrolling. Changeable colour registers. Smooth character movement. Simple colour animation facilities.
   PROGRAMMING FEATURES: Built in Atari Basic programming language supporting peek, poke and USR plus at least 8 other languages available. The help key will provide additional information and menu screens with certain software. Full on-screen editing is available as well as syntax checking on entry.
   INPUT/OUTPUT: External processor bus for expansion with memory and peripherals. Composite video monitor output. Peripheral port for direct connection to Atari standard peripherals. Software cartridge slot is included as well as 2 joystick controller ports.
   SOFTWARE: Over 1,500 items of software are available including self teaching programs with unique voice over. The range of programs includes Education, Home Management & Programming aids. There is also APX (Atari Program Exchange) and of course Atari's famous entertainment software now at only £9.95. In addition there is a host of support and help available from specialist Atari magazines like Antic and Analog and from over 75 Atari books/manuals.
2. **ATARI 800 48K COMPUTER - £69:** We have a limited number of the Mk1 model 800 computer with 48K. The price is £69 (as a games machine) or £99 with the Basic Programmer Kit (Basic cartridge & 2 manuals). Both come with a full 12 months guarantee.
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(continued from page 144)

```
6000 REM
        #TOPIC E#
6010 RESTORE 9200
6020 FOR f=1 TO (RND*7)+1: READ
x$,y$: NEXT f
6030 LET res=9200: LET num=11: G
O SUB 7000
6040 PRINT AT 8,2; INK 2;"In whi
ch city is";AT 9,2;x$;"?"
6050 GO SUB 7090: RETURN
7000 REM
  #CHOOSE QUESTION AND ANSWER#

7020 FOR f=1 TO 3
7022 RESTORE res
7025 FOR g=1 TO (RND*num)+1
7030 IF f=1 THEN READ z$,a$
7040 IF f=2 THEN READ z$,b$
7050 IF f=3 THEN READ z$,c$
7055 NEXT g
7060 NEXT f
7070 IF a$=b$ OR a$=c$ OR b$=c$
OR a$=y$ OR b$=y$ OR c$=y$ THEN
GO TO 7020
7072 LET r=INT (RND*4)+1
7073 IF r=1 THEN LET f$=y$: LET
g$=a$: LET h$=b$: LET i$=c$: GO
TO 7080
7074 IF r=2 THEN LET f$=a$: LET
g$=y$: LET h$=b$: LET i$=c$: GO
TO 7080
7075 IF r=3 THEN LET f$=a$: LET
g$=b$: LET h$=y$: LET i$=c$: GO
TO 7080
7076 LET f$=a$: LET g$=b$: LET h
$=c$: LET i$=y$
7080 RETURN
7090 PRINT AT 11,5; INK 1;"a)";f
$;AT 12,5;"b)";g$;AT 13,5;"c)";h
$;AT 14,5;"d)";i$
7500 GO TO 8040
8010 PRINT AT 4,1;"┌──────────────
──────────┐"
8020 FOR f=5 TO 20: PRINT "│
                          │": NE
XT f
8030 PRINT "└──────────────────
──────────┘"
8035 RETURN
8037 REM
        #INPUT ANSWER#

8040 LET j$=INKEY$
8050 IF j$<"a" OR j$>"d" THEN GO
 TO 8040
8055 FOR f=11 TO 14: PRINT AT f,
5;"                    ": NE
XT f
8060 IF j$="a" THEN LET z$=f$
8070 IF j$="b" THEN LET z$=g$
8080 IF j$="c" THEN LET z$=h$
8090 IF j$="d" THEN LET z$=i$
8100 IF z$=y$ THEN GO TO 8300
8110 REM
        #INCORRECT ANSWER#

8120 PRINT AT 11,2; INK 2;"NO!":
 BEEP 1,-10: PRINT INK 1;AT 13,2
;"The answer is ";y$: FOR f=0 TO
 -4 STEP -1: BEEP .1,f: BEEP .1,
f-1: BEEP .1,f-2: NEXT f
8130 GO TO 8330
8300 REM
        #CORRECT ANSWER#

8310 LET sc=sc+1
8320 PRINT AT 11,2; BRIGHT 1; IN
K 2; PAPER 7; FLASH 1;"YES!": FO
R h=1 TO 2: FOR f=10 TO 15: BEEP
 .05,f: NEXT f: BEEP .3,f: FOR g
=1 TO 5: NEXT g: BEEP .1,f-4: BE
EP .1,f: NEXT f: NEXT h: PRINT A
T 11,2; INK 2;"YES!";AT 13,2; IN
K 1;"That is correct"
8330 PRINT AT 16,2; INK 0;"Score
 so far:"; INK 1;sc;" out of ";q
8340 FOR f=1 TO 100: NEXT f: GO
SUB 8000: RETURN
8500 REM
        #WAIT FOR ANSWER#

8510 PRINT #0;TAB 6; INK 6; PAPE
R 2;"PLEASE PRESS ANY KEY"
8520 PAUSE 0: BEEP .1,1: BEEP .1
,6: BEEP .1,10: BEEP .1,1: INPUT
 "": RETURN
9000 REM
        #UDGs#

9010 FOR f=0 TO 7: POKE USR "a"+
f,128: POKE USR "b"+f,1: POKE US
R "c"+f,0: NEXT f: POKE USR "c",
255
9020 RETURN
9100 REM
        #DATA FOR QUESTIONS#

9110 REM A) Capital Cities

9120 DATA "France","Paris","Spai
n","Madrid","Italy","Rome","Grea
t Britain","London","Canada","Ot
tawa","Norway","Oslo","Sweden","
Stockholm","Switzerland","Berne"
,"Greece","Athens","Japan","Toky
o","Australia","Canberra","Austr
ia","Vienna","The United States"
,"Washington","China","Peking","
Portugal","Lisbon","Bulgaria","S
ofia"
9130 REM B) Population

9140 DATA "Australia","14,074,00
0","The USSR","262,442,000","Spa
in","36,351,000","Norway","4,042
,000","Great Britain","55,852,00
0","France","53,105,000","India"
,"625,018,000","Italy","56,446,0
00","Greece","9,284,000","The US
A","216,817,000","Switzerland","
6,327,000","Luxembourg","356,000
"
9150 REM C) Major Rivers

9160 DATA "London","Thames","Liv
erpool","Mersey","Newcastle","Ty
ne","Hull","Humber","Glasgow","C
lyde","Bristol","Avon","Southamp
ton","Itchen","Cardiff","Taff","
York","Ouse","Chester","Dee","Sw
ansea","Tawe"
9170 REM D) Coastal Towns

9180 DATA "Bristol","Cardiff*","
Gloucester","Naples*","Rome","Mi
lan","Norwich","Lincoln","Plymou
th*","Canberra","Elizabeth","Syd
ney*","Madrid","Alicante*","Gran
ada","Vancouver*","Montreal","Mi
nneapolis","Paris","Nice*","Toul
ouse","Dallas","Galveston*","Hou
ston"
9190 REM E) Land-Marks

9200 DATA "Nelson's Column","Lon
don","the Eiffel Tower","Paris",
"the Kremlin","Moscow","the Coll
eseum","Rome","the Leaning Tower
","Pisa","the Golden Gate Bridge
","San Fransisco","the Statue of
 Liberty","New York","","Los An
geles","","Bristol","","Venice
","","Madrid"
```

Moving averages

STEVE FARRELL of Berkhamsted offers a program to display the statistical tool of a moving average in tabular and graphical form. No knowledge at all is required to use the program to display a moving average trend. However, you do need to know a little about trends to correctly interpret the results.

It will calculate and display a moving average for any time period, automatically centring the average obtained for even periods.

The program as it stands uses mode 1 for the graph and accepts up to 30 data items. If more are required, change the screen mode in lines 540 and 1670, then adjust lines 50, 600 and 610 for the number of items required.

A grid can be superimposed or removed by pressing the Escape key. The vertical scaling is performed to the nearest relevant power of 10 to make the axis look more sensible. When you have drawn the graph, press any key other than N to restart.

```
    1  REM movavg by Steve Farrell c
1983
   10 *FX229,1
   20 *KEY10 OLD|M RUN|M
   40 ONERROR GOSUB1660
   50 DIMdata(32),av(32),sum(32),sum
1(32)
   60 DIMm$(4),n$(4)
   70 FORi%=1TO4:READm$(i%),n$(i%):N
EXT
   80 CLS
   90 REPEAT MODE7:max=0:min=0:k=0
  100 *FX225,240
  110 PROCdouble("MOVING AVERAGES",1
0,1,132,131)
  120 VDU28,0,24,39,4
  130 REPEAT CLS
  140 PRINT'''
  150 PRINT"Please enter the time pe
riod you        intend to plot:"
  160  FORi%=1TO4:PRINT'i%,CHR$(128+
i%);m$(i%):NEXT
  170 PRINT''''"Press 1,2,3 or 4 then
 ";CHR$134;"RETURN"
  180 FORi%=0TO32:data(i%)=0:av(i%)=
0:sum(i%)=0:sum1(i%)=0:NEXT
  190 PROCinput(1,4,31,17)
  200 IFq%=4THENINPUT'"Please specif
y: ";m$(4)
  210  t%=q%
  220 CLS
  230 IFq%=2THEN PRINT"The moving av
erage will be calculated"''''"    over
 a yearly cycle to eliminate "''"
    seasonal fluctuations:  "''CHR$1
33+"     Is this acceptable(y/n)?":
PROCyn(2,10):IFq%<3THENinvl%=4:GOTO2
80
  240 PRINT''"Please enter interval
 for calculating    the moving averag
e: (2 - 6)"
  250 v=VPOS
  260 PRINTTAB(5,v+1);CHR$133;:PROCi
nput(2,6,6,v+1)
  270 invl%=q%
  280 PRINT'"Time is the one variabl
e, what is the"''"other variable you
 are analysing over"''"time ";CHR$13
3;
  290 INPUT""la$
  300  CLS
  310  PRINT''"You have specified th
at you wish to "''"analyse "la$"  "m
$(t%)"."
  320 PRINT''"You wish to calculate a
 moving average "''"on a ";invl%" "m
$(t%)" basis."
  330 PRINT''CHR$133+"Is this all c
orrect (y/n)?";:PROCyn(1,15)
  340 UNTIL q%<3
  350 IFinvl%MOD 2=0THEN centr%=TRUE
 ELSE centr%=FALSE
  360  CLS
  370 PRINT'"You will now have to en
ter the data "''"for each period. Wh
en you have "''"finished press funct
ion key ";CHR$129;"f9"
  380 PRINT''"If you wish to make an
y changes you"''"must do this before
 you press return"
  390 PRINT'''"Press ";CHR$129;"f1";C
HR$135;" when you are ready to start
"
  400 REPEATq$=GET$
  410 UNTIL q$=CHR$241
  420 *FX225,1
  430 *KEY9 999999|M
  440 CLS:PRINTTAB(1,19);CHR$129;" P
ress f9 when you have finished "
  450 VDU28,0,23,39,0:PRINTTAB(0,4);
CHR$133;n$(t%);TAB(14)la$
  460 VDU28,0,20,39,5
  470 PROCinputdata
  480 IFcentr%THENPROCcentrdata ELSE
 PROCcalcdata
  490 CLS:VDU28,0,23,39,0:PRINTTAB(0
,4);CHR$133;n$(t%);TAB(14)la$;TAB(30
);"Trend":PRINTTAB(0,23);CHR$129;"To
 see more press M-to print graph G";
:PRINTTAB(12,12);" ":
  500 VDU28,0,20,39,5
  510 REPEAT q$=" "
  520 PROCprintdata
  530 UNTIL q$="g"ORq$="G"
  540 MODE1:PROCmax:PROCaxes:PROCgra
ph:PROCcentrtrend
  550 q$=GET$
  560 IFq$=CHR$27 THEN PROCescape:GO
TO550
  570 UNTILq$="N" ORq$="n"
  580 END
  590 DEFPROCinputdata
  600 FORi%=1 TO 31
  610 IFi%=31THEN data(i%)=999999:GO
TO640
  620 PRINTTAB(1);i%;
  630 INPUTTAB(14);data(i%)
  640 IF data(i%)=999999 THEN enddat
a=i%-1:i%=50:CLS:GOTO700
  650 IF data(i%)=0 THENv=VPOS:PROCe
rrcheck:IFq%>2THEN620
  660 IF data(i%)>max THEN max=data(
i%)
  670 IF data(i%)<min THEN min=data(
i%)
  680 IF i% < invl% THEN700
  690 FOR j%=i%+1-invl% TO i%:sum(i%
)=sum(i%)+data(j%):NEXT
  700 NEXT
  710 IFenddata<invl% THENVDU7;129;1
36;:PRINT"too little data":q$=GET$:R
UN
  720 ENDPROC
  730
  740 DEFPROCcalcdata
  750 FORi%=(invl%+1)/2 TO enddata-(
invl%-1)/2
  760 sum(i%)=sum(i%+(invl%-1)/2)
  770 av(i%)=sum(i%)/invl%
  780 NEXT
  790 ENDPROC
  800
  810 DEFPROCcentrdata
  820 FORi%=invl%+1 TO enddata
  830 sum1(i%)=sum(i%-1)+sum(i%)
  840 av(i%-(invl%/2))=sum1(i%)/(inv
l%*2)
  850 NEXT
  860 ENDPROC
  870 DEFPROCprintdata
  880 q$=""
  890 FORi%=1TOenddata
  900 IFav(i%)>1 THEN av(i%)= INT(av
(i%)*100)/100
  910 IF i%MOD10 =0THEN q$=GET$ ELSE
GOTO940
  920 IFq$="G"ORq$="g"THENi%=enddata
  930 IFq$<>"m"ANDq$<>"M"THEN910
  940 PRINTTAB(0);i%;TAB(14);data(i%
);TAB(30);av(i%)
  950 NEXT
  960 IFq$="g"ORq$="G"THEN970 ELSEq$
=GET$:CLS
  970 ENDPROC
  980 DEFPROCinput(a%,b%,c%,d%)
  990 REPEAT PRINTTAB(c%,d%)"    ":I
NPUTTAB(c%,d%)q%
 1000 IFq%<a%ORq%>b%THENVDU7;
 1010 UNTILq%<=b%ANDq%>=a%
 1020 ENDPROC
 1030 DEFPROCyn(a%,b%)
 1040 REPEAT q$=GET$
 1050 q%=INSTR("YyNn",q$)
 1060 IFq%=0THENVDU7:PRINTTAB(a%,b%)
"Only press ";CHR$133;"y  ";CHR$155;
"or ";CHR$133;"n ";
 1070 UNTILq%>0
 1080 ENDPROC
 1090 DEFPROCerrcheck
 1100 PRINTCHR$133;"Are you sure abo
ut this item ";:PROCyn(1,v+1)
 1110 ENDPROC
 1120 DEFPROCdouble(a$,a%,b%,c%,d%)
 1130 PRINTCHR$c%;CHR$(157);TAB(a%,b
%);CHR$141;CHR$d%;a$
 1140 PRINTCHR$c%;CHR$(157);TAB(a%,b
%+1);CHR$141;CHR$d%;a$
 1150 ENDPROC
 1160 DATAmonthly,month,quarterly,qu
arter,yearly,year,other,period
 1170 DEFPROCaxes
 1180 COLOUR1
 1190 CLS
 1200 PRINT TAB(39-LEN(n$(t%)),31);n
$(t%);
 1210 VDU29,200;34;
 1220 MOVE0,0
 1230 DRAW1250,0:MOVE0,0:DRAW0,1000
 1240 COLOUR2:PRINTTAB(10,0);invl%"
"m$(t%)" moving average"
 1250 sc=1000/scale0:IFsc>1THENsc=IN
T(sc+0.5)
 1260 VDU5:MOVE-200,990:PRINTSTR$(sc
)
 1270 MOVE-200,500:PRINTSTR$(sc/2)
 1280 MOVE-34,0:PRINT"0":VDU4
 1290 COLOUR1:PRINTTAB(0,4);la$
 1300 VDU5:FORi=enddata/2TO enddata
STEP enddata/2:MOVEi*scale2,0:PRINTS
TR$(i):NEXT:VDU4
 1310 ENDPROC
 1320 DEFPROCgraph
 1330 GCOL0,3
 1340  MOVE1*scale2+k,data(1)*scale0
 1350 FORi%=2TOenddata
 1360 DRAWi%*scale2+k,data(i%)*scale
```

(continued on next page)

Galaxy

Michael Durrant of Blandford, Dorset has submitted a program to simulate the spinning of a spiral galaxy such as our own. The program is quite short and makes extensive use of the VDU19 command.

The program consists of four main procedures

ProcVariables — Set up variables
ProcDraws — draw galaxy (calling Arm)
ProcSpin — spin the galaxy (VDU19)
ProcArm — draw out a spiral arm

The main drawback of this kind of program is the time that it takes to draw the initial picture. However, for disc owners there is a way around this. Put in line 345

*SAVE GSCREEN 3000 8000

this will save the whole of the mode 2 screen to disc. Now the lines 80 to 150, 300 to 440 and 35 can be removed and replaced by line 30

*LOAD GSCREEN.

This will load the complete pattern in a few seconds.

The technique for disc users can be used with many programs that use loops with VDU19 to simulate spinning but which have patterns that take a long time to draw out.

(continued from previous page)

```
0
 1370 NEXT
 1380 ENDPROC
 1390 DEFPROCcentrtrend
 1400 GCOL0,2
 1410 i%=0
 1420 REPEAT i%=i%+1:UNTIL av(i%)>0
 1430 MOVEi%*scale2+k,av(i%)*scale0
 1440 j%=i%-1
 1450 REPEAT j%=j%+1
 1460 DRAW j%*scale2+k,av(j%)*scale0
 1470 UNTILav(j%+1)=0
 1480 ENDPROC
 1490 DEFPROCmax
 1500 scale=1000/max
 1510 i= .000001:REPEAT i=i*10 :scal
e0=i/10:UNTILi>=scale
 1520 scale1=1000/enddata
 1530 i= .000001:REPEAT i=i*10 :scal
e2=i/10:UNTILi>=scale1
 1540 REPEAT
 1550 IFenddata<(1000/scale2)/2THENs
cale2=scale2*2
 1560 UNTILenddata>=(1000/scale2)/2
 1570 ENDPROC
 1580 DEFPROCgrid
 1590 FORk%=100 TO 1000 STEP100
 1600 PLOT4,k%,0:PLOT22,k%,1000
 1610 NEXT
 1620 FORk%=100 TO 1000 STEP100
 1630 PLOT4,0,k%:PLOT22,1000,k%
 1640 NEXT
 1650 ENDPROC
 1660 DEFPROCescape
 1670 IF?&355=1THENPROCgrid
 1680 ENDPROC
```

Galaxy.

```
   10  PROCVariables
   20  MODE2
   25  :
   30  PROCDraw
   35  *LOAD GSCREEN/3000 8000
   40  PROCSpin
   50  END
   60  DEFPROCDraw
   70  VDU23;8202;0;0;0;
   80  FORArms=0TO2.9STEP(3.1/15)
   90  Colour%=Colour%+1
  100  PROCARM(MiddleX%,MiddleY%,XFa
ctor%,YFactor%,Arms,Arms+6.6,Step,Co
lour%)
  110  PROCARM(MiddleX%,MiddleY%,XFa
ctor%,YFactor%,Arms+3,Arms+9.6,Step,
Colour%)
  120  NEXTArms
  130  ENDPROC
  140  :
  150  DEFPROCSpin
  160  L%=1
  170  REPEAT
  180  VDU19,((L%-2)MOD15)+1,4;0;
  190  VDU19,((L%-1)MOD15)+1,1;0;
  200  VDU19,(L%MOD15)+1,7;0;
  210  A$=INKEY$(9)
  220  VDU19,((L%-2)MOD15)+1,0;0;
  230  VDU19,((L%-1)MOD15)+1,0;0;
  240  VDU19,(L%MOD15)+1,0;0;
  250  L%=L%+1
  260  UNTIL FALSE
  270  END
  280  REM DRAW A SPIRAL ARM
  290  DEFPROCARM(MX%,MY%,XF%,YF%,SA
,EA,ST,C%)
  300  GCOL0,C%
  310  FORN=SA TOEA STEPST
  320  PLOT69,MX%+SIN(N)*XF%,MY%+COS
(N)*YF%
  330  XF%=XF%-6+(RND(1)/2):YF%=YF%-
6+(RND(1)/2)
  340  NEXT
  350  ENDPROC
  360  :
  114  DEFPROCVariables
  380  MiddleX%=640:MiddleY%=512
  390  XFactor%=400:YFactor%=400
  400  Step=.1
  410  Colour%=0
  420  ENDPROC
```

Epson screen dump

Wouter Kolkman of Holland has sent in a screen dump for Epson printers using modes 0 and 4. Screen dump mode 4 uses the FX-80 Plotter mode of 576 dots per line to obtain a realistic print. If his option is not available then Esc-K may be used.

Screen dump mode 0 gives large prints with little effort. To increase the BBC's resolution of 640 by 356 pixels, the pixels in the Y direction are printed twice.

So the printer has to be capable of printing at least 512 dots per line. If 480 dots per line is used Y is restricted to a maximum of 960 in the picture.

They are both set in a test-bed of a picture which resides on lines 80 to 280. The dumping routine is on lines 300 to 420 and 440 to 560. The procedure mode 0 is the same as mode 4 with modifications for screen memory to be read.

Epson screen dump.

```
   10 REM Program by Wouter Kolkman
   20 REM Screendump procedures for
the
   30 REM BBC model B
   40 REM for the two colour modes 0
 and 4
   50 REM supplied with an example u
sing them
   60  FOR N=0 TO 1
   70    IF N=0 THEN MODE4 ELSE MODE
0
   80    FOR X%=40 TO 1240 STEP 30
   90      MOVE 640,800
  100      DRAW X%,0
  110      NEXT
  120 PROCMOON
  125 IF N=0 PROCWINDOW:REM The cond
ition is unnecessary if the printer
graphics mode has over 502 dots/line
  130    T=TIME
  135    IF N=0 THEN PROCSCREENDUM4
ELSEPROCSCREENDUM0
  140 VDU2:PRINT''"PRINTINGTIME ";(T
IME-T)/100;" SECS":VDU3
  150    NEXT N
  160  END
  170 DEFPROCMOON
  180  LOCAL R%,R,PHI
  190  R%=60
  200  MOVE 950,900-R%
  210  FOR PHI=-PI/2 TO PI/2+.01 STE
P PI/30
  220    DRAW 950+R%*COS(PHI),900+R%
*SIN(PHI)
  230    NEXT
  240  R=30*SQR(5)
  250  FOR PHI=ATN(2) TO -ATN(2) STE
P -PI/30
  260    DRAW 920+R*COS(PHI),900+R*S
IN(PHI)
  270    NEXT
  275  MOVE0,0
  280  ENDPROC
  290  REM Screendump procedure MODE
 4
  300  DEFPROCSCREENDUM4
  310  LOCALX%,Y%,Z%,M%
  320 VDU2
  330  VDU1,27,1,ASC"1",1,10;0;
  340  FOR Z%=0 TO 312 STEP 8
  350 VDU1,27,1,ASC"*",1,5,1,256,1,1
;:REM If you don't use an EPSON FX-8
0 then replace  ASC"*",1,5 by ASC"K"
  360    FOR Y%=9920 TO 0 STEP -320
  370      M%=&5800+Y%+Z%
  380      FOR X%=7 TO 0 STEP -1
  390        VDU1,M%?X%
  400        NEXT:NEXT:VDU1,10;0;
  410    NEXT:VDU1,27,1,ASC"@";0;:VD
U3
  420  ENDPROC
  430  REM Screendump procedure MODE
0
  440  DEFPROCSCREENDUM0
  450  LOCALX%,Y%,Z%,M%
  460 VDU2
  470  VDU1,27,1,ASC"1",1,10;0;
  480  FOR Z%=-320 TO 312 STEP 8
  490 VDU1,27,1,ASC"*",1,5,1,0,1,2;:
REM If you don't use an EPSON FX-80
then replace  ASC"*",1,5 by ASC"K" a
nd keep in mind that the max Y-value
 in the picture is 960!
  500    FOR Y%=9920 TO -9920 STEP -
640
  510      M%=&5800+Y%+Z%
  520      FOR X%=7 TO 0 STEP -1
  530        VDU1,M%?X%,1,M%?X%
  540        NEXT:NEXT:VDU1,10;0;
  550    NEXT:VDU1,27,1,ASC"@";0;:VD
U3
  560  ENDPROC
  570 DEFPROCWINDOW
  580 PRINT''"TOP LEFT"
  590  DRAW 1279,0:DRAW1279,1023
  600  DRAW0,1023:DRAW0,0
  610  ENDPROC
```

Saving numeric arrays

Arrmake.

```
10  REM
ARRMAKE

100  REM PROGRAM TO CREATE THE
110  REM FILE 'ARR.OBJ' USED BY
120  REM THE BINARY SAVER/LOADER
130  REM SEE 'ARRTEST'

140  REM BY JOHN CAYLEY, 1984

150 D$ =  CHR$ (4)
160  HOME : INVERSE : PRINT  TAB( 15)"ARRMAKE" TAB( 41): NORMAL
170  PRINT : PRINT "THIS PROGRAM POKES THE INTRINSICALLY    RELOCATEABLE C
     ODE USED BY THE ARRAY     SAVING/LOADING ROUTINES INTO THE FREE"
180  PRINT "SPACE AT $300 AND THEN SAVES THE CODE   IN A FILE CALLED ";:
   INVERSE : PRINT "ARR.OBJ";: NORMAL : PRINT "."
190  PRINT : PRINT "PRESS ANY KEY OR A)BORT: ";: GET A$: IF A$ = "A" THEN
     230
200  GOSUB 1000
210  PRINT : PRINT D$"BSAVE ARR.OBJ,A$300,L202"
220  PRINT : PRINT "FILE CREATED"
230  END
1000  REM

POKE CODE $300 - $3C8


1010  FOR I = 768 TO 968
1020  READ CD: POKE I,CD
1030  NEXT
1040  RETURN
1100  REM

OBJECT CODE DATA

1110  DATA  160,0,177,24,197,26,208,8,200,177
1120  DATA  24,197,27,208,1,96,24,160,2,177
1130  DATA  24,101,24,72,200,177,24,101,25,133
1140  DATA  25,104,133,24,165,109,197,24,208,216
1150  DATA  165,110,197,25,208,210,169,0,133,24
1160  DATA  133,25,96,177,24,240,23,162,5,177
1170  DATA  24,145,26,230,24,208,2,230,25,230
1180  DATA  26,208,2,230,27,202,240,40,208,235
1190  DATA  145,26,230,26,208,2,230,27,24,165
1200  DATA  24,105,5,133,24,144,2,230,25,56
1210  DATA  165,30,233,4,133,30,176,2,198,31
1220  DATA  160,0,8,104,9,64,72,40,165,24
1230  DATA  197,28,208,7,165,25,197,29,208,1
1240  DATA  96,112,176,177,24,208,176,230,24,208
1250  DATA  2,230,25,162,5,169,0,145,26,230

1260  DATA  26,208,2,230,27,202,208,245,240,214
1270  DATA  160,0,184,177,26,145,24,165,26,197
1280  DATA  30,208,6,165,27,197,31,240,210,198
1290  DATA  24,165,24,201,255,208,2,198,25,198
1300  DATA  26,165,26,201,255,208,2,198,27,80
1310  DATA  218
```

Arrtest.

```
10  REM
ARRTEST

100  REM SAVING/LOADING NUMERIC
110  REM ARRAYS AS BINARY FILES

120  REM ROUTINES TO BE USED BY
130  REM APPLESOFT PROGRAMS
140  REM RUNNING UNDER DOS 3.3

150  REM BY JOHN CAYLEY, 1984

160  REM NB. THE FILE 'ARR.OBJ'
170  REM MUST BE PRESENT ON DISK

180  HOME : PRINT : PRINT  CHR$ (4)"BLOAD ARR.OBJ,D1"
190  REM FILE LOADS TO $300
200  REM BUT IS INTRINSICALLY
210  REM RELOCATEABLE
```

(listing continued on page 151)

JOHN CAYLEY of Durham has sent in some routines which allow you to save numeric arrays, both integer and real, in binary files. The routines are for use in Applesoft programs running under DOS 3.3. They are very fast and use disc space economically.

Even with discs, saving large arrays can take an inordinate amount of time if you employ the usual Basic/DOS expedient of opening text files and then Printing from within nested loops. Reading such files takes just as long.

If you have settled on the size and structure of a large array in a particular application, it should be possible to save it straight to disc as a binary file by copying an image of its representation in memory. This would be much faster than the Basic method. Unfortunately, in the case of large real arrays it would also use a lot of disc space because every number takes up five bytes in real representation.

By contrast, Applesoft crunches the values it sends to text files so that, for example, the value 1 is stored in two bytes, the ASCII values of 1 and Return. The routines give you the speed of the original idea and also deal with the problem of disc space.

Many arrays in applications are sparse, in that they contain unused elements or a lot of zeros. Such arrays can be found, squeezed and then saved to disc as a binary image. The process ceases to have any disadvantages. Arrays that are solidly filled will, on average, take just as much space in text form as in binary; for instance 235.78 would take up seven bytes of text.

To use the routines the first thing you must do is type in and run the program Arrmake which will create an object file containing the machine-code module you need to integrate with your own programs. The code treated is relocateable, which means it can be loaded anywhere in memory. However, it does fit nicely into the free space on page $300.

The code has three entry points. The first one should correspond to the address at which the code was loaded. If you look at the program Arrtest, you will see that they can all be assigned to variables and that the other entry points can be expressed relative to the first. But you have to make sure that the relationships are right and that the first variable, Find, points to the address where the code was loaded.

Type in the program Arrtest and watch the routines in action. The program will also allow you to make comparisons with Basic doing the same job. The routine itself is contained in Arrtest as the subroutine from lines 1000 to 1300. Certain variables used by the subroutine must be pre-declared by assigning a value before the routine is called. *(continued on page 151)*

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(listing continued from page 149)

```
220 AK = 0:BK = 0:CK = 0:AD = 0:LN = 0:LK = 0:PK = 0:LC = 0:IT = 0:P% = 0
230 DO$ =  CHR$ (4)
240 FIND = 768:SQEZE = FIND + 110:SHUNT = SQEZE + 50
250  REM ENTRY P'NTS: ALTER FIND
260  REM TO ADDRESS OF ARR.OBJ

270  REM ALL THE ABOVE VARIABLES
280  REM MUST BE PRE-DECLARED IN
290  REM ANY PROGRAM USING THESE
300  REM ROUTINES !!!!!

310  DIM TEST(19,19),TEST%(19,19)
320  REM
330  REM ARRAYS DIM'ED FOR TEST
340  REM HARNESS

350  REM

TEST HARNESS

360  HOME : INVERSE : PRINT  TAB( 15)"ARRTEST" TAB( 41): NORMAL
370  PRINT : PRINT "TYPE THE ARRAY'S NAME INCLUDING THE '%' IF IT CONTAINS
      INTEGERS."
380  PRINT "ONLY 'TEST' AND 'TEST%' (BOTH 19,19) AREDIM'ED IN THIS PROGRAM
    ; BUT YOU MAY LIKETO SEE WHAT HAPPENS IF YOU TYPE THE NAMEOF AN UNKNO
    WN ARRAY."
390  INPUT "> ";A$:F$ = A$
400  PRINT : INPUT "LOAD (0) OR SAVE (1)? ";CK
410  IF  NOT CK THEN 480
420  PRINT : INPUT "TYPE A NUMERIC VALUE WITH WHICH TO PART-IALLY FILL THE
      TEST ARRAY: ";AK
430  PRINT : PRINT "FILLING EVERY 2ND ELEMENT WITH: ";AK
440  FOR I = Z TO 19: FOR J = Z TO 19 STEP 2
450  IF  RIGHT$ (A$,1) = "%" THEN TEST%(I,J) = AK: GOTO 470
460 TEST(I,J) = AK
470  NEXT : NEXT
480  PRINT : PRINT "NOW ATTEMPTING TO ";
490  IF CK THEN  PRINT "SAVE ";
500  IF  NOT CK THEN  PRINT "LOAD ";
510  PRINT "THE ARRAY": PRINT "USING THE ROUTINE..."
520  GOSUB 1000: IF  NOT AK THEN 580
530  IF CK THEN  PRINT : PRINT "COMPARE THE TIME TAKEN FOR THE SAME      TH
     ING IN BASIC ONLY...": GOSUB 2000: GOTO 580
540  PRINT : PRINT "AFTER USING THE ROUTINE TO LOAD, HERE ISA DISPLAY OF S
     ELECTED VARIABLES FROM THETWO TEST ARRAYS TO PROVE THAT THE VALUESHAV
     E BEEN LOADED."
550  PRINT : PRINT "RECALL THAT A 'CLEAR' IS DONE AFTER      EVERY LOAD OR
     SAVE IN THIS TEST PROGRAM"
560  PRINT : INPUT "WHICH ROW? ";R
570  PRINT : PRINT "COL.","TEST","TEST%": PRINT : FOR J = Z TO 19: PRINT J
     ")",TEST(R,J),TEST%(R,J): NEXT : PRINT
580  HTAB 1: VTAB 24: PRINT "PRESS ANY KEY OR A)BORT: ";: GET A$: IF A$ =
     "A" THEN  END
590  CLEAR : GOTO 190
600  REM


1000  REM

SAVE/LOAD NUM. ARRAYS

1010 AK =  ASC (A$):LN =  LEN (A$):AD =  ASC ( RIGHT$ (A$,1)):IT = 0
1020  IF LN < 2 OR (LN = 2 AND AD = 37) THEN BK = 0: GOTO 1040
1030 BK =  ASC ( MID$ (A$,2))
1040  IF AD = 37 THEN AK = AK + 128:BK = BK + 128:IT = 1
1050  POKE 24, PEEK (107): POKE 25, PEEK (108): POKE 26,AK: POKE 27,BK
1060  CALL FIND:AK =  PEEK (24) + 256 *  PEEK (25)
1070  IF  NOT AK THEN  PRINT : PRINT  CHR$ (7)"ARRAY NAME NOT FOUND!":
      RETURN
1080 BK =  PEEK (AK + 4):BK = 5 + 2 * BK:AD = AK + BK
1090  IF  NOT CK AND IT THEN 1280
1100 LK =  PEEK (AK + 2) + 256 *  PEEK (AK + 3):LN = LK - BK
1110  IF IT THEN 1290
1120  REM

SAVE REAL ARRAY

1130 PK = AK + LK:LC = 28: GOSUB 1300
1140  IF  NOT CK THEN 1210
1150 PK = AD:LC = 24: GOSUB 1300
1160 PK = AD:LC = 26: GOSUB 1300
1170 PK = LN:LC = 30: GOSUB 1300
1180  CALL SQEZE:LN =  PEEK (30) + 256 *  PEEK (31)
1190  GOSUB 1290:PK = AD + LN - 1:LC = 26: GOSUB 1300: GOTO 1250: REM VALU
     ES LEFT INTACT
1200  REM
```

(listing continued on page 154)

(continued from page 149)

In particular, three variables are used to pass parameters to the load/saving routine. The first, A$, must be set to the name — including the % if it contains integers — of the array you wish to save or load. The array must have been previously Dimensioned or it will not be found. For example to save the array

SCORES(5,20)

set

A$ = "SCORES"

Similarly, setting

A$ = "GL%"

would save the array GL%(15,15). You do not include the part in parenthesis in the name.

The second variable, F$, should contain a file name under which the figures will be saved on disc. In Arrtest F$ and A$ are set to the same. Finally, the third array, CK, should be assigned the value 1 to save, or 0 to load the array. Once you have coded the routine, saving or loading any numeric array becomes a simple matter of setting these variables and performing a Gosub. You do not have to write all the DOS commands and tailored nested loops for each array you want to save.

Once you have passed appropriate parameters for a save the routine first Pokes values for the array's name into the user's zero page and the Find routine is called. This either returns with the start address of the array or issues the message "Array not found."

Once you have got the address, calculations based on information supplied in the *Applesoft Manual*, page 137, will give you the length of the array in memory and the start address of the data itself. If the array contains integers the data is BSaved. Otherwise, Sqeze is called, compressing the array before saving. After the save is complete the array is re-expanded so that values accessed will be correct.

Loading uses Find to decide where to put the file requested and then BLoads it if it is an integer array, or shunts and expands the array after loading it from disc.

To integrate the routines with your own programs, either ensure that the file created by Arrmake is on disc and BLoad it where required, or merge the code-Poking subroutine of Arrmake with your program and Gosub to it before calling the load/saving routine. You will also have to merge the load/saving subroutine of Arrtest with your program.

The most important thing to note is that variables used within the load/saving subroutine should be pre-declared in the initialisation phase of your program. This is because Applesoft moves all arrays and string pointers when simple variables are given a value for the first time. For example, if AD were given a value for the first time after finding the array but before saving it, the addresses for the BSave would be wrong.

Once saved any program containing

(continued on page 154)

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152

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153

(listing continued from page 151)

```
LOAD REAL ARRAY


1210  GOSUB 1280
1220 PK = AD + ( PEEK (43616) + 256 *  PEEK (43617)) - 1:LC = 26: GOSUB 13
     00
1230  REM THE ABOVE LINE IS 48K


1240  REM AND DOS 3.3 SPECIFIC
1250 PK = AK + LK - 1:LC = 24: GOSUB 1300
1260 PK = AD:LC = 30: GOSUB 1300
1270  CALL SHUNT: RETURN
1280  PRINT D0$"BLOAD"F$",A"AD: RETURN
1290  PRINT D0$"BSAVE"F$",A"AD",L"LN: RETURN
1300 P% = PK / 256: POKE LC,PK - P% * 256: POKE LC + 1,P%: RETURN
2000  REM


SAVE IN BASIC ONLY

2010 F2$ = F$ + ".BA"
2020  PRINT D0$"OPEN"F2$: PRINT D0$"WRITE"F2$
2030  IF IT THEN 2070
2040  FOR I = Z TO 19: FOR J = Z TO 19: PRINT TEST(I,J);: NEXT : NEXT
2050  PRINT D0$"CLOSE"F2$
2060  RETURN
2070  FOR I = Z TO 19: FOR J = Z TO 19: PRINT TEST%(I,J): NEXT : NEXT
2080  GOTO 2050
```

(continued from page 151)

these routines which has a real or integer array of exactly the same size and structure as the original may be loaded with the saved values, regardless of the name of the array. The routines are ideal for a suite of programs using the same data sets. However, loading a file saved from an array of different size or structure could have fatal or, at least, very confusing results.

The squeezing and expanding of the array is done within the data space of the array in memory. No extra memory is required or used in these operations apart from the 201 bytes used by the machine code.

One of the lines in the load/saving subroutine — line 1220 in Arrtest — is specific both to DOS 3.3 and to a 48K system. The locations 43616/7 contain the length of the most recently BLoaded file. This address was obtained from the *DOS Manual,* page 144 in the section on DOS entry points, where there is also a program to find the corresponding locations on a system of any size.

Basic changer

This program from Roni Dar-Ziv allows you to temporarily change Apple's Basic keywords, prompt character and bell tone. As a utility it may not be very useful but it encourages you to change ROM routines to your needs.

Making the ROM addressable is done by a monitor routine in line 2 which shows how to enter monitor commands via Basic. The program does not allow you to shorten Basic keywords, although this can be done with some annoying side effects.

Basic changer.

```
0  TEXT : HOME : HTAB 18: VTAB 12
     : PRINT "WAIT"
1  POKE 1013,4 * 16 + 12: POKE 10
     14,16 + 7: POKE 1015,3
2 A$ = "2000<D000.FFFFMD000<2000.
     4FFFMC08BMD000<2000.4FFFMD9C
     6G": FOR L = 512 TO 511 +  LEN
     (A$): POKE L, ASC ( MID$ (A$
     ,L - 511,1)) + 128: NEXT : CALL
      - 144
10 A1 = 53456:A2 = 53854: DIM C$(
     106),ADR(106),F$(106)
20  FOR I = A1 TO A2:W$ = W$ +  CHR$
     ( PEEK (I)): IF  PEEK (I) >
     128 THEN C$(C) = W$:C = C +
     1:W$ = ""
30  NEXT
39 C = 0
40  FOR I = A1 - 3 TO A2 - 4
50  IF  PEEK (I) > 128 THEN ADR(C
     ) = I + 1:C = C + 1
60  NEXT
90  FOR I = 0 TO 106:F$(I) = C$(I
     ): NEXT
95  TEXT : HOME : INVERSE : PRINT
      SPC( 2);"BASIC CHANGER-BY G
     ANDALF SOFTW@RE (C) "
97  NORMAL
100  PRINT : PRINT : PRINT  TAB(
     5);"OPTIONS ARE:": PRINT : PRINT
      TAB( 5);"L)IST COMMANDS": PRINT
      TAB( 5);"C)HANGE COMMAND": PRINT
      TAB( 5);"Q)UIT": PRINT  TAB(
     5);"S)AVE COMMANDS": PRINT  TAB(
     5);"T)INKER (WITH) BELL"
101  PRINT  TAB( 5)"P)ROMPT CHANG
     ES..."
110  GET K$: IF K$ <  > "S" AND K
     $ <  > "C" AND K$ <  > "Q" AND
     K$ <  > "L" AND K$ <  > "T" AND
     K$ <  > "P" THEN 95
120  IF K$ = "L" THEN 200
130  IF K$ = "C" THEN 300
140  IF K$ = "Q" THEN  TEXT : HOME
     : PRINT "GOOD BYE...": END
150  IF K$ = "S" THEN 500
160  IF K$ = "T" THEN V = 0: GOTO
     600
170  IF K$ = "P" THEN 700
200  TEXT : HOME
210 H = 1:C = 0
220  FOR I = 1 TO 5
230  FOR J = 1 TO 20: HTAB H: VTAB
     J: PRINT F$(C);: HTAB H + 8:
      PRINT "=";: HTAB H + 16: PRINT
     C$(C):C = C + 1: NEXT J
240  VTAB 23: PRINT "PRESS [CR] T
     O CONTINUE": GET K$: TEXT
245 C = 100: TEXT : HOME
250  FOR J = 1 TO 7: HTAB H: VTAB
     J: PRINT F$(C);: HTAB H + 8:
      PRINT "=";: HTAB H + 16: PRINT
     C$(C):C = C + 1: NEXT J
260  VTAB 23: PRINT "PRESS [CR] T
     O CONTINUE:";: GET K$: GOTO
     95
300  TEXT : HOME : PRINT : PRINT
     : INPUT "ENTER COMMAND TO CH
     ANGE:";W$
310  IF W$ = "" THEN 95
320 S$ =  LEFT$ (W$, LEN (W$) - 1
     ) +  CHR$ (128 +  ASC ( RIGHT$
     (W$,1)))
330  FOR I = 0 TO 106: IF C$(I) =
     S$ THEN WA = I: GOTO 350
340  NEXT : PRINT : PRINT S$;" WA
     S NOT FOUND.": GOTO 1000
350  PRINT : PRINT S$;" WAS FOUND
     .": PRINT : INPUT "ENTER NEW
      COMMAND:";N$: IF N$ = "" THEN
     95
360  IF  LEN (N$) >  LEN (S$) THEN
      PRINT : PRINT "COMMAND TOO
     BIG.": GOTO 1000
370  IF  LEN (N$) <  LEN (S$) THEN
      PRINT : PRINT "COMMAND TOO
     SMALL.": GOTO 1000
380 H$ =  LEFT$ (N$, LEN (N$) - 1
     ) +  CHR$ (128 +  ASC ( RIGHT$
     (N$,1)))
389 C = 1
390  FOR I = ADR(WA) TO ADR(WA) +
      LEN (H$) - 1: POKE I, ASC (
      MID$ (H$,C,1)):C = C + 1: NEXT

400 C$(WA) = H$: PRINT : PRINT "C
     OMMAND CHANGED."
410  GOTO 1000
500  TEXT : HOME : PRINT "INSERT
     DISK IN DRV 1": PRINT : INPUT
     "NAME:";FL$: IF FL$ = "" THEN
     100
510  PRINT  CHR$ (13) +  CHR$ (4)
     ;"BSAVE";FL$;",A$DODO,L$18F"

520  GOTO 1000
600  TEXT : HOME : FOR I = 1 TO 4
     0 STEP 2: HTAB I: VTAB 10: PRINT
      CHR$ (65 + V):V = V + 1: NEXT

610  VTAB 11:P = 19: HTAB P: PRINT
     "*"
620 Q =  PEEK ( - 16384)
630  IF Q = 149 AND P < 40 THEN  VTAB
     11: HTAB P: PRINT " ":P = P +
     1: POKE  - 1051,P: HTAB P: VTAB
     11: PRINT "*"
640  IF Q = 136 AND P > 1 THEN  VTAB
     11: HTAB P: PRINT " ":P = P -
     1: POKE  - 1051,P: HTAB P: VTAB
     11: PRINT "*"
650  IF Q = 155 THEN  VTAB 23: PRINT
     "PRESS ANY KEY": GOTO 1000
660  GOTO 620
700  TEXT : HOME : INPUT "ENTER L
     ANGUAGE PROMPT";L$
705  IF L$ = "" THEN 95
710  PRINT : INPUT "I)NVERSE OR N
     )ORMAL";I$: IF I$ <  > "I" AND
     I$ <  > "N" THEN 700
720  IF I$ = "N" THEN PO = 128 +
      ASC (L$)
730  IF I$ = "I" THEN PO =  ASC (
     L$)
740  POKE 64874,169: POKE 64875,P
     O
750  GOTO 95
999  END
1000  FOR D = 0 TO 500: NEXT : GOTO
     95
```

Back to the beginning

The current craze is for machine-specific publications but general books on micros still exist. Glyn Moody selects some of those worth dipping into.

WHEN BOOKS about micros first appeared, their purpose was fairly clear. Since they were preaching to the unconverted, they started with the rudiments of the subject and held your hand all the way along. Jocularity was order of the day, with appalling elbow-in-the-rib nudges on the subject of bytes, Peeks and floppies.

General books are now much thinner on the ground. Machine-specific publications are much more popular. As recent reviews in *Practical Computing* have shown, publishers seem to be working on the principle that if the market can take 50 books on the Spectrum or IBM PC, it can take 51.

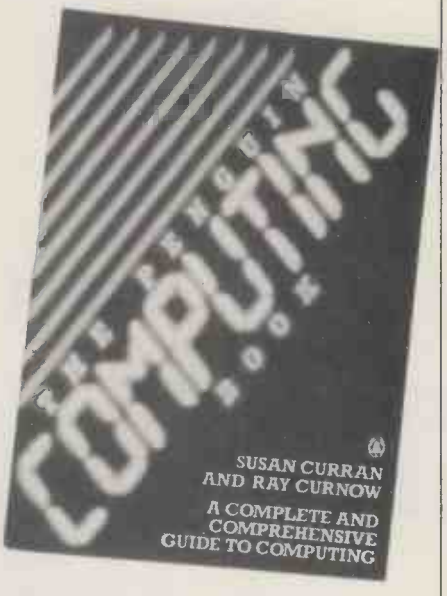
However, a few machine-independent guides are still being published. Some of these are at the bits and bolts level, and are unlikely to be of interest to the seasoned reader of *Practical Computing*. But some offer genuine insights into the world of micros, or are just plain good fun to read.

One book that rather surprisingly falls into the latter category, is the *Dictionary of Computing* from OUP. This is a book to dip into. In fact it is practically impossible to use it as a boring reference work. The trouble is that as you search for some definitive statement on fourth-generation computers your eye catches sight of entries on fail-soft and graceful degradation; gulps, cocktail shaker sorts and megaflops are sprinkled amid more familiar words. Really exotic items include Grzegorczyk hierarchy, Flynn's classification and Bose-Chandhuri-Hocquenghem codes.

This gives some idea of the scope of the dictionary. Within its 393 pages and 3,750 definitions, most aspects of the world of computing are encompassed. The fundamental definitions of words like bit and floppy are sensible and avoid further jargon. Words in definitions that are explained elsewhere are helpfully marked with an asterisk.

However, the dictionary has a slight mathematical bias, and explanations of category theory, topology, set and communication theory abound. But this is counterbalanced by short, down-to-earth notes on leading companies, specific machines like the ZX-80, and services like Ceefax and Oracle. There are also some omissions. For example WordStar is mentioned but perhaps the most important micro application-program ever written, VisiCalc, is not. Virtual disc is defined, but there is no virtual memory. Eurocards also slip through the net.

But these are quibbles. In the main, this is a comprehensive and useful work of reference. It is sad, though, to see Britain's premier dictionary publishers using American spelling throughout and not just for "program" and "disc", but even for "analogue" and "grey".



It was inevitable that Penguin should produce its own version of Everything You Need To Know About Computers. *The Penguin Computing Book*, by Susan Curran and Ray Curnow, weighs in at 450 pages and has a clear brief to omit nothing. This includes an introduction to electronics which begins with the atom, a history of digital calculation starting with the abacus, and the inevitable whistle-stop tour of computer history from Babbage's difference engine onwards, and including old faithfuls like Hollerith, Turing and von Neumann.

The main part of the book concentrates on explaining all the component parts of a computer, from chips to peripherals. It does this very well in the main. Less useful are the sections devoted to discussing Emma, a 6502-based board computer. The authors get very bogged down in specific features of the machine. Few people are going to rush out and buy this tutorial micro, and without the hardware the text disappears in a swirl of meaningless facts. It is a pity, too, that the typical small business system chosen for closer investigation is the TRS-80 model II, which even uses 8in. discs. An Apple II would have been far more sensible and representative, as well as historically neater.

Two other sections are also strangely specific. One on computer-aided design concentrates on a particular commercial system rather than the subject, and there is a whole chapter headed "Computers in the U.K. Meteorological Office". This is presumably intended to be an example of large computers at work, but instead wanders off into the details of radiosondes — weather balloons to you and me.

If this otherwise very well-written and interesting book has a fault, it is loose editing. The order of chapters is a little arbitrary and some of the material could have been tightened up considerably. Nonetheless, practically everything the authors have to say is sensible, even in notoriously dangerous area like AI and the future of computers. For an all-round introduction to computers that never patronises, the Penguin will be hard to beat.

A rather different tack is taken by *The Personal Computer Handbook* by Helen Varley and Ian Graham. After a full rundown on the elements of a computer, there are some interesting sections on living with computers, the electronic home and the electronic office. Apart from offering interesting sidelights on these areas, the book manages to give some fairly sensible advice about the practicalities of designing what the Americans call the media room. The buyers' guide to equipment that follows is less useful, and the obligatory section on "The Computer in the Future" is too short. But it is good to see a book concentrating more on the personal and social aspect of micros for a change.

Inside Your Computer does just the

(continued on next page)

(continued from previous page)

opposite. It is a strictly circumscribed but in-depth discussion of what exactly goes on inside the processor in your micro. Such books are often dry or incomprehensible; this is neither. Its author, Ian Sinclair, draws on his wide writing experience to produce a book that will tell you most things you need to know about chips without turning you into a silicon freak.

The Micro Enquirer by Benjamin Woolley and *Practical Computing*'s very own Chris Bidmead is rather unusual in structure. Despite these two gentlemen's names appearing on the cover, the bulk of the text has been recycled from articles in the magazine *Computer Answers* by various authors. The result is about 66 sections, laid out alphabetically, on subjects ranging from the game of Life to word processors.

Its origins mean that it assumes a certain familiarity with micros. Even old hands will find some real nuggets of information or new ways of looking at things. It is the kind of book you might like to wander idly through rather than read from cover to cover. A very full index is included, as are small machine-specific sections. Versions of the book for Spectrum, BBC, Commodore 64 and Atari XL users are available. Personally I found these sections of little interest. They read more like a half-hearted marketing ploy. But if you are after something different, this book is for you.

Another rather different book is *Newnes Book of Personal Computing,* in which nine authors each write a chapter that is meant to sum up some particular area of personal computing. The result is a book of variable interest that succeeds in falling between most stools. Some individual contributions are perfectly acceptable, for example the ubiquitous David Tebbutt writes quite entertainingly about micros in business, but the overall conception seems misguided. Particularly insidious are the advertisements dotted about the book.

Finally, a book that you will either love or hate. *Electronic Life* is by Michael Crichton, author of *The Andromeda Strain,* and a doctor and film maker as well. This very idiosyncratic partial dictionary of computers includes headings like "Computers and Gender", "Paranoia" and "Parents", as well as more conventional ones like "Keyboard" and "I/O". His anecdotal style effortlessly mixes fact with gently provocative assertions. Chrichton comes across as a very sane human being who enjoys using computers, but is not blind to their dangers. *Electronic Life* succeeds in communicating this with rare humour.

Dictionary of Computing. Published by Oxford University Press, £15. ISBN 0 19 853905 3

The Penguin Computing Book by Susan Curran and Ray Curnow. Published by Penguin Books, £5.95. ISBN 0 14 046 599 5

The Personal Computer Handbook by Helen Varley and Ian Graham. Published by Pan, £5.95. ISBN 0 330 28108 9

Inside Your Computer by Ian Sinclair. Published by Granada, £4.95. ISBN 0 246 12235 8

The Micro Enquirer — Spectrum by Christopher Bidmead and Benjamin Woolley. Published by Century Communications, £8.95. ISBN 0 7126 0409 X

Newnes Book of Personal Computing edited by Philip Chapman. Published by Newnes Technical Books, £6.95. ISBN 0 408 01320 6

Electronic Life by Michael Crichton. Published by Heinemann, £7.95. ISBN 0 434 14840 7

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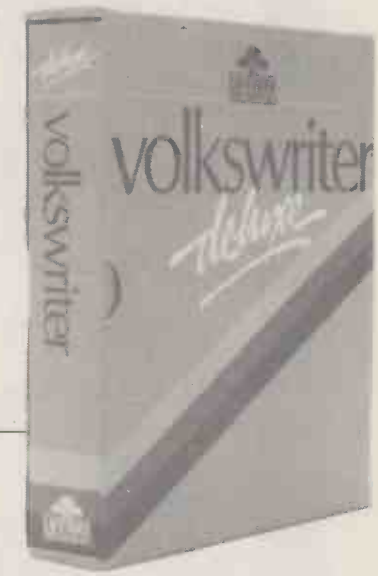

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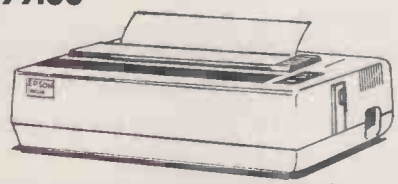

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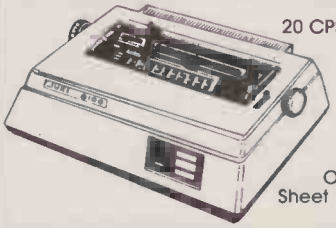

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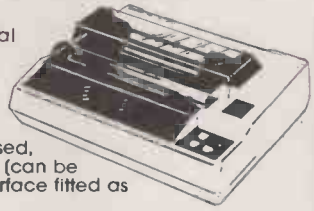

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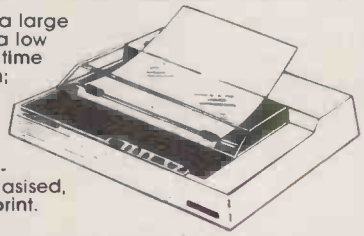

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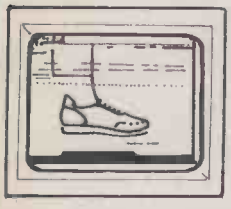

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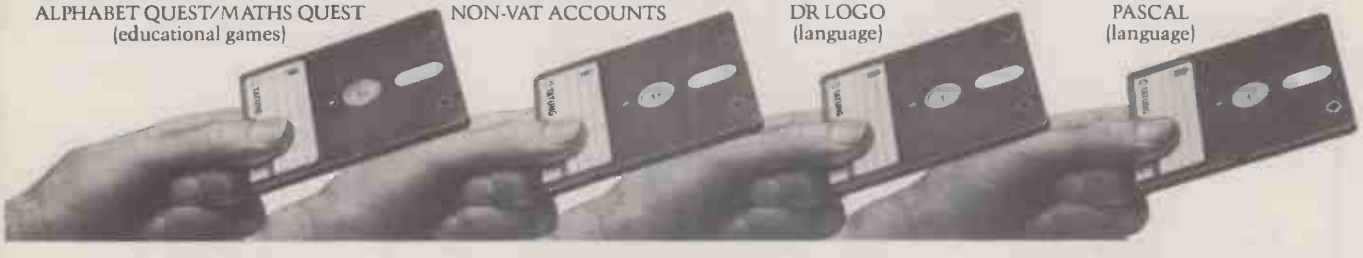

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>HOT 100!

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>COMPUTER OF THE YEAR

Every year seven of the world's leading computing magazines combine to present the Computer of the Year awards in four categories. This year a software section has been added. The results will be in the December issue.

>NEWS AND REVIEWS

Next month we investigate two important forerunners of things to come, the PC/AT and the One. IBM's Advanced Technology PC/AT model uses the Intel 80286 chip, and maps out the future of the PC line. Data General's One is a 9lb. battery-powered portable with two microfloppies and a full-size LCD screen.

We have hands-on reports on both of these and other micros, plus all the usual news, software reviews, columns and programming features, including part 3 of David Levy's strategy games programming tutorial . . . and not forgetting the pages and pages of free software in Open File.

Make sure you don't miss the December issue of

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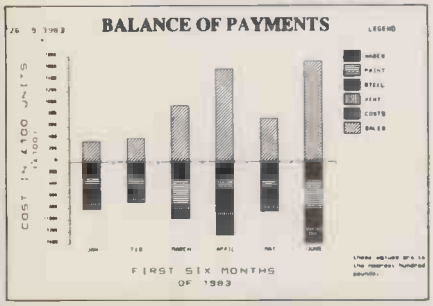

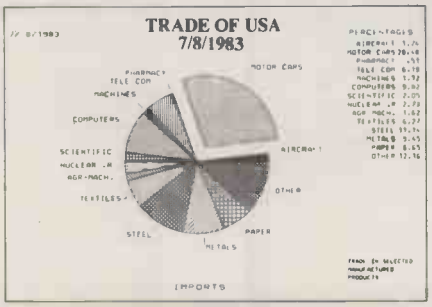

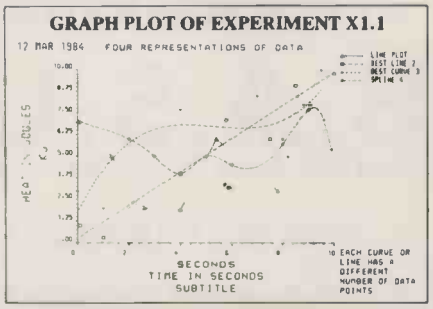

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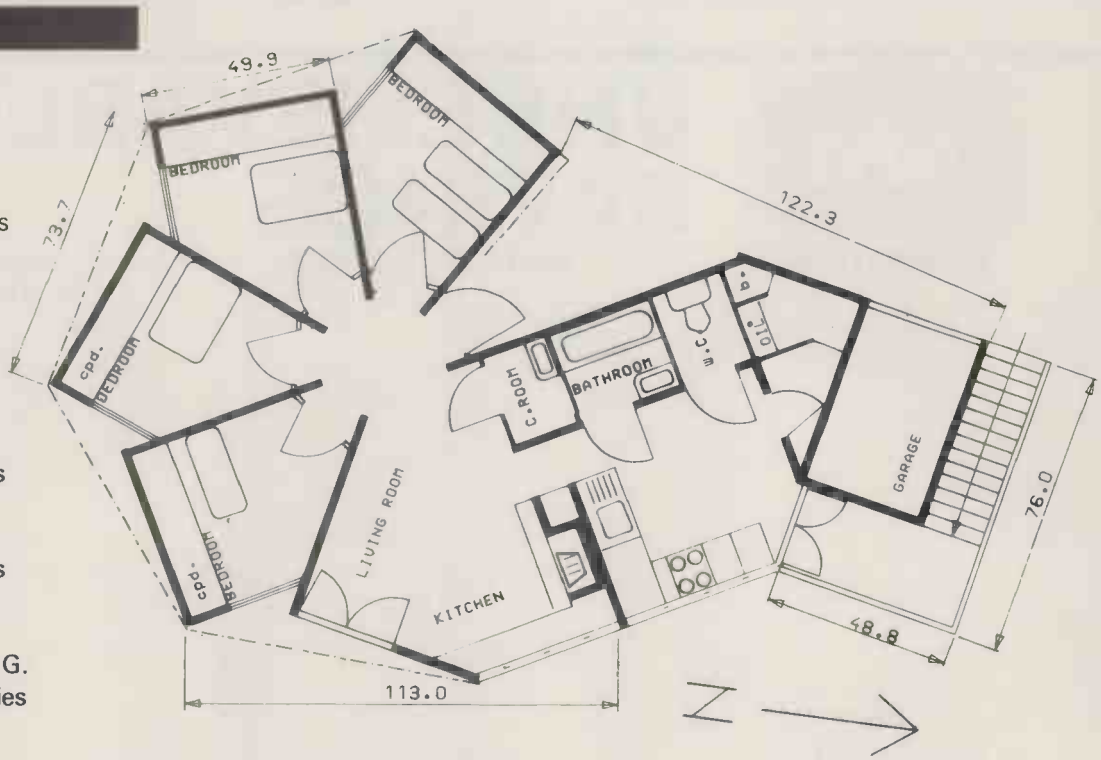

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Micro madness

Roger Conibear discusses the frenzy of interest in computers in education and suggests how this spate of enthusiasm could best be directed.

ONE OF the first suggestions for using computers in the classroom came from the British Computer Society in 1965 when it formed the Computer Education Group CEG. In 1972 the CEG held its first conference, with Computers in the Classroom as its theme. Since then computers in the classroom have been seen in two different ways by those promoting their introduction into education. Should we teach about computers? Should we teach with computers?

Teaching about computers has emerged as part of almost every secondary school curriculum. From the age of 12 onwards there are computer awareness courses in the information technology lessons. By the time students reach the fourth year they are enthusiastically opting for CSE or O-level courses in computer studies or computer science. Beyond 16 a few students go on to take A-level computer studies.

In a short space of time computer studies has come to be the seventh most examined subject in the curriculum. Is enthusiasm for computer studies out of control?

Enthusiasm

We do not have to look far to explain the explosion of interest and the fury of participation in this new curriculum area. Almost every staff common room seems to have its computer enthusiast, the guardian of the school micro who sees every avenue of social advance lined with computers. There is also the parental pressure on schools to provide computer studies courses. Most parents' associations are only too pleased to raise money for yet another micro provided it increases the opportunity for more computer studies classes. The pupils themselves create additional pressure to provide such courses.

While we might be happy with the explanation as to why we have become so involved with computer studies, it is still necessary to justify in educational terms the commitment of so large a proportion of the available resources. Are we educating society about computers or are we encouraging the Tin Man image put over by the science-fiction writers?

There are considerable advantages in using computers, but no computer system, no matter how wonderful the software, can compare to the human mind.

Society has absurdly high expectations of both computers and the computerisation of a system. A good example of this within our own education system is the number of head teachers who believe that the computerisation of the school administration system would be the answer to all of their problems. For any system that is working well there is the possibility that there will be additional advantages gained from computerising the system. On the other hand, computerising a poor and ineffective system can only produce an even more chaotic system.

Parents and pupils have equally absurd expectations of what a computer studies course will achieve in terms of a marketable qualification. What is computer studies achieving? Are we preparing our children for life in a society in which devices and systems based on microelectronics are commonplace and pervasive? Or, are we encouraging a fantasy which will make tomorrow's citizen more microid than human?

What I have written is not an attempt to damn computer studies. There is a need to educate tomorrow's citizens. Members of a democratic society should have sufficient understanding of the nature and potential of the technology to be able to interpret its effects and intelligently influence its adoption and use.

The use of computers in the classroom presents the teacher with an educational resource. Computers are the most powerful and versatile educational resource available to the teacher. Why, therefore, has the average classroom teacher been slow to take advantage of such wonderful technology? The usual reasons given to answer such a question lie in the fear and anxieties of teachers with regard to the new technology. This may be true but there are more concrete reasons.

Disadvantage

The hardware is not available in schools; it is being used in the computer awareness or computer studies lessons. There are technical problems associated with setting up a computer system in different classrooms on a temporary basis. Desirable and usable software is in short supply. Where the software does exist the teacher is abandoned with it rather than being presented to him or her as an integral part of a curriculum package. The cumulative effect is to disadvantage those who would teach with computers as an aid.

However, this is about to change. Schools are acquiring more hardware, sufficient for there to be computers both in the computer lab and separate systems in other teaching areas. There is a rapid growth in published software. Public awareness and even teacher awareness as to the jobs that computers can do well is increasing. These jobs are: in word processing, managing a database, as a viewdata system, in the area of control, and in data capture. This is how we should and will use the computers in the classroom.

Roger Conibear is West Midlands Regional Director of MACE, Microelectronics and Computers in Education, which is part of the Microelectronics Education Programme.

Content-free

Even though there is a dramatic rise in the availability of subject specific software, this will not be the principal use of computers. It is the content-free software and the emancipatory role of the computer which will have the greatest use and the most effect in the classroom. The microcomputer as a word processor will begin to make an impact on both teachers and pupils alike.

This is not to suggest that we are all about to join the business studies class or that we need to. Word processing is a skill which can be acquired on a need-to-know basis. Once the word processors are available and the skill acquired, word processing will do for creative writing and project work what the pocket calculator has done for mathematics.

The use of the computer in information handling will change the way we approach certain subjects. In certain subject areas database managers will allow us to centre our studies on the real world as opposed to the artificial examples generated for classroom convenience. Computerised information handling will cause us to focus more precisely on the information skills we are already teaching. Viewdata systems will cause us to look at new ways of sorting and presenting information.

In teaching with computers and using them to do real jobs, both teachers and pupils will acquire an understanding of the technology while at the same time comprehending real limitations and disadvantages of that same technology. It is in this way that we will educate tomorrow's citizens to use the most sophisticated tool accessible, to remove the Tin Man myth and to dispose of any fear that the computer could ever replace a human being.

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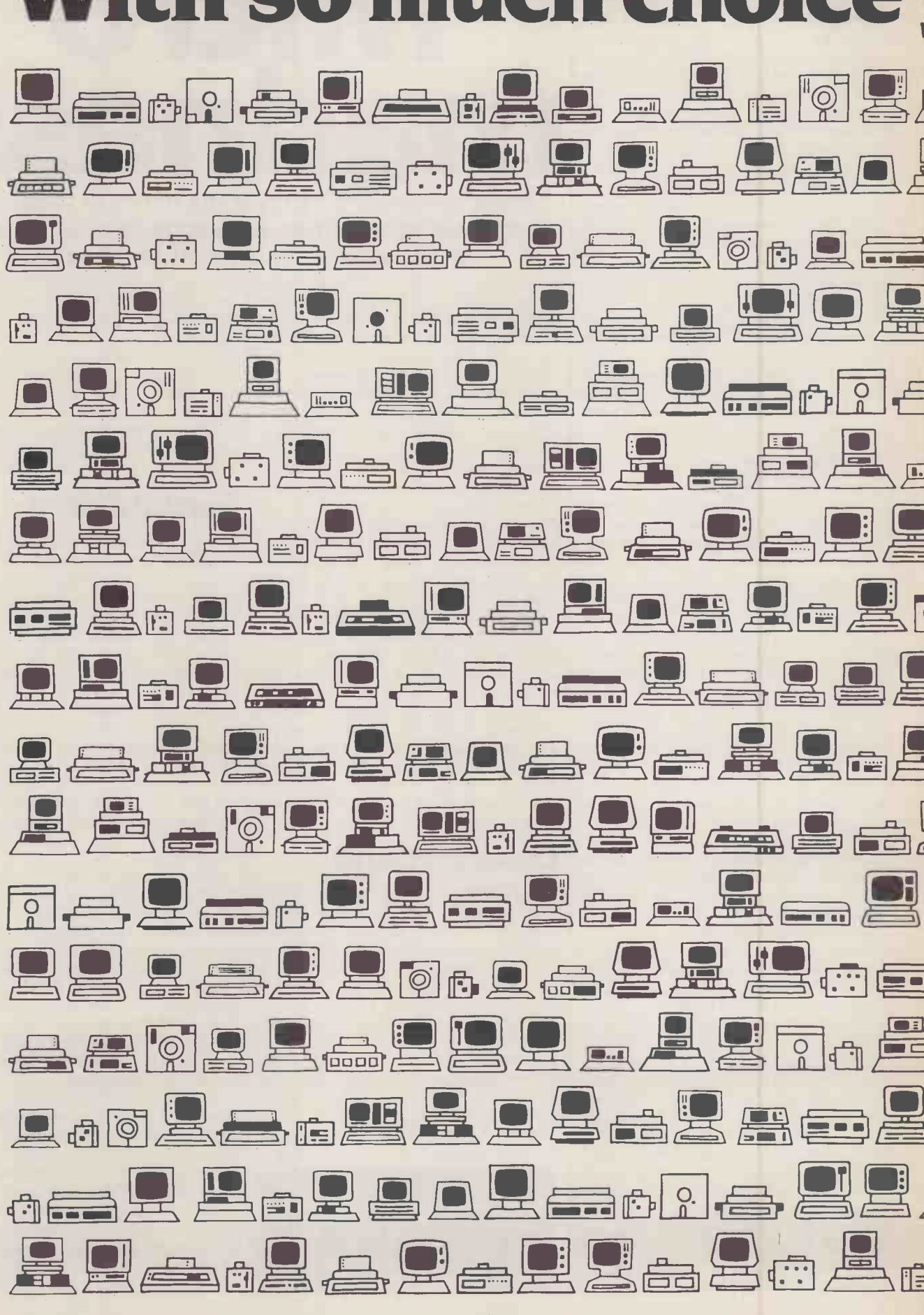

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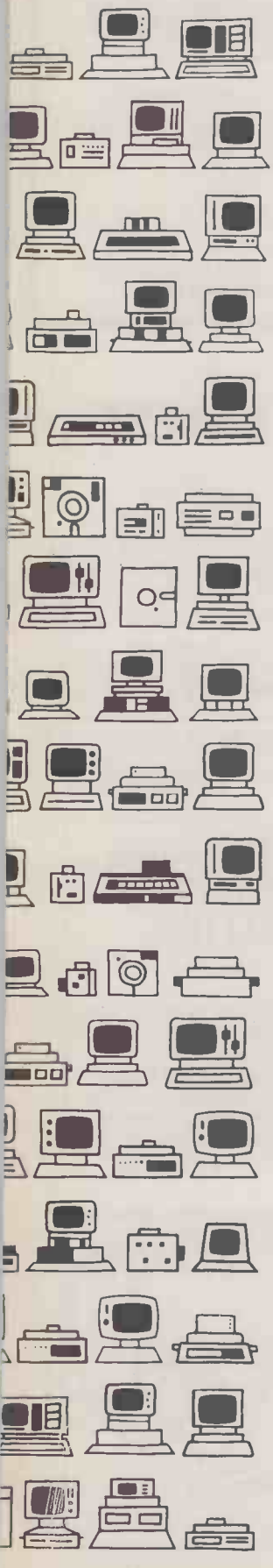

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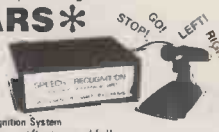

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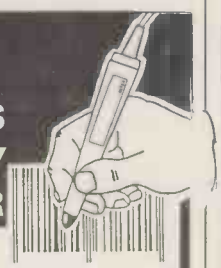

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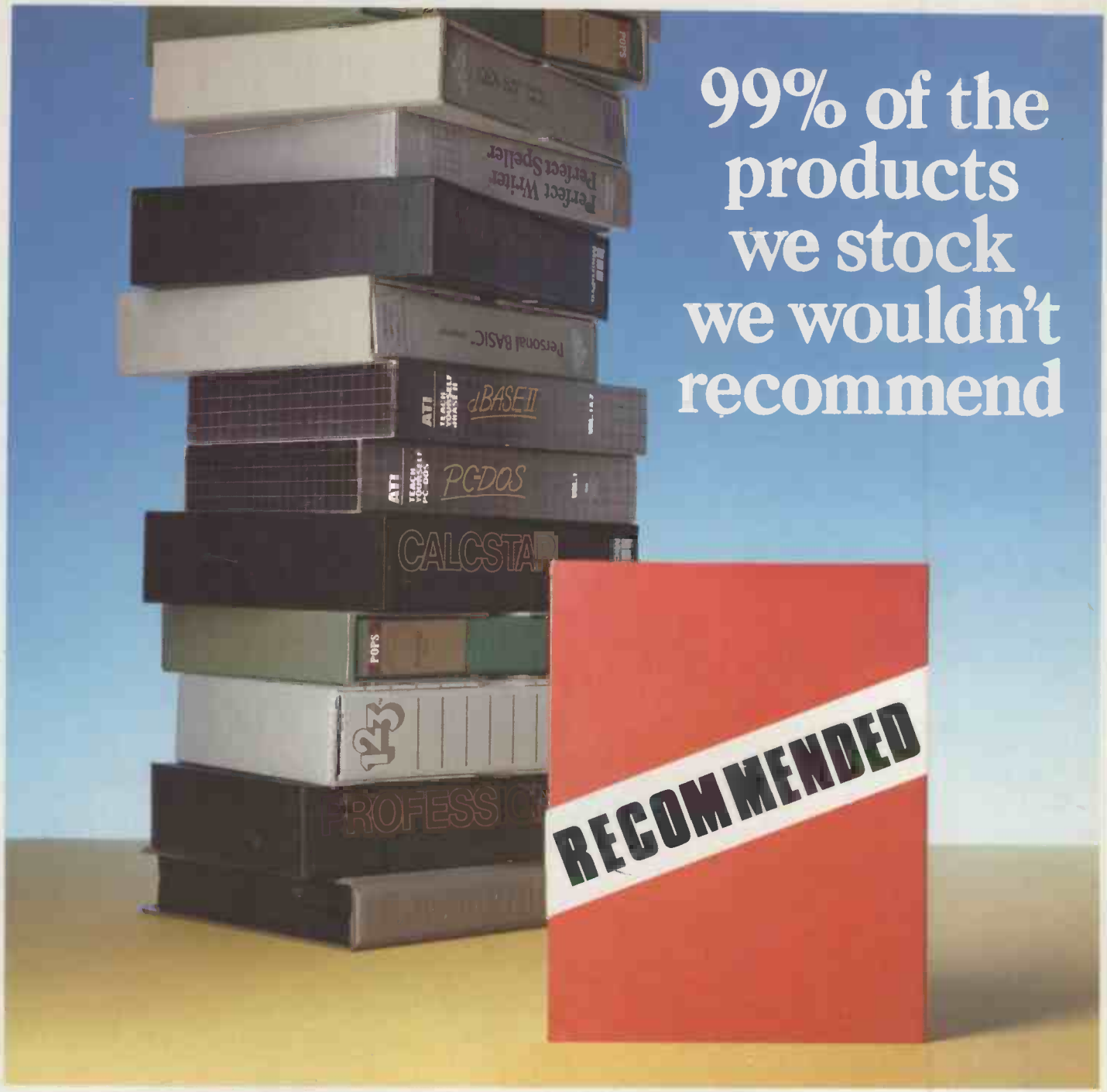

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