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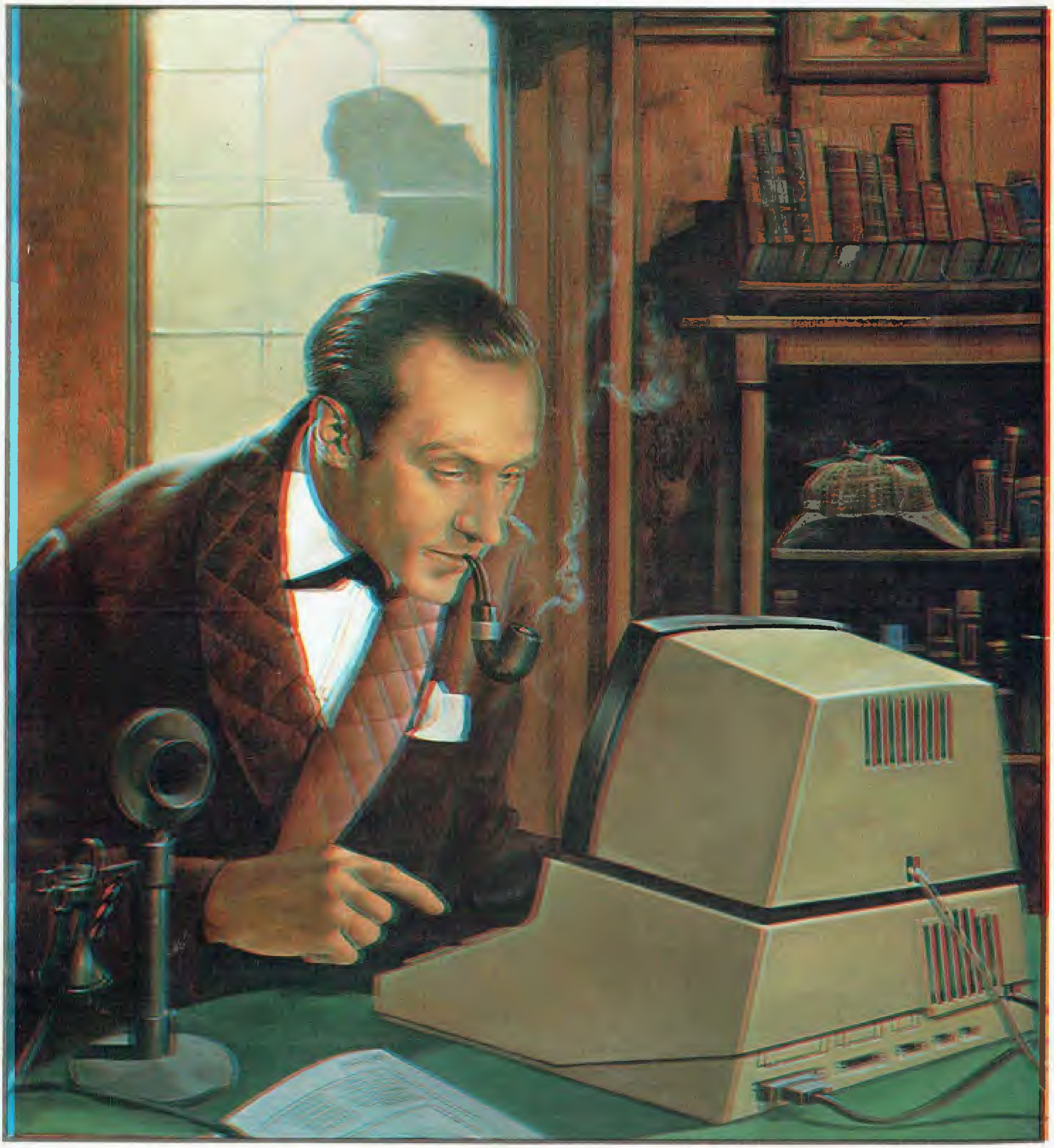

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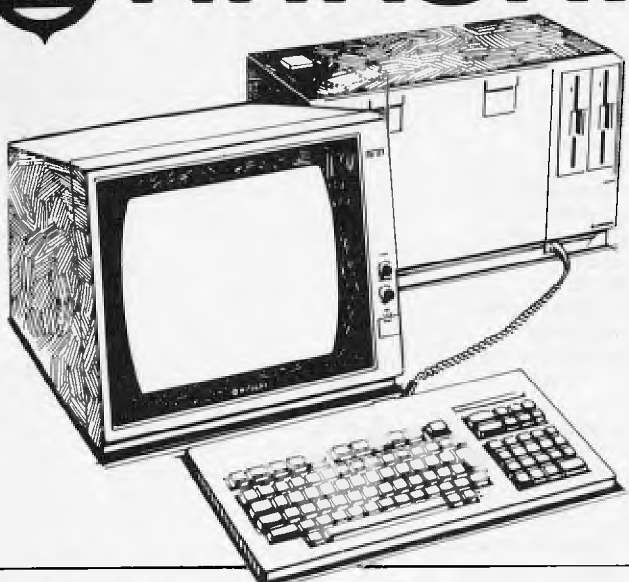

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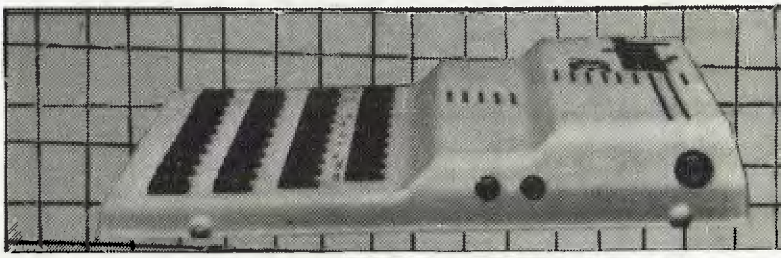

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APC reports on the latest news from the world micro scene.

'You must need a computer to keep track of this lot!'

Osborne sets the King whistling

To cheer himself up after parting company with Tom Davidson, Adam Osborne paid a visit to the King of Thailand recently.

This king is apparently the son of the young prince whom Deborah Kerr taught to "just whistle a happy tune" in The King and I.

He should be whistling – he got two Osborne computers as a gift from the wealthy Adam.

"For various reasons, we presented a machine to his chief minister," explained Adam. "That meant we had to do a bit better for the King."

Adam also says he is producing a Kanji Osborne – one which uses the Chinese ideogram characters of Japanese formal script.

Our resident Japanese expert says this is nonsense.

"Possibly he has got Katakana," he said sceptically. "That's a sort of shorthand phonetic alphabet."

Legal matters

Atari says it is suing Commodore for ripping off the Pac-Man game, and selling it as Jelly Monsters. Commodore says that Atari has lost a similar lawsuit in Hong Kong, and as a result has withdrawn from this one. Atari says no, it hasn't withdrawn, it has just 'stood over its application for a temporary injunction, but obtained an order for speedy trial'. Commodore says it will be pressing for costs.

When we know more, we'll tell you. I can't help feeling a touch of irony at the wording of Atari's press release, however.

The release itself refers to the 'substantial commitment to the development and marketing of new and original software' – which is very true and valid – and says that it will 'continue to enforce its rights against those who would seek to misappropriate the fruits of Atari's labours,' which is a matter for the courts to settle.

The irony of the case is the fact that Pac-Man is not a program which Atari wrote. It happens to be one they bought from a Japanese company.

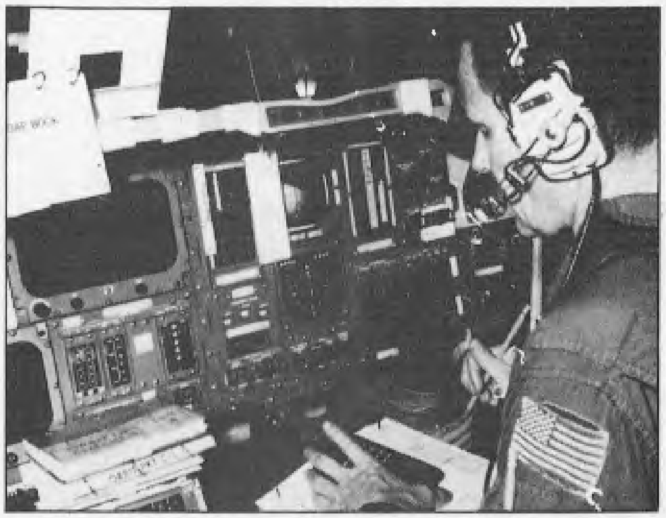
Apple: IBM

The Apple-IBM Connection enables computer users to transfer information between the Apple II and the IBM Personal Computer. The software duplicates files created on one machine, and transfers them onto files that can be used on the other.

The Apple-IBM Connection program enables companies to transfer VisiCalc models from the Apple to the IBM, and also allows the transfer of WordStar and other word processor files.

Apple-IBM Connection costs $195.

Alpha Software Corporation, 6 New England Executive Park, Suite 400/Burlington, MA 01803. Phone: (617) 229 2924.



All that is missing from this Space Shuttle simulator is the green face of the astronaut. He is practising using his Hewlett-Packard programmable HP-41C calculator which had been pre-programmed 'to help with several duties, including manual manoeuvring of the space-craft in an emergency, and calculation and adjustment of the shuttle's centre of gravity prior to re-entry.' A shame one of the guys got so seasick (space-sick, then) they had to come down early – not the sort of emergency the calculator was programmed to deal with, I suppose.

Who holds all the aces in

HiS

When it comes to software for the Hitachi Peach computer, we believe in dealing an unbeatable hand.

Hisoft*, the authorised Hitachi Software distributor, has developed high quality software specifically for the Hitachi Peach, now readily available through our authorised dealers.

Nothing is better than having extra aces up your sleeve and our software packages are all aces with a range that's ideal for commercial, graphic and entertainment applications. Our software features full colour facilities and step by step visual instructions. (with CPM now available).

HiSoft's opening hand

HiFinance.
This fully comprehensive package is specially designed for Australian business conditions.

HiWriter.
A professional word processing package incorporating full mail merge capabilities.

ProCalc.
A sophisticated visual calculator utilizing all the Peach features.

DataBase.
An advanced yet easy to use package offering sophisticated report generators.

Entertainment.
Features a full range of arcade and assorted games, music, etc...

NE

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Hisoft is very proud of the fact that it's "the only computer company in Australia to have developed a complete range of software including both general, business and financial programs." While, at first glance, this appears to be a rather daring statement, Hisoft is quick to point out that the operative word is "developed", ie, the software has been produced locally enabling better backup and support.

The company is, no doubt, looking forward to the imminent mass release of Hitachi's new 16-bit business micro, and the resulting demand for software which in the case of this and many Japanese micros is large because of its release in Australia before the US. This provides an opportunity for software houses to produce and export general programs and utilities.

Portable business

A range of new business and professional uses has become possible with the Sharp PC-1500 portable computer under an agreement reached between Sharp Corporation of Australia and Link Computer Systems.

Link, a Sydney-based company, will develop and supply software packages for off-the-shelf sale with the computer by Sharp's extensive dealer network throughout Australia.

The recommended selling price for the PC-1500 is $575. Each Link software package will sell for between $150 and $300.

The first application software to be released by Link includes a motor dealers' system, a portable electronic diary, a term insurance program, a professional time and billing system, a personal finance and budget planner, and an income tax instalments system.

Link is developing more software for such applications as a car rental program, instant invoicing, finance control, inventory valuation, and project control.

For more information contact Link Computer Systems on (02) 436-2046.

HP sees the wood from the trees

A novel application for the programmable Hewlett Packard HP41C has been developed by the Commonwealth Scientific and Industrial Research Organisation to help foresters do a better job.

According to Dr Wilf Crane of CSIRO, the small size and easy to use nature of the calculator make it ideal for use in the field.

The machine's memories are used to store the characteristics of plants, animals and soils to aid their identification.

Flexible portable

The Screen-Pac recently announced by Osborne gives the Osborne user a choice of three screen widths: the Osborne's normal 52 column screen width, the standard 80 column and a 100 column screen width which is ideal for spreadsheet programs. No other personal computer can offer this flexibility.

The three screen widths are software selectable and can be changed dynamically in user-written programs.

The option costs $299 (recommended retail) including installation by an authorised Osborne dealer.

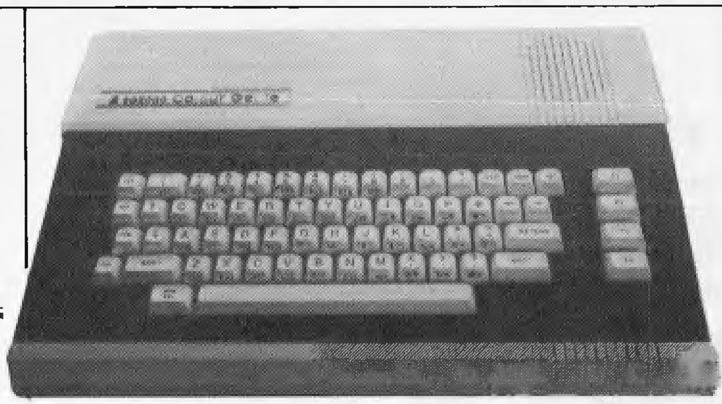
Bludners extra

Not really a bludner but some relevant information omitted: the Jupiter Ace Benchtested in this issue can be mail ordered from the manufacturer, Jupiter Cantab Ltd, 22 Foxhollow, Bar Hill, Cambridge, CB3 8EP for £89.95 which excludes the UK's value added tax but includes export postage and packing. The TV standard used by the Jupiter Ace is 625 lines and UHF; power requirements are 220/240V AC.

No system color

According to Jim Rowe of Dick Smith, Australia will not be seeing the newest version of the System 80 micro – a full 160 x 96 "hi-res" color machine. It's almost completely software compatible with the existing System 80 and TRS-80 machines but apparently, at this stage, DS has no intention of importing.

Pity . . . as a lot of people have been waiting for a low cost machine which could take advantage of the ocean of TRS-80 software *and* have full color graphics to ride on the current games machine boom.



The colour Genie.

IXO Telecomputing system

The IXO Telecomputing System, pictured elsewhere on this page, is a terminal which the exclusive importers, Computer Country, intend to market in association with The Australian Beginning.

The unit sells for $750 which includes a built- in modem for communication over telephone lines. It weighs around 0.5 kg (making it a contender for your coat pocket) and incorporates a full keyboard, albeit fairly small, and an LCD display which can be replaced by a television with the appropriate peripheral.

Other features of the system are a built-in telephone auto-dialler (which, together with its ability to permanently store log-on codes and protocols, makes for very easy use of the unit); and derivation of power from the telephone lines.

The IXO Telecomputing System.

Purchasers in the next three months will also receive a complimentary membership to The Australian Beginning. Dealer enquiries are welcome.

Atari latest

After a long time in the doldrums, Atari is launching a new product to succeed its ageing 400 and 800 machines – but in the US only.

Its new 1200 model was unveiled at a special pre-Consumer Electronics Show conference recently, and will be available early next year to American dealers. It will be more expensive, in a more modern looking case.

But it is likely to be a severe disappointment to Atari fans, even though word from inside Atari is that it has been rushed through development several months earlier than scheduled.

The only apparent difference between it and the 800 is the fact that it has 56 Kbytes instead of 48, and that it can be made to run around 30% faster by adopting the Sinclair tactic of blanking the screen.

All other changes are largely cosmetic – it only takes one cartridge, and it only takes two joysticks, although there are no games requiring more than two.

Press Release of the Year Award

Every day we receive up to 50 press releases at APC. Something like half of these go straight into the bin, either because they're nothing to do with micros or because they're plain boring. Occasionally, though, one appears which is either so ludicrously wild in its claims, or so riddled with errors, or so arcane in subject matter that it deserves to be considered for some sort of award. We're proud to announce, then, the APC Press Release of the Year Award for 1982. There have been quite a few contenders during the year but we feel that Mitsubishi Electric Corporation wins hands down. The prize is the dream of every PR man: a verbatim reprint of the entire press release. So here goes:

Mitsubishi Electric Corporation has developed Melsort pattern recognition software which promises to have wide application in the automated sorting and grading of commodities at the manufacturing and distributing stages. The microcomputer-operated Melsort system can recognise commodoties by identifying their images with memorised key diagrammatic features.

One application is the fish sorting and grading system developed jointly with Mitsubishi Kakoki Kaisha Ltd. It recognises sardines, herring, anchovies and a variety of macherel by shape while grading them into three sizes – small, medium and large. The task of fish sorting, which used to require skilled human labour is now done automatically, based on information regarding five to 10 selected diagrammatic elements such as length, width, snout shape, etc.

The system typically consists of a supplying unit, lighting unit, line sensor (TV camera), picture processing unit, conveyor and sorter which are controlled from the central control monitor linked to the data processing unit.

Fish first go through light to activate the line sensor which transmits diagrammatic information to the picture processing unit for identification and sorting. Fish up to 500mm in length and 150mm in width can be handled at a speed of about 14,000 per hour.

Melsort is also used in a cucumber sorting and grading system which Mitsubishi Electric is marketing to save time and labour in this hitherto tedious task. It sorts and grades cucumbers according to thickness, length and curvature and shape, which are appreciated by Japanese customers. The system has gained wide acceptance (in Japan), among agricultural co-operatives in particular.

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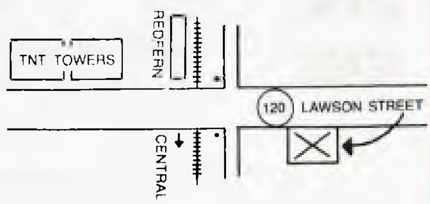

Sage hard disk is removable

There will never be a Sage III microcomputer, Rod Coleman (company president) announced at Comdex, presenting the multi-user Sage IV to enthusiastic trade buyers.

The Sage IV attracted more attention because of its removable Syquest hard disk – the disk platter is removable.

Earlier, Syquest astonished the silicon world by showing its $40 to $60 disk cartridges, a mere 3.9 inches in diameter, and tough enough to withstand dust, smoke and other abrasive substances.

Otherwise, the Pascal-based Sage is little different from its single-user predecessor – apart from the fact that up to six simultaneous terminals can be used, plugged into it.

It also comes with more memory capacity – it starts at 128 Kbytes (same as the Sage II) but goes to a megabyte.

Lifeboat help

Lifeboat Associates has released several products for both CP/M-86 and MS-DOS, including an emulator program which allows CP/M software to be run under MS-DOS. Emulator-86 makes a single operating environment possible for the major 16-bit software packages.

A similar product EM80/86 permits CP/M 80 programs to be run on 8088/8086 systems without modification.

Lifeboat's other 16-bit software products include a C Compiler for MS-DOS called Lattice C, a financial modelling package Plan86. and a comprehensive file management system MAGbase.

Killdal's CP/M Plus card for Apple leads implementations

Gary Killdal's CP/M Plus card for Apple II's takes full advantage of extra memory addressing ability.

The clue to the appearance of "yet another" CP/M card for the Apple, from Digital Research itself, lies in the word "plus".

A rival card to Microsoft's best-known plug-in for the Apple II was launched at Comdex by Gary Killdal's company together with ex-Apple boss Steve Wozniak (who now has a new company called Advanced Logic Systems).

It has the brand-new Digital Reserach upgrade to CP/M, CP/M Plus – making it one of the very first systems to get this software after the Altos, together with a new Epson machine.

One of the big innovations of Plus is its ability to work with more than the 64 Kbyte memory limit of normal CP/M 2.2. The Advanced Logic card includes its own 64 Kbytes of memory on top of any memory already in the Apple, to take advantage of this.

The new Epson, the QX-10, (still not available in this country) also had CP/M Plus – it had to, because it sports a vast amount of memory including 128 Kbytes of display memory.

Demonstrating the system, however, Epson America soon showed the futility of announcing it (or its new operating system) as "truly user-friendly".

It became apparent that no new system can be more friendly than anything with which it is compatible – because it has to run all the old software which doesn't use the "friendly" features.

Epson's demo program ran under Microsoft Basic. No sooner had this been loaded than the fine new friendliness features flew out of the window, to be replaced with the terse Microsoft "OK" prompt – no help menus, no structured CP/M file names, no extended memory, and no cursor based line editor. Just an ordinary Microsoft emulation of a Teletype. As usual.

Tracker ball beats joystick

Easily the most popular games controller in arcades is the 'tracker ball' which users have found much more ergonomic than the normal joystick.

American games firm Wico has now produced a small tracker ball for micros from Apple to Atari – based on the machine which the same company supplies to Atari for its arcade game Centipede.

At $80, including interface, the tracker ball isn't cheap – though there are joysticks that cost more. But as an interface to graphics programs, its potential is regarded by many observers as huge.

"The point of the tracker

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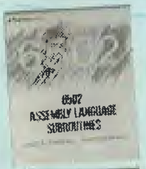

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ball is that it gives the user control over speed, as well as direction," said a Wico executive.

"The ball spins on frictionless wheels, and the system counts the speed that these wheels turn. That way we can gauge the absolute direction of rotation and the speed – and can move a cursor around.

"Generally, it's very much harder to control a joystick with the same accuracy."

Most system builders, who are aware of this conflict between human requirements and the old four-arrow cursor approach, are tending towards a 'mouse' controller, which sits on a desk and has a few control buttons.

The 'mouse' however does require a flat surface, and is vulnerable because of its cable – whereas the tracker ball can be built into the work surface.

Clues to new Apple in high density drives

Apple is now confidently expected to launch a new machine on January 19, but not everybody is sure whether it will be an enormous 68000 based Lisa system, or the cheaper Rev E version of the Apple II.

At Comdex, however, new disk drives appeared, and were whispered to be the disks that Lisa would use, when it finally appears.

Both are 'ordinary' floppy drives – but the single drive has 871 Kbytes, which is a lot, and the double drive has 1.7 megabytes. The single drive is called Unifile and the dual is called (wait for it) Duofile.

Apple insists that the technique used to get this density involves a 'first', in that normal double-sided disks are read by heads which grip the disk between them. This system, says Apple, is the first to offset the heads, so that the wear and tear on the surface is less.

It also uses the system which Chuck Peddle incorporated in the Sirius, to get extra density.

Normal diskettes have the inside tracks recorded at the maximum possible density – but because the disk spins at constant angular speed, the data is recorded far less compactly on the outer tracks.

Peddle, and now Apple, arranged to spin the disk less quickly on the outer tracks, getting more data on them.

Ace 1200 is Apple clone

Fresh from a legal triumph against Apple, US system supplier Franklin has produced an enhanced version of its imitation Apple II.

The new machine is a hybrid of Apple II and CP/M Apple, with all the enhancements that people usually plug into the machine.

That is: it has a Z80 processor as well as its native 6502, it has an 80-column screen with upper and lower case letters, and it has expanded (128 kbyte) memory.

With a single disk drive in the integrated case (there is room for two drives) the American price for the model 1200 is $2,495.

Franklin says it expects to be in full production with the ACE1200 in January. By then the Dutch lookalike (similar spec) is expected to be available in the UK through CWP Computers.

The ACE 1200: an enhanced Apple II.

New King as portable market grows

A portable computer, very near the Osborne in price, but with the software and hardware facilities of an enhanced IBM Personal Computer, led the hardware announcements at Comdex in Las Vegas.

The new portables generally try not to compete directly with Osborne, however. This appears to be something other than cowardice – they take the apparently more demanding challenge of competing with the IBM Personal Computer.

The list of portables now has a new king, with the arrival of an IBM-compatible system called Corona. At $2,395, it costs not much more than an Osborne.

Close behind comes the Canadian Hyperion machine. weighing only 18lb, from Dynalogic InfoTech.

Less aggressively priced, but with more impressive financial muscle than either of the other two, is the Compaq (which APC told readers about a month ago) from Texas-based Compact Computer Corporation.

And at the top of the price range, is the Computer Devices Dot, the only machine to cost more than the original IBM PC on which it is modelled. And the only one in the new family which cannot read IBM diskettes.

Corona is the company now led by Robert Harp who left Vector Graphics to his ex-wife Lora a year ago, and he has obviously jazzed the firm up considerably.

His portable miracle will be released in April. Before then, in January, he will release the desktop version, fully configured at the rather higher price of $2,595. An extra floppy costs $400.

Those prices include a single half-height diskette (320 Kbytes) with room for one more on the portable, or three more (or one plus a hard disk) on the desktop. They also include a high res monitor, considerably better than IBM's and much bigger than Osborne's.

The machine goes much further than the IBM PC in several design points, particularly graphics, power supply, and expandability. Any card or software which will run on the IBM, will run on the Corona, said Harp.

The Hyperion is a cut-down version of a desktop machine launched six months ago in Canada. Its $3,395 price includes 256 Kbytes of memory, MS-DOS, Basic and a single diskette. Extras like a text editor, Multiplan (Microsoft's spreadsheet) and a modem take

The Corona's desk top sibling.

the price to an extra $1,065, while the second diskette costs $650.

There were other portables at the show. Kaycomp showed the world's second portable Winchester system, upgrading its Osborne look-alike with the hard disk option. And Grid showed its ultra-portable, ultra-expensive Compass, with a flat-screen and bubble memory.

The only cause for doubt and fear for the future is the uncomfortable rumour that is now persistently being leaked from IBM – that IBM itself is only months away from its own portable PC.

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It's a sort of treasure hunt for the information age; let your fingers do the walking.

Don't expect it to be easy; $2,500 is enough to buy a fantastic holiday, stereo *and* video system or an eighty three year subscription to *APC*, so you're going to have to work for it.

Each month we will present a puzzle for you to solve, starting in this issue. In the March issue you'll get the final instalment and by combining the answers to all the puzzles in the right way you will be led to the name and phone number of a person resident in Australia.

You will then phone this number and an answering machine will tell you if it's the right one. Then you leave a message consisting of one of the puzzle answers. The first person to get onto the answering machine tape with the right answer gets the loot. We'll give you more detailed instructions as we go along; right now let's get down to the first puzzle.

All you have to do this month is find the smallest palindromic integer whose square, when reduced by a million, gives a result which contains each of the digits 0 to 9 at least once.

For the uninitiated, a palindromic integer is a whole number which reads the same from left-to-right as it does from right-to-left, eg, 121, 3443, 12421.

When you have the number take its digital root – you'll need both for the final – by adding all the digits together repeatedly until you have a single digit. For instance the digital root of 987654 is three:–

9+8+7+6+5+4=39
3+9=12
1+2=3

Don't send in the answer as usual please; we're not interested until after the last puzzle. Just keep these two numbers safe and look out for the next puzzle next month. Best of luck.

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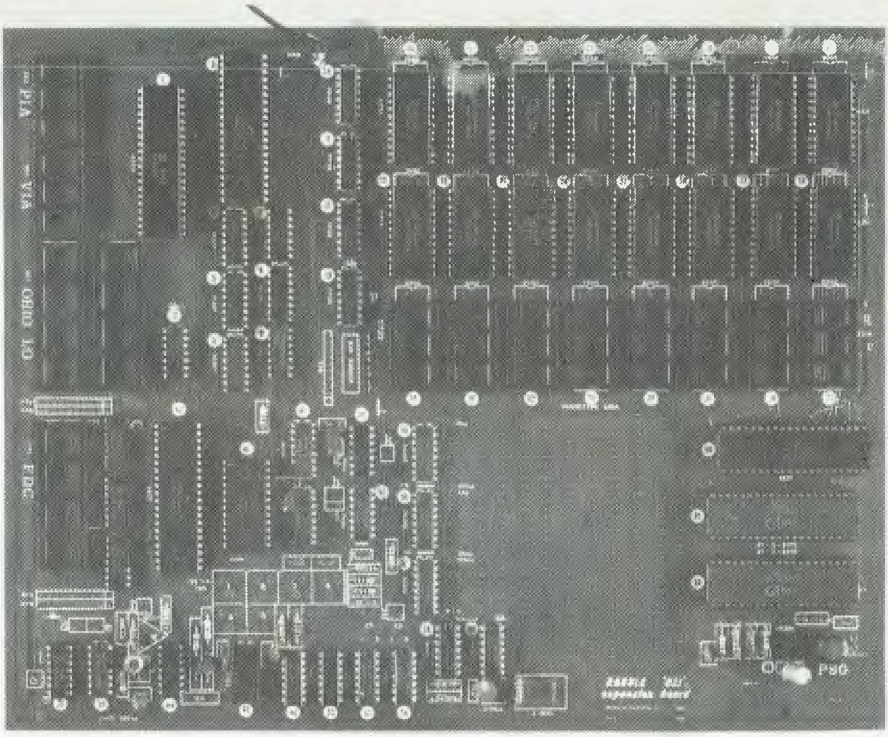

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Bare Board	$45.00
Kit	$125.00
Assembled & Tested	$155.00
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C1 64x32 DABUG Replacement	$15.00
C4 64x32 DABUG Replacement	$15.00

If you don't have a DABUG already, your C1 or C4 DABUG will cost you $25.00.

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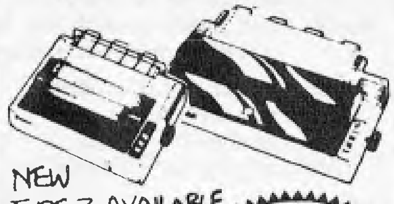

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INVASION LAUNCHED IN TOKYO

Peter Rodwell reports on the new products at this year's Tokyo Data Show.

Expectations that the Japanese would do with computers what they've already done with motor-cycles, cameras, hi-fi's and watches have been rife for several years. The fact that, so far, we haven't seen our micro industry going the way our motor-cycle and hi-fi industries went has encouraged not a little complacency in some quarters: many people seem to think there's something different about computers which will prevent the Japanese from flooding us with shiploads of low-cost micros.

Meanwhile, oblivious to this difference, the Japanese are mass-producing computers on nearly the same scale as they do audio equipment, TV's, etc, and are preparing to flood us with shiploads (or, more probably, planeloads) of them. October's Tokyo Data Show gave a good preview of the latest Japanese machines, most of which are already selling well in Japan and many of which will be reaching our shores over the next few months (in fact one or two have already been seen in Australia).

The outstanding trend at the show was for 16-bit micros, most of them at least software-compatible with the IBM Personal Computer and some hardware-compatible as well. The 'mainstream' trend was for 8088 and 8086-based machines, typically with at least 128k of RAM, twin disks, good quality keyboard and medium-to-high resolution graphics displays.

Although, in a certain sense, the new wave of Japanese machines are much of a sameness and scarcely innovative, two features about them all struck me as particularly interesting: as we have long since grown to expect from Japanese products, they are all superbly made, with minute attention to detail and rigorous quality control; and they nearly all retail in Japan at prices which are typically between half and two-thirds the price we expect to pay for such machines in Australia.

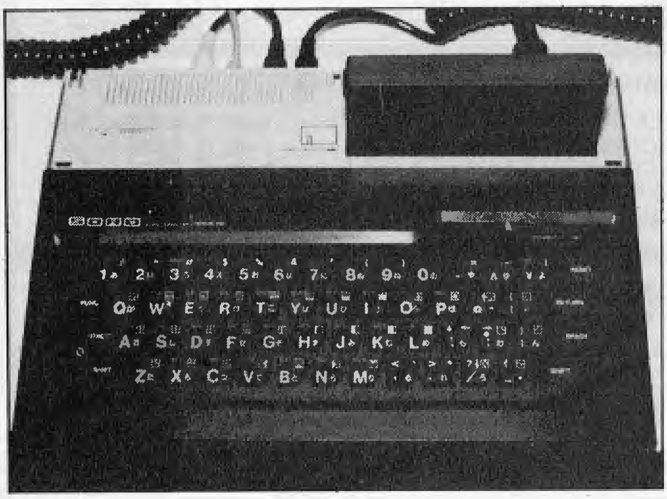
Before we look at the products, a word about the show itself: it lasts four days, had 127 exhibitors this year and was confidently expected to attract more than the 139,100 who attended last year. The 1983 Data Show will be from 18 to 21 October; for details, contact the Japan Electronic Industry Development Association, Kikai Shinko Building, 3-5-8 Shibakoen, Minato-ku, Tokyo 105.

Toshiba's home computer.

New 16-bit micros

Nearly all the well-known names launched 16-bit machines, with the notable exceptions of Sharp and Casio. NEC seemed to offer best value for money with its PC-9800, which starts at 298,000 yen, say $1285. For this you get a system based on NEC's equivalent of the 8086 with 128 kbytes of RAM (expandable to 640 kbytes) and a bumper 96k of ROM containing N88-Basic and the system monitor. The display gives 25 lines of 80 characters in text mode and three pages of 640 x 400 dots or six pages or 640 x 200 dots monochrome graphics. Colour graphics are also available – 640 x 400 dots in eight colours. The PC-9800 runs both CP/M-86 and MS-DOS.

Here's the National Mybrain 3000. Silly name but slick machine, note low-profile disk drives. It's now sold in Australia as the National Panasonic JB 3000.



Sord's neat little home micro, the M5. Note plug-in ROM pack (16k).

Definitely outside the mainstream is Chuo Electronics, which rather bravely opted for the Zilog Z8001 CPU and Unix as the basis for a pretty smart business system housed in an all-in-one box and with a 20 Mbyte hard disk as an optional extra.

Sord launched two interesting new systems. Well, actually, the M343 16-bitter wasn't totally new but was making its first big appearance in public. And very nice it is, too, with full colour, high resolution graphics and 256k RAM (expandable to 768k) and twin floppy disks. However, it's certainly not cheap (by Japanese standards): 1,300,000 yen or about $5600.

Toshiba caused a big stir with the Pasopia 16 – a neat, 8088-

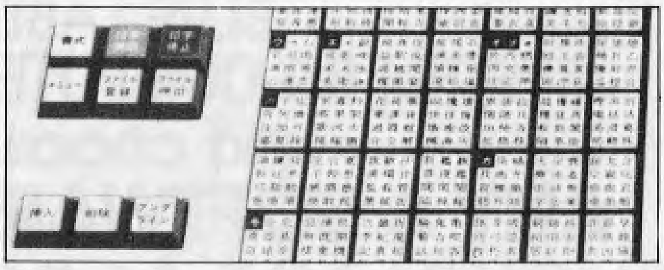
based machine running MS-DOS — version 1 was on show but version 2 is promised for production machines. The machine comes as a 'mainframe' box with two built-in double-sided, double-density disk drives and separate keyboard. The basic version comes with 192 kbytes of RAM, expandable to 512k. Basic video display is 80 x 25 lines of text using just 4k of video RAM but this, too, can be expanded to four pages of 640 x 500 dot graphics in 16 colours, using a massive 512 kbytes (yes, half a megabyte) of video RAM! The Pasopia starts at 398,000 yen ($1715) and Toshiba is planning a 100,000-units production run over the next three years.

This is Sharp's MZ-700 with the optional four-colour plotter and cassette deck. It's software-compatible with the MZ-80K/A machines, has 64k RAM as standard and colour output to a TV set.

8-bit micros

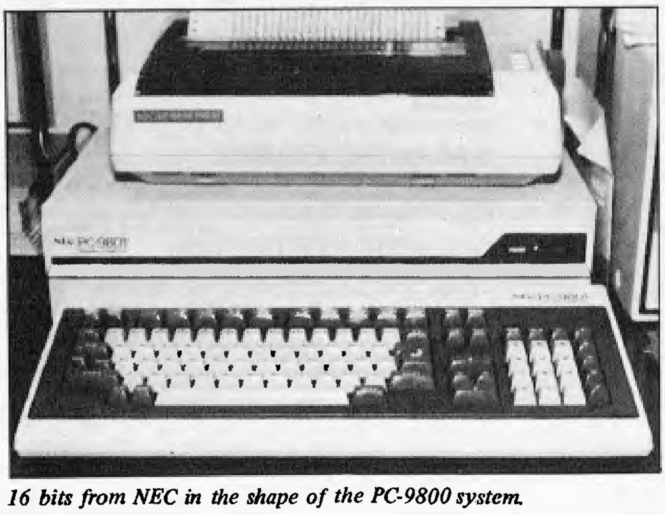
Although the 16-bit machines grabbed a lot of attention, the 8-bit world is by no means dead; the Tokyo show reassured me that my private conviction about 8-bit machines is true: there's a lot of useful software around for these machines and their performance is certainly adequate for many business applications. Thus there's still a place for them and what's happening is that — as I suspected — we're either getting more for our money, or paying less or, in some cases, both.

Take, for example, Sharp's new MZ-3500. It's a smart-looking beast which departs from Sharp's usual all-in-one configuration by coming in the 'standard' (for everyone else, nearly) three-box layout: keyboard, screen and 'mainframe' housing the disks and electronics. Inside are two Z80s (one for processing, one for I/O) plus a separate dedicated processor for the keyboard. The entry level machine has 64k of RAM, internally expandable to 128k and there's provision for taking this to 256k with an external add-on. Its display system seems a typical piece of Sharp complexity (or ingenuity?): three kbytes of character video RAM, 2k for kanji (Chinese) characters and 96k of graphics RAM. And there's more: the machine has provision for up to 32 kbytes of program ROM (presumably a Basic interpreter and some sort of operating system) and an incredible megabyte of kanji generator ROM, which probably won't be in much demand if/when the machine goes on sale here! How those poor little Z80s cope with all this heavens knows, but the graphics demo at the show looked acceptably quick and slick. Starting price in Japan is 320,000 yen, say $1380.



Eat your heart out, Clive Sinclair. This Japanese word processor managed to squeeze 12 functions from each key!

Here's Toshiba's Pasopia 16. Slimline keyboard plugs into the box under the printer which houses electronics and disk drives.



16 bits from NEC in the shape of the PC-9800 system.

Sharp also showed its MZ-2000, a very similar machine to the MZ-80B in specification and selling for 218,000 yen ($940). And the company also introduced its PC-1251, a tiny hand-held machine with Basic, very similar to the PC-1211 but considerably smaller — doubtless Dick 'Hand-held' Pountain will be telling you more about this in the next month or so.

The Sharp machine which I liked best was the MZ-700, a small home-hobby machine with 64k of RAM and a Z80, with colour TV output and sound, and software compatible with the MZ-80K/A machines. You can upgrade the machine to include a larger version of the incredibly neat four-colour plotter used in the PC-1500 and add a tape recorder as well. Both of these slot into the main unit and the result is a very useful, neat little system indeed. Japanese prices are $340 for the basic unit and $555 with plotter and recorder.

Epson launched its HX-20 portable (see Benchtest in last month's *APC)* and a range of peripherals which included a rather nice acoustic coupler, a 5¼ in disk drive and a TV interface. Epson was also doing interesting things with its range of printers — but see the 'Peripherals' section below. In addition, Epson showed a very neat 8-bit desk-top machine which can interface to an HX-20 for up- and down-loading and generally communicating. We could be seeing this machine in Australia sometime in '83.

Back on the Sord stand, a 12-deep crowd was jammed around a couple of tables showing the Sord M5, a tiny games machine in the Sinclair Spectrum mould (although Sord prefers to describe it as being suitable for 'studies, household accounts, playing intellectual games and for data processing and correspondence'). This all strikes me as a little ambitious but it's a very nice machine with excellent colour graphics (including sprites on 16 planes) and a good range of peripherals including 'joypads' (actually sort of flattened games paddles). Inside you get a rather measly 4k of user RAM, 8k of

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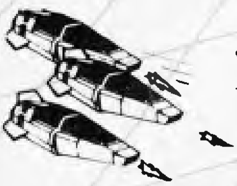

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The latest version of the arcade favourite. Your mission is to destroy the enemy submarine pack. Good graphics and includes sound. Cassette based. 16K. Cat X- 3686 normally **$14.95**

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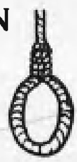
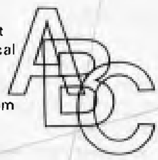


2 games for the price of 1. Hangman – a computer version of the well known word guessing game. The words can be chosen by either the program or a second player. Concentration – Two players or teams have to match prizes from behind numbers on the screen, then guess the mystery food word. Req. 16K. Cat X-3969 normally **$11.95**

ALPHABET COUNTDOWN



A great teaching & learning aid. Sets of words taken at random from a large group, must be placed in alphabetical order, in the shortest possible time. It has 3 levels of difficulty. Rhyme Time displays a series of unfinished rhymes, & the player has to type in the missing word from the clues given in rhyme itself. Cat X-3698 normally **$11.95**

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Combines basic maths drill with the ever popular Space Invaders' game – maths has never been such fun. Before being able to shoot, the player has to feed in the 'correct data' to the spaceship computer. 3 levels. Cassette based Cat X-3694 normally **$11.95**

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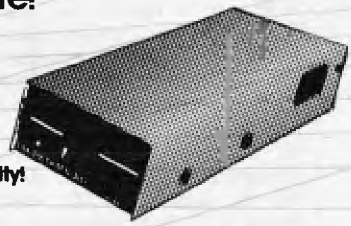

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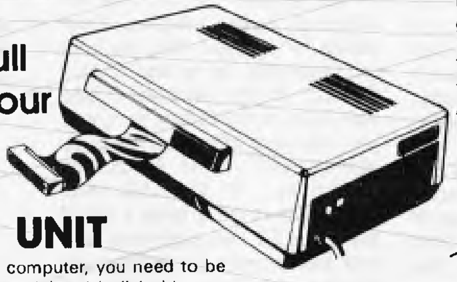

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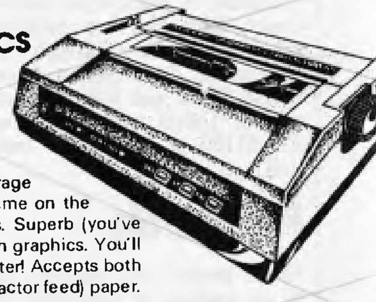

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TOKYO

ROM and a handy 16k video RAM. Software — mostly games, as far as I could see — comes in the form of plug-in 16k ROM cartridges and, apart from the joypads, you can interface the M5 to printers and to other Sord machines. The basic price of the M5 in Japan is $200, which places it a little awkwardly in the market in Australia: its graphics are far superior to the Spectrum but the latter — on paper at least — still looks better value for money, allowing for the fact that the Sord will probably sell for over $300 or so in this country

NEC and Toshiba both came up with hand-held machines of which the NEC looked the better buy, with a nicer keyboard and an LCD display of two lines of 40 characters, both upper and lower case. It has 20k of ROM, expandable to 32k externally, and 8k of RAM, externally expandable to 16k. Best news is that it's software-compatible with NEC's PC-8001 desk-top micro, but it's not cheap at $255. The Toshiba hand-held has a single-line display of only 24 characters and, it seemed, was less powerful and versatile than the NEC while selling at almost the same price — $235.

Finally in this section, there's Casio's 8-bit desk top machine, on which I have virtually no information other than it seems to run CP/M and I found it on sale in Tokyo computer shops for $1190 or so for the basic unit.

Peripherals

Epson proved that printers can be as exciting as computers by showing an ink-jet printer with a very high-quality printout indeed. Not exhibited at the show, but demonstrated privately at Epson's headquarters, was a four-colour ink-jet printer with a really impressive output; unfortunately, Epson still has a few problems to iron out (mainly with the jets getting clogged with ink, the universal problem with these printers) and nobody was able to say when the machine would be on sale or how much it would cost. Nothing to do with computers (yet) but at the same time I got to see Seiko's wristwatch TV, which uses an LCD display just over an inch diagonally. Actually, 'wristwatch TV' is a slight misnomer as the tuner and batteries are housed in a separate unit, about the size and shape of a Sony Walkman, and you run a wire down your sleeve to plug into the watch. Yes, it does function as a watch too, using a smaller display above the screen. The picture quality wasn't too good and the Seiko people reckoned that, although they will be marketing it in Japan this Christmas for about $495, a better version should be on its way next year.

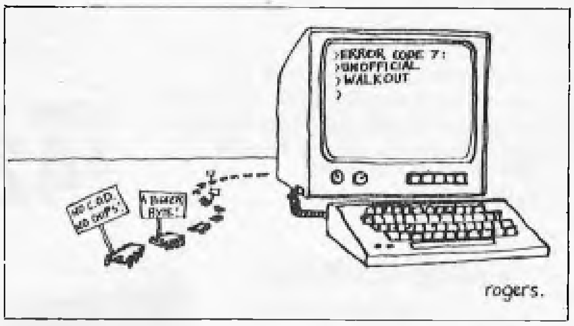
Epson did, however, show its four-colour dot matrix printer, an MX100-sized device which, while being very good, wasn't quite the same as the ink-jet machine. Over on Canon's stand they were into lasers in a big way and had several 'desk-top' laser printers eating up paper at a frightening speed. 'Desk-top' here seemed to mean 'the same size as a desk top' rather than something you'd actually stick on your desk and still have room to eat your sandwiches. The smallest laser printer was about the size of a medium-sized photocopier, in fact.

Elsewhere, we had a plethora of disk drives — hard and floppy — including the Hitachi micro-floppies but excluding the Sony variety; oddly, Sony had only a medium-sized stand devoted exclusively to Tektronics graphics displays but not even a hint of a micro to be seen.

There were several companies exhibiting video disks as high-density, low-cost-per-bit computer storage media. The fact that you can't erase and over-write them was regarded as unimportant by many of the technical people manning these stands: if a single disk can hold two gigabytes or so and costs a fraction of the price of a hard disk pack, so the theory goes, well you can just afford to keep on writing stuff to it instead of overwriting. If the disk ever does fill up (and it takes a lot of typing to fill two gigabytes) then you just transfer the latest copy of your data to a new disk and throw the old one away!

END

Sord's 16-bitter shows off its graphics.



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JUPITER ACE

Elsewhere in this issue is Dick Pountain's presentation of his proposed Forth Benchmarks, so we thought it appropriate to Benchtest a newly released microcomputer which spurns Basic in favour of Forth. It's not available in retail stores in Australia but then it doesn't retail anywhere in the world. The machine is available by mail order only from an English company (details at the end of this article) for the remarkable price of $150. Unfortunately, as of the time of going to press we've been unable to establish the additional costs of airmailing the Jupiter to Australia. So look out for the February issue of APC where full details will be given.

At last there has appeared on the market a small computer which does not use Basic as its principal language — and about time, too, as many people will no doubt think. There is no doubt that Basic is a good language for absolute beginners to play about with, but it has severe limitations and most people would soon outgrow it if it were not for the rash of 'super-Basics' with limitless features which only really hide the problem rather than solve it.

Forth has long been touted as a possible alternative to Basic for very small systems because of its compactness and high speed of execution; but although Forth is now available for many machines no one up until now has taken the plunge and produced a machine for the mass market which has Forth as its main — and indeed its only — language.

This ground-breaking machine is the Jupiter Ace and it comes as a surprise to those of us who have been waiting for a Forth machine: for a start it is a much smaller machine than I would have anticipated, priced to put it in direct competition with the Sinclairs, VICs and other giants of the mass market; and secondly it uses the Z80 which, excellent chip though it may be in other ways, is less suitable for a Forth machine than say a 6809. However, the Ace is certainly an interesting machine with many features to recommend it both to absolute beginners and Forth enthusiasts.

Hardware

The Ace has the look of a ZX80 about it: a small white plastic case measuring 210cm by 190cm and a rubber keyboard, each key having a number of symbols on it. The Sinclair background of the designers shows through in a number of other ways too. There are two edge connectors at the back of the case, one of which looks just like a Sinclair interface but isn't quite; in fact the same signals appear on this connector as do on a ZX81 but they are not quite in the same order so you cannot plug in extra memory and the printer straight away: however, an adaptor between the two would be easy enough to make and doubtless one will be appearing soon. There are four sockets around the side of the case: one jack socket for the power which comes from a separate power supply with an integral mains plug, one phono socket for the UHF output to a normal television and two for connection to a cassette recorder.

All leads are supplied — the power lead and the television lead are of quite reasonable length, but the cassette leads are a bit short and use only jack plugs instead of the more common DIN plugs. The sockets are labelled on the underside which means that anybody (like me) who gets worried about plugging the power supply into the wrong socket has to keep turning the machine upside down. The underneath also holds the interesting observation 'No user serviceable parts inside'. The user is clearly not intended to venture inside this machine, for the case is held together bv a sort of plastic rivet which needs the application of pincers to remove.

The insides of the Ace are very much as you might expect: there is a single board, the front half of which is taken up by the keyboard. The rubber sheet which forms the keyboard lies loose on the board, and when a key is pressed the part of the rubber under the key moves down to make a contact on the board. It may be simple but it is hardly elegant. I have been told that the design has been improved to overcome the tipping problem, but it still does not impress me very much. I think I would prefer to pay the extra and get a machine with a proper keyboard. The Z80 processor sits at the back left hand side of the board with 8k of ROM in two chips next to it, and the loudspeaker. The rest of the board is taken up with discrete logic TTL; no ULAs and so hopefully no delays! The design again is reminiscent of the ZX80. The board itself is not of the highest quality but it looks well put together; it will need to be strong because the case itself is quite flimsy.

There is no on/off switch — the power plug being simply removed and inserted to perform this function. When the plug is inserted and the television tuned in then you are rewarded by a black screen with a small rectangular cursor at the bottom left hand corner, a refreshing change from the usual blowing of horns (and own trumpets) so beloved of many manufacturers.

A good approach to any new Forth system is to get it to 'VLIST' all the words in the dictionary, which breaks the ice by filling the screen with characters; it worked normally on the Ace.

The first noticeable thing about actually using the Ace is that the keyboard could take a lot of getting used to; each key needs a firm push in the centre otherwise it is liable to tip sideways and not make contact. There are both lower and upper case letters available, and most keys also have a symbol on them; there is a normal shift key on the lower left hand side which gives upper case letters but also gives some control functions when used on the top row of numeric keys. For example, shift-0 is to delete the previous character, shift-9 switches to graphics mode, shift-5 to 8 are the four cursor controls, shift-4 inverts the video, shift-2 is CAPS LOCK and shift-1 deletes an entire line.

The second shift key on the right hand side is labelled 'symbol shift' and is used to obtain the mathematical and punctuation symbols on most keys. All keys are the same size except for the space which is double sized and in the extreme bottom right hand corner; shift space acts as a BREAK in most circumstances. The display is black and white giving 24 lines each of 32 characters. It is not a particularly good display (but reasonable for this price of machine), having no proper descenders on lower case letters, for example. All commands are entered on the bottom line of the display, and on pressing return they are moved to the next available line at the top of the screen and then executed. Ace Forth does not distinguish between upper and lower case for commands, all words being converted to upper case before incorporation into the dictionary, though they are distinguished in anything that is not a dictionary name — ie, string input.

Software

The list of words produced by the VLIST command shows a fairly normal Forth basic dictionary with one or two omissions and one or two additions to the 79-Standard. The one major departure from any other Forth system I have ever used is

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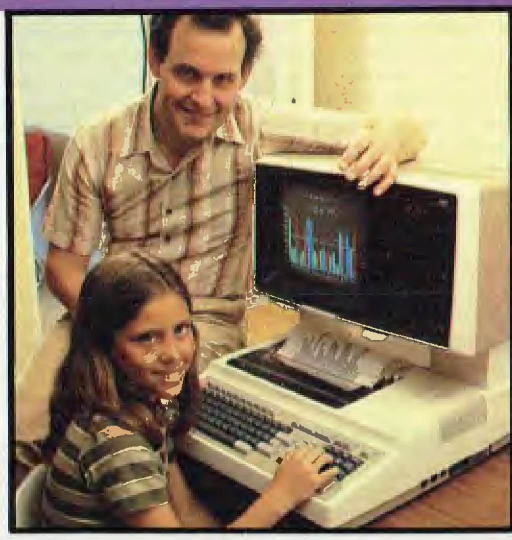

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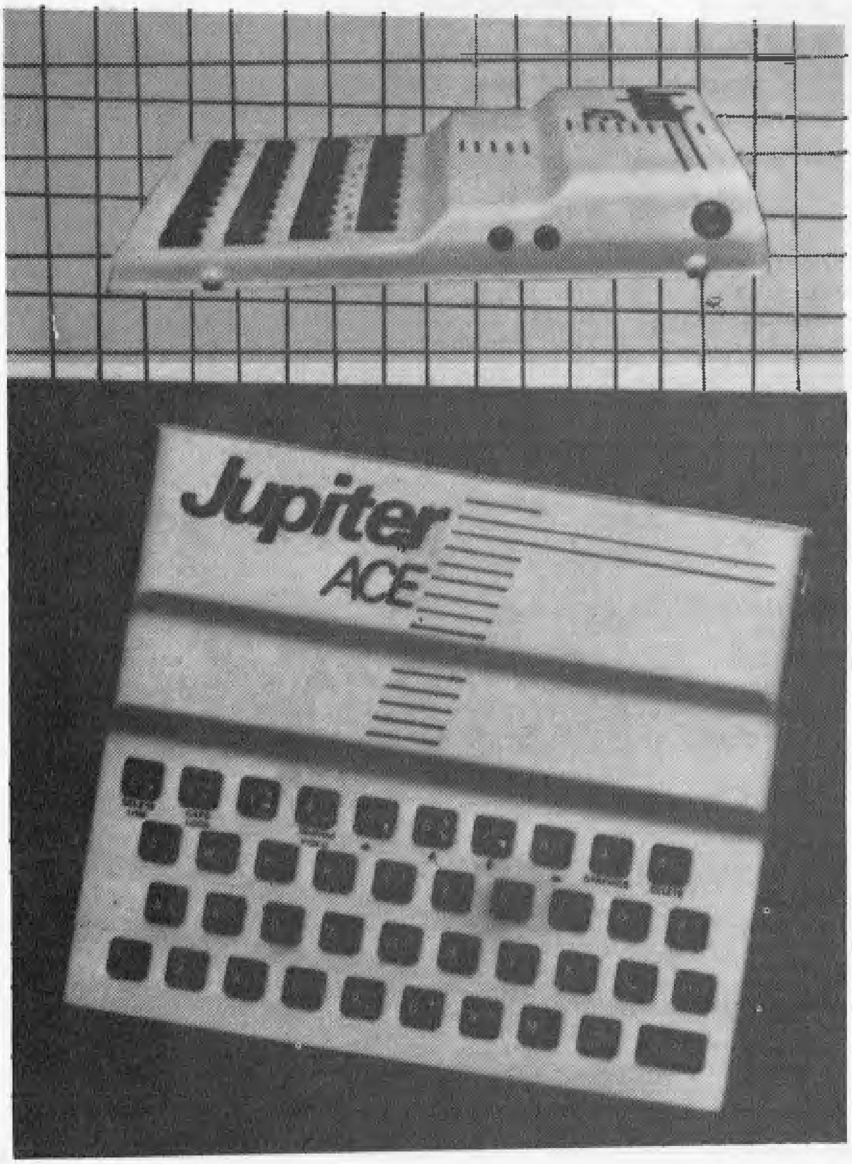
JUPITER ACE

the way of entering and editing source code. Normal Forth systems are 'screens' which are 1K blocks of memory normally held on disk and transferred into a buffer when needed: a vocabulary of editor commands is used to manipulate text on these screens while they are in memory — for example to write Forth code which can be saved on the disk or loaded into the dictionary. A sort of virtual memory is used, where the system will decide whether a given screen is in memory, and fetch it from disk if it is not. This has always been a difficulty with cassette-based Forth systems; how to duplicate this system? It has normally been resolved by the use of a number of buffers in RAM as a pseudo-disk whose contents could be written to or read from tape.

The Ace uses a different technique entirely: incorporated into the basic dictionary are three words LIST, EDIT and REDEFINE which use a powerful decompiler to edit source code. Forth definitions are entered at the keyboard and entered into the dictionary immediately; this can be done on most Forth systems but that new definition is not normally accessible anymore except to execute it or forget it. The Ace, however, can access any word that has been defined in this direct way; LIST will list the definition of the word on the screen, EDIT will make it available for editing using the cursor keys. As soon as enter is pressed the new definition is added to the top of the dictionary. This of course leaves you with an extra copy of your word but the use of the command REDEFINE causes the new copy to be put back to the previous position in the dictionary with the rest of the dictionary being adjusted accordingly.

The same edit mode is entered if there is an error in a word definition. An interesting side effect of this form of editing is that it is possible to make forward definitions, using words that have not yet been defined; the trick is to use an arbitrary predefined word in place of the yet-to-be-defined word. Later, when you have defined this word properly, you can return to the higher level word which is meant to use it and insert it in the appropriate place. REDEFINE will now move this high level word back, pointing forward for one of its components.

The problem of saving to tape is overcome in two ways: the entire RAM dictionary (that is, excluding the predefined words in ROM) can be saved to tape using the SAVE command, and these tapes can then be loaded using the LOAD command to be added onto the dictionary. There is also a VERIFY command to check the contents of a tape against the contents of memory. The second way of saving data is by the BSAVE, BLOAD and BVERIFY commands which save, load and check a block of memory between two addresses on the stack. This could be particularly useful for saving screen pictures from the memory mapped screen. I tried recording and playing back on two standard cassette recorders; one gave no trouble at all, the other gave a few problems but it's one I've had trouble with before. The standard of recording seems quite adequate and fast at 1200 baud.



The rest of the supplied dictionary is fairly standard (see the accompanying table of words for a more comprehensive comparison with 79-Standard Forth), but there are some more interesting features. There is a floating point facility supplied, which should placate many Forth critics. Words F+, F−, F*, F/, F., FNEGATE, INT and FNEGATE allow a full range of floating point calculations to be done to 6-digit precision and the normal Forth double numbers are available as well. There are words VIS and INVIS which can cause the screen to blank out and reappear and (another relic of the ZX80?) the words FAST and SLOW to control the speed of execution. FAST does not use any error-checking procedures (such as stack size) so programs run appreciably quicker, but of course this should not be used until the program is known to be working properly in the SLOW mode.

There is a limited sound generation facility using an internal speaker, and the word BEEP is provided to control this. It takes two parameters off the stack to specify pitch (period in units of 8 microseconds) and duration in milliseconds. There is a table in the manual giving appropriate pitch values for various notes. The sound produced is rather weak but it could produce reasonable sound effects for games. The other major provision is a graphics facility provided by the word PLOT. The resolution is 64 pixels across by 46 down, which is hardly high by today's standards but the graphics are generally easy to use; it is quite painless and a good exercise to define your own words to draw lines or shapes, and the speed of execution, even in slow mode, is very good as you would expect from Forth. Animation is straightforward and it is possible to get a higher resolution if desired by programming the character generator which is RAM-based. Some examples of how to do this are given in the manual.

One other noteworthy difference between Ace Forth and 79-Standard is the provison of two constructions DEFINER .....DOES> and COMPILER.....RUNS> to replace the normal CREATE.....DOES> construction to define new defining and compiling words. They work in the same way, though, and so anyone who is familiar with Forth or who is using a book such as *Starting Forth* should find no difficulty.

CODE definitions are provided to produce faster execution for hex instructions (or decimal or any other base) as no assembler is included, which is fairly unusual for a Forth system. Given the extensible nature of Forth, however, once the user has become a reasonably competent programmer they should soon be able to produce an ASSEMBLER vocabulary if desired. The way that this Forth system works is another interesting departure from the norm. Most Z80 Forth systems use the machine stack for the data stack and arrange the return stack by other means, but Ace Forth does the opposite. Indeed the data stack is not in a fixed position at all but remains at 12 bytes up from the current top of the dictionary, the ROM part of the dictionary occupying the bottom 8k on the memory map. The return stack is placed via a system variable at the top of available memory and grows downwards, the dictionary and data stack growing up to meet it. The 3k or so of space that is available for this is available for this is much more usable than you would expect because of the compact nature of Forth, but it is not exactly huge and you are going to run out of space fairly soon; there is not sufficient space to store all the Benchmarks at the same time, for example. This organisation does, however, mean that the system can immediately take advantage of extra memory simply by initialising the return stack at the highest available memory.

The version of Forth implemented on the Ace, in summary, is a good version which incorporates all the desirable features of a standard Forth dictionary with additions to make full use of the features of the machines; some useful words which are omitted can easily be added if the need arises.

Documentation

The manual is impressive; written by Steven Vickers, one of the two designers, it sets out to be both a user's manual and a self-instruction course in Forth. It does not quite succeed but it does as good a job as most other manuals for machines in this class. It has 181 pages with illustrative examples of the use of all the words in the dictionary, and reference sections including details of the memory map and locations for all the system variables, so all features of the machine are available to the user. A section of the manual explains how to write code definitions (words defined in machine code for extra speed). The manual is written in a fairly light-hearted manner, so that anyone intelligent enough to want a computer in the first place should be able to make sense of it. An illustration of the style is this quote from the section on loading programs from tape: 'Let us suppose that your tape has an interesting program called DVLC — it runs a game in which you are menaced by hundreds of vehicle licence application forms falling out of the sky, and you have to destroy the enclosed vehicle registration documents.' Clearly the author has had a recent unfortunate experience.

Benchmarks

The Benchmark timings given below were taken using the Benchmark programs discussed elsewhere in this issue. They were taken in SLOW and FAST modes. The word SP! which is an essential element of these benchmarks is not available in Ace Forth, so I have defined it as

```
: SP! HERE 12 + 15419 ! ;
```

Where HERE 12 + calculates the bottom of the stack at 12 bytes up from the next dictionary space and 15419 is the address of the system variable SPARE (not available as a Forth word) which holds the next free space on the stack. The timing of 'magnifier' is subtracted from the other figures to compensate for the time taken by SP! which would, of course, have been much quicker if defined as CODE.

Conclusions

The Jupiter Ace is a cheap computer at $150, and externally it looks cheap. It does not have colour and with the price of colour machines dropping fast this could turn out to be a big disadvantage. It has as yet no peripherals, though Sinclair ones can be adapted and Jupiter themselves will shortly be bringing out a parallel Centronics interface. There is no software around either as yet but hopefully this will change soon especially if a large number of machines are sold; it could even bring about a boom in Forth software which could be run on a variety of machines. It is a bit difficult to imagine what the market for this machine will be; a lot of people may be put off by the Forth language itself with its use of Reverse Polish notation (calculators which use this system have never been particularly popular except in the scientific community). However, there are real benefits to be had from this machine as opposed to many of its competitors; programs will run appreciably faster than their equivalents on a Basic machine and anyone who is prepared to persevere with Forth will find it a rewarding experience which will lead to a quicker program development time, and more reliable programs as well as a better understanding of the operation of the machine. The Jupiter Ace is a very interesting machine; I would not like to predict whether or not it will be a sales success but it deserves to be. It uses a very good version of the Forth language and has a reasonably clear and detailed manual.

The Jupiter Ace is available only through mail order at present from Jupiter Cantab Ltd, 22 Foxhollow, Bar Hill, Cambridge CB3 8EP, England. The price including power supply and leads is £89.95, which is **about $150.**

Benchmark timings

BM	Name	Time SLOW	Time FAST
1	magnifier	10.6	6.3
2	do-loop	27.8	20.9
3	literal	44.5	28.6
4	variable	42.6	27.4
5	literal-store	77.1	43.6
6	variable-fetch	60.7	36.1
7	constant	43.3	27.4
8	dup	64.7	39.9
9	increment	62.9	38.0
10	test>	3.1	51.5
11	test<	113.9	71.6
12	while-loop	131.3	81.9
13	until-loop	127.9	78.6
14	dict.-search	16.7	12.4
15	arithmetic	98.5	62.6

See also 'Forth Benchmarks' elsewhere in this issue.

Fig 1 Table of Forth words used by the Jupiter Ace

!	★	★/	★/MOD
(	°	°/	°/MOD
+	+LOOP	.	.
-	."	/	/MOD
0<	0=	0>	1+
1-	2+	2-	:
;	<	<£	=
>	>R	?DUP	@
ABORT	ABS	ALLOT	AND
ASCII	AT	BASE	BEEP
BEGIN	BLOAD	BSAVE	BVERIFY
C!	C,	C@	CALL
CLS	COMPILER	CONSTANT	CONTEXT
CONVERT	CR	CREATE	CURRENT
D+	D<	DECIMAL	DEFINER
DEFINITIONS	DNEGATE	DO	DOES>
DROP	DUP	EDIT	ELSE
EMIT	EXECUTE	EXIT	F*
F+	F-	F.	F/
FAST	FIND	FNEGATE	FORGET
FORTH	HERE	HOLD	I
I'	IF	IMMEDIATE	IN
INKEY	INT	INVIS	J
LEAVE	LINE	LIST	LITERAL
LOAD	LOOP	MAX	MIN
MOD	NEGATE	NUMBER	OR
OUT	OVER	PAD	PICK
PLOT	QUERY	QUIT	R>
REDEFINE	REPEAT	RETYPE	ROLL
ROT	RUNS>	SAVE	SIGN
SLOW	SPACE	SPACES	SWAP
THEN	TYPE	U*	U.
U/MOD	U<	UFLOAT	UNTIL
VARIABLE	VERIFY	VIS	VLIST
VOCABULARY	WHILE	WORD	XOR
[	]		

The following 79-Standard words do not appear in Ace Forth: ', +!, -TRAILING, 79-STANDARD, >IN, ?, CMOVE, COMPILE, COUNT, DEPTH, EXPECT, FILL, KEY, MOVE, NOT, STATE, [COMPILE], SP!.

The following words are extra to 79.Standard Forth: ASCII, AT, BEEP, CALL, CLS, FAST, IN, INKEY, INVIS, LINE, OUT, PLOT, RETYPE, SLOW, VIS.

Technical specifications

Processor	Z80 3.25MHz
ROM	8k
RAM	3k
Keyboard	Rubber keys, 40 keys with auto-repeat and caps lock
Mass storage	Domestic cassette recorder, 1500 baud.
Screen	TV (black and white), 32x24 characters, 64x46 dots in graphics
Sound	Internal speaker
Ports.	Expansion port contains power rails, address, data and control lines. Accessible through IN and OUT.
Language	Ace Forth

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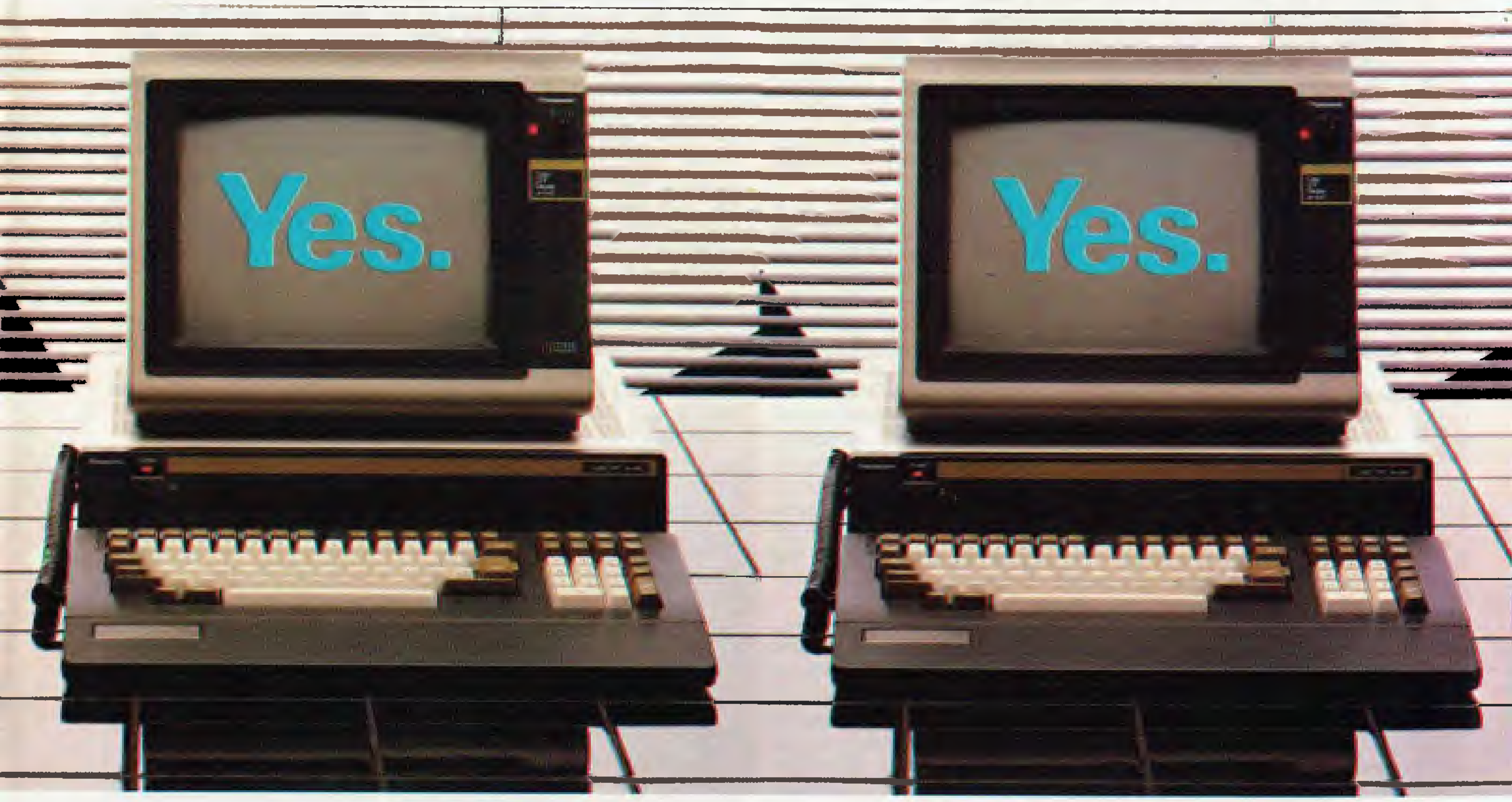

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FORTH BENCHMARKS

APC already has a set of Benchmark programs for Basic so, as Forth is becoming more widespread on personal computers Dick Pountain has produced an equivalent Benchmark set, the first results of which are printed here.

It seems likely that during 1983 Forth will finally emerge from the shadows and take its place as a major microcomputer language. The evidence for this assertion is not hard to find: during 1982 Forth systems at reasonable prices have become available for most of the popular low priced micros, while the Jupiter Ace, reviewed in this issue, makes the language available to beginners for less than the price of many software systems. The number of professional level Forth systems under CP/M is now quite bewildering. At the West Coast Faire last year there were more Forth than Pascal products on display. IBM has commissioned and sold Forth developed software for its PC while Atari's arcade games are now developed in a graphics Forth. This is not the place to go into how Forth works (see *APC* Jan 1982 or Brodie's magnificent book *Starting Forth).* Nor am I going to oversell Forth as the universal panacea for programming problems as has, unfortunately been done so often before.

After a year of working in Forth I have formed a somewhat more realistic opinion of its capabilities and shortcomings; suffice it to say that I remain impressed enough to use it whenever appropriate for serious programming tasks and to offer these Benchmarks for evaluating Forth systems.

Forth is definitely not a suitable replacement for Basic as a beginner's language, anymore than a Ferrari is a suitable car for learner drivers. Logo is a much better bet to take on this role. What Forth does offer, as a second language, is a complete programming environment which offers more control over the computer than any other interactive system which is currently available. Notice the word interactive; the main rival to Forth for flexibility and power in systems programming is C (and its progenitor BCPL). C offers advantages over Forth in that it produces stand-alone machine code modules which can be linked to programs produced by other compilers, whereas Forth generally requires run time support from a Forth interpreter. C-produced code will usually run slightly faster, too. But C is not interactive; it is a compiler in the old Fortran tradition (and even slower to compile) and thus goes against the grain of the microcomputer philosophy. For large projects by professional programmers this doesn't matter, but for we mortals the interactive 'suck-it-and-see' approach is what makes programming bearable.

Forth is not only interactive; it is more interactive than any other language in existence. How else can you sit at a terminal and work in any number base you desire at a keystroke, dump blocks of memory, mix Assembler in with your high level code, manipulate any object from a bit up to an array or file without ever leaving the system? And it's structured, too. One myth which circulates about Forth is that the code is always unreadable; the truth is that it can be as readable as you want to make it. The commenting facilities in Forth are unlimited and since you decide word names (up to 31 characters on my system) it is your responsibility to make them intelligible. One day soon I intend to publish in *APC* a fairly heavyweight piece of Forth code I have produced which is certainly as readable as Pascal.

Anyway, on to the Benchmarks. Since Forth is an extensible language it presents some problems in choosing the level at which to write Benchmark programs. In order to produce programs which stand a chance of running on all systems it is necessary to restrict the functions tested to the 'core' words which are mainly control constructs or stack manipulation words. I have not tested any lower, byte level, words as these tend to be almost 'naked' machine instructions and one ends up Benchmarking the processor not the implementation. Similarly high level structures like strings and arrays are excluded because they are not implemented on many systems. Floating point extensions are becoming more widespread and could be a candidate for future addition.

Even having decided to stick to core words there were problems over standards. There are two major variants of the Forth core, the Forth Inc version and the Forth 79 Standard plus lots of 'eccentric' versions such as Transforth and Stackworks Forth. The differences are usually only a matter of names; there are equivalent words in most systems but they may be called by different names. I have chosen (with one exception) to go for Forth 79 Standard words in these programs as this gives compatibility with most fig-Forth systems. The fact that my own system is 79 Standard of course didn't influence me at all.

The exception I mentioned is the word SP! which removes all the contents of the data stack. This isn't required in the standard though it is in fact implemented in a lot of 79 systems. The reason it's required is as follows. *APC's* other Benchmarks are analytical in the sense that by subtracting the timings of successive tests one can isolate the time due to a given instruction (not completely true for the arithmetic functions). We feel that this is a desirable feature which is why we haven't adopted catch-all tests such as Eratoshenes Sieve. (For a full account of Benchmarks see *APC* Nov '82.

Forth is so fast that most of the programs test 100,000 iterations (and that is barely sufficient for 'magnifier'). No Forth system in the world can hold 100,000 items on its stack and so the stack has to be cleared if we are to get a direct timing for any word which leaves a result on the stack. Hence SP! is required. I have deliberately placed it in 'magnifier' which is meant to be subtracted from the other timings as a constant overhead. If you want to run the BMs on your system and don't have SP! or an equivalent, you must write one; it hardly matters whether it's in machine code or high-level as it's part of the overhead. I had to write SP! for two of the systems timed here, PicoFORTH and GraFORTH. PicoFORTH keeps the stack pointer in a processor register; the definition in 8080 code is:–

```
CODE (SP!) H POP SPHL NEXT JMP
  : SP! S0 @ 2 – (SP!) ;
```

The word S0, which is present in most systems is a variable holding the address of the stack base; many systems also have SP@ which fetches the address of the stack top.

GraFORTH uses RAM locations and has the unForthlike PEEK and POKE so

```
: SP! 7680 156 POKEW ;
```

```
Block 8001
 ( PCW Forth Benchmarks - Dick Pountain 10th Nov 1982)

  FORTH DEFINITIONS   DECIMAL

 : magnifier  ." S" 10001 1 DO
                      SP! LOOP ." E" ;

 : do-loop    ." S" 10001 1 DO
                            11 1 DO LOOP
                      SP! LOOP ." E" ;

 : literal    ." S" 10001 1 DO
                            11 1 DO  9  LOOP
                      SP! LOOP ." E" ;
                                                     -->

```

```
Block 8002
 ( Benchmarks 2)

  VARIABLE V

 : variable       ." S" 10001 1 DO
                              11 1 DO  V  LOOP
                        SP! LOOP ." E" ;

 : literal-store  ." S" 10001 1 DO
                              11 1 DO  9  V !  LOOP
                        SP! LOOP ." E" ;

 : variable-fetch ." S" 10001 1 DO
                              11 1 DO  V @  LOOP
                        SP! LOOP ." E" ;
                                                     -->
```

does the trick here.

Some readers may wonder why TEST> and TEST< are both included. When I was checking out different candidates I discovered that on my system (xForth 1.2) a > test is 50% slower than a < test, because it is defined at high level using <. I thought this was useful knowledge as by choosing appropriate logic it is possible to save time, and so included both in the BMs.

I deliberately haven't included any timings for compilation as this is so I/O dependent: there would be no basis for comparison between disk and cassette based systems for example.

What of the systems timed here? Z-80 FORTH is a product of Laboratory Microsystems in Los Angeles and has established itself as one of the best CP/M systems available. It is based on fig-FORTH 1.1 recoded for the Z80. It features a first class screen editor, floating point extensions, and a true Z80 assembler and it has the ability to generate a new system for any RAM size of host with any required extensions included. All the high level source code is included and it uses a CP/M-compatible file format to store screens.

xForth is a British product from AIM Research of Cambridge, and also runs under CP/M. It has a 79 Standard kernel with lots of very advanced extensions. In particular, it has facilities for modular programming with local variables, run-time conditionals and conditional assembly (8080 assembler), and full CP/M file handling capabilities which can access, for instance, Wordstar files. Floating point and sequential files (with pipes and spooling) are available as extras. It has an even better screen editor than Z-80 FORTH which includes a global search-and-replace and user configurable control codes.

PicoFORTH is a 'kosher' product from Forth Inc, itself. Meant as an introduction to Forth programming rather than as a professional system, it is a smallish single-user subset of multitasking polyFORTH. An 8080 assembler is provided but only the original Forth line editor which is rather spartan compared to the editors on the other systems tested. Although it boots from CP/M it does not use CP/M compatible files but 'pure' Forth blocks. This means you cannot, for instance, copy files with PIP nor interface with CP/M via system calls.

GraFORTH is a special graphics language, based on Forth, for the Apple II; it is written by Paul Lutus of Applewriter fame (notoriety?). It provides some very nice features for animated 3D graphics and music synthesizing. The demo programs impressed everyone who saw them, even given the limited resolution of Apple graphics. It is possible to draw a wire-frame picture using turtle graphics and then animate it by scaling, rotation and translation without any more drawing at all. As a Forth system it is rather eccentric with numerous wilful deviations from Forth practice which make it hard to come to or go from this to a 'standard' system. For instance, variables are handled in a Basic-like assignment statement eg. L 1 + –> L and put their value rather than address on the stack when called (which is why I have no timing for 'variable'). The editor is based on the Apple Basic editor using the same ESC codes and line numbers; it is quite nice to use. No floating point or assembler is included. Unusually GraFORTH is directly threaded – ie, it compiles 6502 code rather than pointers into its headers; the effect on the time for 'dictionary-search' is very noticeable.

Working Forth is a teaching system from Mountain View Press of California based on standard fig-FORTH. Like picoFORTH, this is a 'pure' system which doesn't use CP/M files. It has a large number of screens of teaching-machine type instruction which have the nice feature that the student can come out into Forth and do exercises and then easily start at the point he/she left off (or indeed repeat a lesson). The quality of the teaching is high, if perhaps rather forbidding the total novice: it would be better to know Basic and best to know some Assembler before approaching it. It represents terrific value for money, though, because you get a full Forth system with assembler and editor (an enhanced line editor) which will keep you happy long after you finish the teaching course. They even give you the assembler source for the kernel on disk. The documentation is very rudimentary, however, as most of it is meant to be on the screen.

At the last minute before hitting the press I received a copy of Kuma Computers' Forth for the Sirius 1. This is a fig-1.1 based system written in genuine 8088 code, and as you will see from the timings it is indeed quicker than a 4MHz Z80 version except in the odd case of 'increment' (maybe in high-level?). It seems, at cursory aquaintance, to be a nice implementation, with a simple but effective screen editor. It goes well beyond the 79 Standard with a large part of the Reference Word-set included. It comes with

```
Block 8003
( Benchmarks 3)
9 CONSTANT K
: constant   ." S" 10001 1 DO
                       11 1 DO  K  LOOP
                 SP! LOOP ." E" ;
: dup        ." S" 10001 1 DO
                       11 1 DO  9 DUP  LOOP
                 SP! LOOP ." E" ;
: increment  ." S" 10001 1 DO
                       11 1 DO  9 1+  LOOP
                 SP! LOOP ." E" ;
                                          -->
```

```
Block 8004
( Benchmarks 4)
: test>     ." S" 10001 1 DO
                      11 1 DO  9 9 >  LOOP
                SP! LOOP ." E" ;
: test<     ." S" 10001 1 DO
                      11 1 DO  9 9 <  LOOP
                SP! LOOP ." E" ;
: arithmetic   ." S" 10001 1 DO
                      9  2 / 3 * 4 + 5 -
                  SP! LOOP ." E" ;
                                          -->
```

```
Block 8005
( Benchmarks 5)
: while-loop   ." S" 10001 1 DO
                       1  BEGIN 1+ DUP  11 < WHILE REPEAT
                  SP! LOOP ." E" ;
: until-loop   ." S" 10001 1 DO
                      20  BEGIN 1- DUP  11 < UNTIL
                  SP! LOOP ." E" ;
                                          -->
```

```
Block 8006
( Benchmarks 6)
: ten ;
: nine  ten ;
: eight  nine ;
: seven  eight ;
: six  seven ;
: five  six ;
: four  five ;
: three  four ;
: two  three ;
: one  two ;
: dictionary-search  ." S" 10001 1 DO
                          one
                     SP! LOOP ." E" ;     -->
```

System	Z-80 FORTH v 1.14	xForth v 1.2	Working Forth v 2.5	picoFORTH	GraFORTH	Kuma Forth
Host machine	Transam Tuscan 4Mhz Z80	Sharp MZ80B 4Mhz Z80	Transam Tuscan 4Mhz Z80	Superbrain 4Mhz Z80	Apple II Euro+ 1Mhz 6502	Sirius 1 5Mhz 8088
Operating System	CP/M 2.2	CP/M 2.2	CP/M 2.2	CP/M 2.2	DOS 3.3	CP/M 86
magnifier	1.3	1.2	1.4	3.6	4.3	1.0
do-loop	9.5	8.6	10.1	11.4	18.0	6.5
literal	13.2	11.4	13.7	14.7	26.5	8.9
literal-store	19.4	16.4	20.1	21.0	27.9	13.7
variable	12.2	10.6	12.9	14.1	Not applicable	8.7
variable-fetch	15.8	13.6	16.5	17.7	26.8	11.5
constant	13.0	11.2	13.7	14.9	Not applicable	9.1
dup	16.4	14.0	17.0	18.4	30.7	11.5
increment	16.2	13.8	16.9	17.8	41.4	19.5
test>	21.4	28.0	36.2	22.9	52.1	23.3
test<	21.4	18.3	23.8	22.7	51.7	15.3
while-loop	22.5	18.9	25.4	24.2	56.2	25.9
until-loop	20.4	16.8	22.9	21.7	54.7	18.9
dictionary-search	10.0	8.0	10.3	12.1	5.3	6.3
arithmetic	29.1	21.0	41.3	26.0	25.7	23.5

FORTH BENCHMARKS

floating point but no assembler, and does not have full CP/M86 file compatibility though you can read a CP/M86 file into RAM at a chosen address using a routine called READFILE. It has a reasonable manual and user guide which is short on low-level information, however.

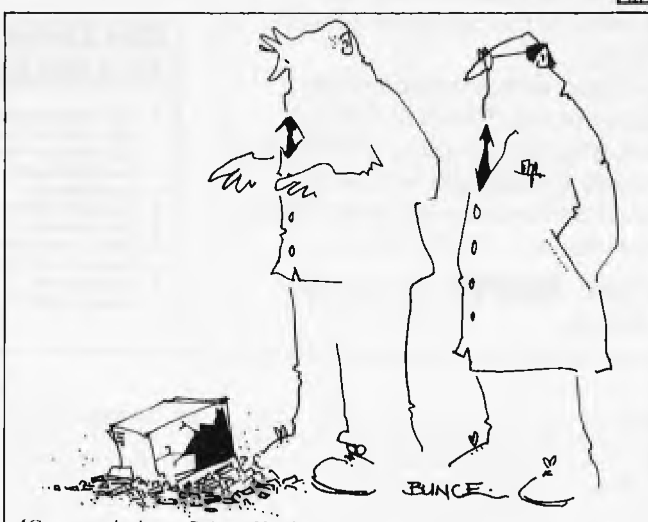
What is my overall impression of the products? As far as speed is concerned the Z80 systems were not far apart as you can see from the table. The 6502 system was slower overall than I would have expected. My money is already on the table as I am an xForth licence holder (and extremely happy with it), although Z-80 FORTH runs it pretty close. The ability to work on CP/M files from either of these is of inestimable value to me; I can write utilities such as word count programs to work on Wordstar or Cardbox files without having to buy a CP/M Basic or resort to assembler. These two also have excellent documentation which allows you to probe as deep as you will into the system.

I hope that any Forth using readers will run the Benchmarks and send in their timings so that I can print updates on an annual basis. Please specify what processor and clock-rate if you do this. Any suggestions for improvements or modifications will also be welcome.

Addresses of suppliers

AIM Research, 20 Montague Road, Cambridge – xForth.
Laboratory Microsystems, 4147 Beethoven St., Los Angeles, CA. 90066 – Z-80 FORTH.
Mountain View Press Inc., PO Box 4656, Mountain View, CA 94040 – Working Forth.
Insoft, 10175 Barbur Blvd, Suite 202B, Portland, Oregon, OR 97219 – GraFORTH.
Kuma Computer Ltd., 11 York Road, Maidenhead, Berks – Kuma FORTH.

END



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HOW TO MAKE EPSON, WORDSTAR AND OSBORNE SING AND DANCE

Bob Huckle shows how to get the best from your Osborne/Epson combinations.

When I first discovered the Epson MX-80 I believed I had grasped all the reasons for its success. In my view it scored heavily on all fronts — practicality, ease of use, reliability, and cost-effectiveness. On top of all this it batted along bidirectionally and logic-seekingly at 80cps, it looked good, and it was portable (it came in a sturdy box with a handle on it).

One morning I received a telephone call from a distressed customer. In desperation he had taken a stop watch to his MX-80. It was only printing at 50 cps! Oh dear, had those 'awfully nice' Epson people let me down? Further investigation showed that it was also printing with a jolly nice but non-standard typeface (this however was of no interest to my customer).

I took the printer along to the surgery where I received some sound advice from the chief fitter. . . 'When in doubt, read the manual!' It seemed like a good idea and an hour or so later I was almost overcome with the delights displayed before me (I get excited easily) . . . Print options galore, true superscripts and subscripts, the ability to change line heights, a host of international character sets, and full graphics capability! All this for what price?

Being reasonably versed in the art of Wordstar, it was not long before I was experimenting with the different ways of making the MX-80 sing and dance from within a document file. I have also spent some time heavily involved with the Osborne 1 and decided that the combination of these three world leaders required further investigation.

Let's start with the MX-80. Figure 1 shows some of the different print options available. If you find one of the options so pleasing that you would like to use it all the time, the best approach is to modify the printer internally. Refer to the section in your Operation Manual entitled 'Setting the DIP Switches'. Take it slowly and you should find this a simple matter.

It would be nice, however, if you could get the MX-80 to obey your will by selecting the different print options whenever you desire. The way you do this is by sending a sequence of control characters to the printer while it is turned on. The different characters determine the different print options. When you turn the printer off and back on again it resets itself back to normal. You can send these characters directly from the keyboard of your computer (in this case an Osborne). Or you can send them from within a program (in this case Wordstar).

Direct from keyboard

I suggest this method for experimental purposes initially. Load your Wordstar disk and then return immediately to the operating system by typing X. The CP/M prompt A>_ is displayed on the screen. Now type ^P and <CR>. The printer should have jumped into action. From now on, everything you type at the keyboard will be sent to the printer. Let's tell it to print everything in emphasised mode. Type <ESC> E <CR>. Some gibberish will appear on the screen and on the printer — don't worry about this. Now type ^P and <CR> again. This stops your typing being sent to the printer. Return to Wordstar by typing WS <CR> and away you go!

Anything you now print will appear in emphasised mode. Remember, by turning the printer off you set it back to normal. To select other print options, merely enter the correct sequence of characters instead of <ESC> E above. Table 1 gives the correct sequences to be sent for each different option. To choose one print option while using another, you first have to deselect the one in use. The simplest method is to turn the printer off or send <ESC> @ to initialise the printer.

Try experimenting with some combinations. In particular send the combination <ESC> S ^A <ESC> A ^F. This combination is ideal for those terms and conditions you don't want anyone to read!

The table also includes the sequence of characters which turns off the paper end detector. With this off you can feed single sheets through without that blasted buzzer sounding and the printer stopping half way down the page.

Direct from Wordstar

Of course, the ideal solution for a user of Wordstar and the MX-80 would be the ability to select the printer's options while creating a document. Hence enlarged titles, emphasised subtitles, condensed tables, etc, could all be chosen at will, to enhance the presentation of the text. We have seen how print options are selected and deselected by sending a unique sequence of characters to the MX-80. These sequences can be sent from within Wordstar and the ^P menu

Print Option	Keyboard Entry Sequence
Condensed	^O
Double Strike	<ESC> G
Emphasised	<ESC> E
Enlarged	<ESC> W ^A
Subscript*	<ESC> S ^A
Underline	<ESC> -
Line Heights	
6 lines per inch (default)	<ESC> 2
8 lines per inch	<ESC> 0
3 lines per inch (double spaced)	<ESC> 3 H
1.5 lines per inch (triple spaced)	<ESC> A 0
12 lines per inch	<ESC> A ^F
Other Options	
Initialise Printer	<ESC> @
Turn off paper end detector	<ESC> 8

* Sadly you can't access the Superscript option directly from the keyboard, because you need to send <ESC> S ^@ Does anybody know a way of typing ^@ on the Osborne?

Table 1: Direct keyboard entry sequences from the Osborne 1.

This is the normal default printing mode. Here the MX-80 prints at 80 cps and produces 6 lines per inch. This mode is usually used for fast draft printing.

This is condensed mode which will print up to 132 characters on A4 paper. It's useful for financial reports.

These are double printed characters. They are different to WordStar ^PB characters because the printer offsets slightly on the second pass of the head.

This is emphasised printing. It gives an even stronger impression on the paper. The print speed is reduced to 50 cps.

This^{1} line^{2} demonstrates* true superscript printing.

Some enlarged printing

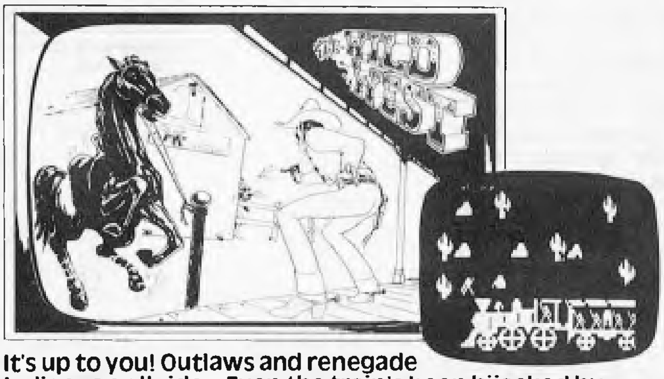
The MX-80 has its own underlining facility. It provides a true underline instead of dashes and you don't have to fill in the spaces manually!

Most combinations are possible. One of the most interesting is Enlarged/Condensed. It produces 66 columns on A4 paper.

This is a combination of Double Printing and Emphasised. Find the dots in this one!

Fig 1 Some examples of MX-80 print options.

If your hands start to sweat, your mouth gets dry, and hair stands on end, you're probably playing one of our new games.



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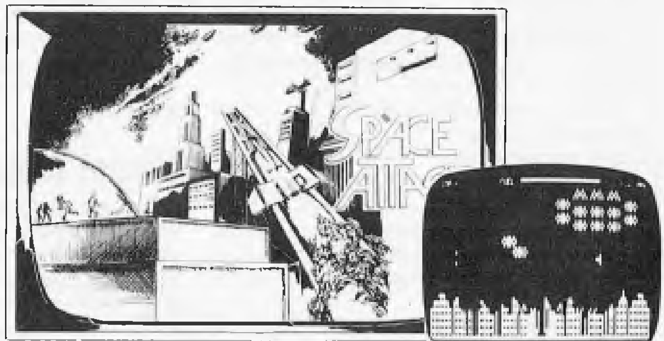

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SING AND DANCE

holds the clue. Choosing one of the options from V through to R sends a unique sequence of characters to the printer! At the moment, they're not sending the sequences we want to send, but some of them we can easily change. MicroPro has made it easy for us to change Q, W, E and R. But you can also change V, T (these are not true sub/superscripts at the moment), Y (there is no alternative ribbon colour on the MX-80), A and N (there isn't really an alternative pitch either). I won't go into the reasons why, but the others are best left for the time being.

Ignore for the moment what the above options are supposed to do. Just look upon them as sequences of characters being sent to the printer. By changing these sequences, we can decide what the relevant ^P menu options will be. I have decided that the easiest way to do this is by using DDT. For Osborne users, DDT is located on your CP/M utilities diskette. We are about to mess about with the Wordstar program itself. Don't do this on your master diskette. Make a copy.

Before we begin, there are some things we need to be aware of. Wordstar is stored on disk in hex code. One hex character is in fact represented by two normal characters. Hence 1B 00 2D 6C represents four hex characters. Each cell of your 64k memory has a unique address. These addresses are also represented in hex. Typical addresses might be 06DD 0799 and 06CF. DDT gives you the ability to:

1. Load a program into memory, putting each hex character into its own individual cell
2. Locate and change particular hex characters by telling DDT which cells they are stored in (the unique hex address)
and
3. Write the modified program back to disk.

We are now going to change the sequences sent when options Q, W, E, R, A, N, V, T and Y are chosen from the ^P menu. It is important to note that the first six options send only one sequence to the printer whenever they are chosen. Option Y is a toggle. The first time it is used it sends one sequence to select the option. The second time, it sends another sequence which deselects the option. Options V and T are also toggles, but just a trifle more complex. They were originally designed to raise or lower the carriage of the printer half a turn. This gives somewhat compromised superscripts and subscripts. They work in conjunction with each other by sending the same sequences from the same memory addresses — only the opposite way round. V raises the carriage the first time it is chosen, and lowers it the second. Vice versa for T. We now have true superscripts and subscripts on the MX-80. There is no need to merely raise or lower the carriage, and I can't think of any two operations we could usefully combine in this way. We are stuck with only being able to use one of either V or T. The other is redundant.

Table 2 gives the start addresses of the sequences sent by the associated ^P options. Table 3 gives the sequences we need to send to select or deselect the associated MX-80 options. As an example, let's make ^PQ turn on emphasised printing and ^PW turn it off.

Load your CP/M utilities disk (drive A) and your copy of Wordstar in drive B. Type DDT B:WS.COM <CR>. The following message appears on the screen:

DDT VERS 2.2
NEXT PC
3F00 0100

(I don't know what it means either!) Now type S6C9 <CR> (the address is actually 06C9 but leading zeros can be ignored). The screen will now display what currently resides in this memory address. To change the sequence for Q we first enter the number of hex characters in the new sequence and then the sequence itself. Type 02 <CR> (the number of characters) 1B <CR> 45 <CR> (the sequence). Type X <CR> to finish. The same goes for W. Type S6CE <CR> 02 <CR> 1B <CR> 46 <CR> and X <CR> to finish. ^C brings us back out of DDT to the CP/M prompt. To overwrite the changes on disk type SAVE 62 B:WS.COM. Now load Wordstar in drive A. Prepare and print a document using ^PQ and ^PW somewhere within. Exciting isn't it!

As we've discovered, the MX-80 is extremely versatile. To use all the options in Table 3 we would have to include 22 different sequences within Wordstar. We can include only 10, so some compromise is called for. Combining the information in Tables 2 and 3 with the above procedure will enable you to allocate the available ^P characters to the options of your choice. I found the decision of what to include and what not to include an extremely difficult one to make. I decided to opt for maximum flexibility, which meant choosing lowest common denominators. These basic choices could be combined to provide even further options with a few more key-strokes. I waved goodbye to superscripts and subscripts, as I would use these least of all. True MX-80 underlining was a must — this is so superior to broken dashes. Line heights I chose to control directly from the keyboard and outside Wordstar. Before printing, either single, double or triple-spacing can be selected. The same applies to configuring the printer for single sheets. Table 5 shows my final solution.

Wordstar also enables you to include an end of print sequence. This is located at memory address 06F8 and is normally used to set the printer back to its normal default values. I left this and used the scientific method (when in doubt, turn the printer off and back on again). Most of my work I prepare ragged right. I don't usually include page numbers. I never use hyphens at the end of a line and I find it useful to be able to produce computer zeros (Ø). You may also find it useful to use Wordstar with INSERT off. The following are the memory addresses and patches to produce a Wordstar with the necessary defaults.

Justification off	0386	00
Omit page numbers	03D3	FF
Hyphen-help off	0389	00
Insert off	0362	00
Strike-out character '/'	070B	2F

With reference to the Osborne, there is no need for words to wrap round at column 80. The computer has a unique, scrollable 128-column screen and the Osborne version of Wordstar allows you to edit documents up to 120 columns wide. Editing Supercalc models with Wordstar has for-

^P Option	Memory Address	^P Option	Memory Address
Q	Ø6C9	Toggles	
W	Ø6CE	Y (select)	Ø6DD
E	Ø6D3	Y (deselect)	Ø6E2
R	Ø6D8	T (select)	Ø6BF
A	Ø6B5	T (deselect)	Ø6C4
N	Ø6BA		

Table 2: Memory addresses for available ^P options.

Print Options	Select	Deselect
Condensed	ØF	12
Double Strike	1B 47	1B 48
Emphasised	1B 45	1B 46
Enlarged	1B 57 Ø1	1B 57 ØØ
Subscript	1B 53 Ø1	1B 54 1B 48
Superscript	1B 53 ØØ	1B 54 1B 48
Underline	1B 2D Ø1	1B 2D ØØ
Line Height		
6 line per inch	1B 32	
8 lines per inch	1B 3Ø	
1.5 lines per inch	1B 41 3Ø	
3 lines per inch	1B 41 18	
12 lines per inch	1B 41 Ø6	
Other Options		
Initialise printer	1B 4Ø	
Paper end detector off	1B 38	
Paper end detector on	1B 39	

Table 3: MX-80 print options with the associated select/deselect HEX sequences.

Ø:	^PXØ^PX
1:	<ESC>3H<CR>
2:	<ESC>AØ<CR>
3:	<ESC>Ø<CR>
4:	<ESC>8<CR>
5:	^PQ^PE
6:	^PR^PW
7:	^PT^PA
8:	^PN^PT
9:	^OD

Table 4: Osborne 1 function key configuration.

KEYBOARD ENTRY				WORDSTAR SELECTION					
LINE HEIGHTS			SINGLE SHEET FEED	STYLE 66	STYLE 66	SUPER BOLD	SUPER BOLD	CONTROL DISPLAY	COMPUTER ZERO
DOUBLE SPACED	TRIPLE SPACED	8 LINES PER INCH		-ON-	-OFF-	-ON-	-OFF-	ON - OFF	(Ø)

Fig 2 The Osborne function key template.

^PQ	Condensed ON
^PW	Condensed OFF
^PE	Enlarged ON
^PR	Enlarged OFF
^PA	Emphasised ON
^PN	Emphasised OFF
^PT (select)..	Double Strike ON
^PT (deselect)	Double strike OFF
^PY (select)..	Underline ON
^PY (deselect)	Underline OFF

Table 5 Allocation of options.

ced me to make full use of this. I also prepare documents with a right margin at column 50 and reformat before the final print. Hence the following patches.

Default right margin 50	0380	33
Set screen size to 120	0249	78

Now let's put the icing on the cake by utilising the function keys of the Osborne. These can be used to make life very simple by merely transferring the Δ P options directly to each function key. This reduces key strokes and you can put a prompt card behind the numbers on the alpha pad. But remember, the aim is flexibility. I have used the function keys firstly to combine couples of Δ P options, and secondly to store sequences I may send directly from the keyboard (because I can't remember them).

To configure the function keys use SETUP, which is located on your CP/M system diskette. I won't explain how to use this. The Osborne manual does it far better than I could. Figure 2 shows my function key template.

Table 4 shows the values entered for each number. I have called the combination of Double Strike and Emphasised 'Super Bold' and the Enlarged/Condensed combination 'Style 66'. Using these different options to the full, the screen can get cluttered with control characters (roll on the day when screens emulate printers!). I have put Δ OD on the template, because I find it useful to be able to turn these control characters on and off easily. To achieve a zero with a slash through it is also cumbersome, hence function key 0.

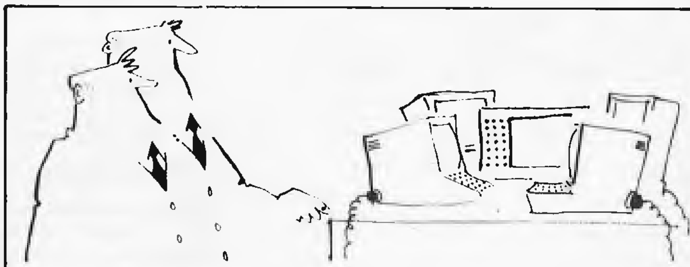
We could put a few cherries on top of the icing by redesigning the print menu to reflect the changes we've made. Use DDT on WSMSGS.OVR – consider this one your project.

I have enjoyed giving these worldbeaters a thorough bashing. However, my investigation has highlighted some areas of frustration. On the Wordstar front – wouldn't it be super if there were more Δ P function keys available for us to access? Unfortunately Δ PB Δ PD and Δ PS are now virtually redundant, but we're unable to amend them fully so that we can use them for something else. It would also be nice if there were some user-definable dot commands. I would use these for selecting line heights. On the Epson front – having a different deselect sequence for each option doubles the number of function keys needed. Also, most of my deselecting merely sets the printer back to its default values. I have tried using the initialisation string, but this is no good in the middle of a document. It sends a line-feed and a carriage return.

What about the Osborne? Well Adam, the pencil tray in the new case is a splendid idea, but where do I stick my template?

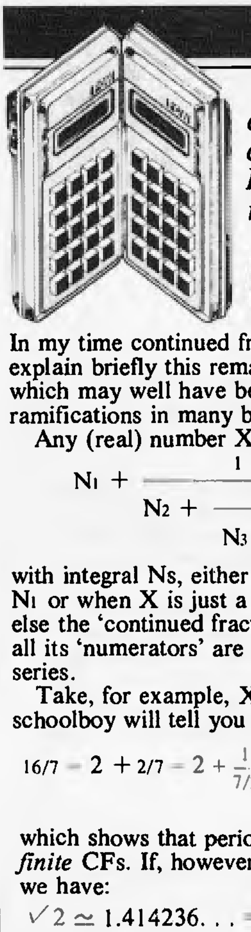
Stepping aside for a moment, I hear that Epson will soon be launching a new, super dot-matrix printer that will knock spots off the daisywheels. I can't wait to get my hands on it.

Lastly, the MX-80 I have been using is a type III. It has some differences from the type II. Notably, the lack of true sub/super-scripts and proper underlining on the earlier version. I am also told that the sequences may be different on the MX-100. Compare closely the relevant sections of your manual with the procedures herein. You should be able to establish the correct sequences for your printer. On some earlier MX-80s, using select and deselect in the same line cancelled the option before printing. The Osborne uses Wordstar version 2.26. Version 3 allows lines to continue beyond column 120 without wrapping round on the screen. If you're not using the Osborne the keyboard direct-entry sequences may be different. There is a good chance that the relevant memory addresses will be the same.



'They've called their first stop-work meeting'.

PORTABLE COMPUTER WORLD



Time marches on and Calculator Corner must march with it. From now on this column will be called PORTABLE COMPUTER WORLD, so that not only calculators but new machines like the Sharp PC1500 and the HP-75C and Epson HX20 can be covered without hurting anyone's feelings. Just to prove that I don't intend to forget calculators, this months column, by Ed Rosenstiel, is for the TI-59

CONTINUED FRACTIONS

In my time continued fractions were not done at school, so I'll explain briefly this remarkably easy to understand concept which may well have been known in antiquity, and which has ramifications in many branches of higher mathematics.

Any (real) number X has a unique counterpart of the form

$$N_1 + \cfrac{1}{N_2 + \cfrac{1}{N_3 + \cfrac{1}{\text{etc}}}}$$

with integral Ns, either finitely many — when trivially X = N_1 or when X is just a common fraction, ie, rational — or else the 'continued fraction' (technically called 'simple' since all its 'numerators' are 1) goes on for ever, like an infinite series.

Take, for example, $X = 2.\dot{2}8571\dot{4}\ldots$ which any schoolboy will tell you is equal to 16/7. To work out its CF:

$$16/7 = 2 + 2/7 = 2 + \frac{1}{7/2} = 2 + \frac{1}{3+\frac{1}{2}} = 2 + \cfrac{1}{3 + \cfrac{1}{1 + 1/1}}$$

which shows that periodic decimals (being rational) have *finite* CFs. If, however, you start with a square root like $\sqrt{2}$ we have:

$$\sqrt{2} \simeq 1.414236\ldots = 1 + \cfrac{1}{\frac{10000000}{4142136}} = 1 + \cfrac{1}{2 + \frac{1715728}{4142136}}$$

$$= 1 + \cfrac{1}{2 + \cfrac{1}{\frac{4142136}{1715728}}} = 1 + \cfrac{1}{2 + \cfrac{1}{2 + \frac{710678}{1715728}}}$$

$$= 1 + \cfrac{1}{2 + \cfrac{1}{2 + \cfrac{1}{2 + \ldots}}}$$

Considering that we started with an (8-digit) *approximation* it is a fair guess (and true) that the twos go on *ad infinitum.*— ie, we have a *periodic* CF with a 1-digit period, usually abbreviated as

$\sqrt{2} = [1;\overline{2}\,]$.

In fact, all square roots of *integers* are periodic CFs, eg:

$\sqrt{3} = [1;\overline{1,2}\,]$

$\sqrt{13} = [3;\overline{1,1,1,1,6}]$

An important use of CFs follows from the property that, whenever one truncates an infinite CF after any number of terms, a common fraction results which is a 'best' approximation to the infinite CF. Eg,

$$\sqrt{2} \simeq 1 + 1/2 = 1.5$$

$$\simeq 1 + \frac{1}{2 + 1/2} = 1.4$$

$$\simeq 1 + \cfrac{1}{2 + \cfrac{1}{2 + 1/2}} = 1 + \frac{1}{2 + 7/5}$$

$$= 1 + \frac{10}{24} \simeq 1.417\text{, etc.}$$

The first of two TI-59 programs is based on a formula of Patz (1941). It displays the list representing the CF of $\sqrt{N}$ (called the list of 'partial quotients') whenever the N is entered and followed by keystroke A. All these lists will be periodic after a certain point, and some periodic CFs will also show other striking regularities first proved by the French mathematician Lagrange (1766).

The simplest periodic CF is $[1;\overline{1}\,] = X$, say. Then

$$X = 1 + \cfrac{1}{1 + \cfrac{1}{1 + \text{etc}}} = 1 + \cfrac{1}{1 + \cfrac{1}{x}} = 1 + \frac{x}{x+1}$$

Continued Fraction of $\sqrt{X}$

```
000  76 LBL   032  43 RCL
001  11  A    033  04  04
002  99 PRT   034  95  =
003  98 ADV   035  59 INT
004  42 STO   036  99 PRT
005  01  01   037  66 PAU
006  34 ΓX    038  42 STO
007  42 STO   039  05  05
008  02  02   040  65  X
009  59 INT   041  43 RCL
010  42 STO   042  04  04
011  03  03   043  75  -
012  99 PRT   044  43 RCL
013  66 PAU   045  03  03
014  43 RCL   046  95  =
015  01  01   047  42 STO
016  75  -    048  03  03
017  43 RCL   049  33 X²
018  03  03   050  94 +/-
019  33 X²    051  85  +
020  95  =    052  43 RCL
021  42 STO   053  01  01
022  04  04   054  95  =
023  76 LBL   055  55  ÷
024  12  B    056  43 RCL
025  43 RCL   057  04  04
026  02  02   058  95  =
027  85  +    059  42 STO
028  43 RCL   060  04  04
029  03  03   061  61 GTO
030  95  =    062  12  B
031  55  ÷    063  00  0
```

Enter X and press A

Inverse CF Program to recover X from the Continued Fraction of $\sqrt{X}$

```
000  76 LBL   032  42 STO   061  13  C    090  12  B    119  91 R/S
001  15  E    033  13  13   062  42 STO   091  67  EQ   120  61 GTO
002  99 PRT   034  65  X    063  16  16   092  14  D    121  11  A
003  98 ADV   035  43 RCL   064  65  X    093  42 STO   122  76 LBL
004  42 STO   036  12  12   065  43 RCL   094  17  17   123  13  C
005  10  10   037  65  +    066  14  14   095  65  X    124  43 RCL
006  91 R/S   038  43 RCL   067  85  +    096  43 RCL   125  12  12
007  76 LBL   039  10  10   068  43 RCL   097  12  12   126  55  ÷
008  16  A'   040  95  =    069  12  12   098  85  +    127  43 RCL
009  67  EQ   041  66 PAU   070  95  =    099  43 RCL   128  11  11
010  13  C    042  99 PRT   071  66 PAU   100  14  14   129  95  =
011  42 STO   043  42 STO   072  99 PRT   101  95  =    130  47 CMS
012  11  11   044  14  14   073  42 STO   102  66 PAU   131  99 PRT
013  65  X    045  43 RCL   074  12  12   103  99 PRT   132  98 ADV
014  43 RCL   046  13  13   075  43 RCL   104  42 STO   133  91 R/S
015  10  10   047  65  X    076  16  16   105  14  14   134  76 LBL
016  85  +    048  43 RCL   077  65  X    106  43 RCL   135  14  D
017  01  1    049  11  11   078  43 RCL   107  17  17   136  43 RCL
018  95  =    050  85  +    079  15  15   108  65  X    137  14  14
019  42 STO   051  01  1    080  65  +    109  43 RCL   138  55  ÷
020  12  12   052  95  =    081  43 RCL   110  11  11   139  43 RCL
021  66 PAU   053  42 STO   082  11  11   111  85  +    140  15  15
022  99 PRT   054  15  15   083  95  =    112  43 RCL   141  95  =
023  43 RCL   055  99 PRT   084  42 STO   113  15  15   142  47 CMS
024  11  11   056  98 ADV   085  11  11   114  95  =    143  99 PRT
025  99 PRT   057  91 R/S   086  99 PRT   115  42 STO   144  98 ADV
026  98 ADV   058  76 LBL   087  98 ADV   116  15  15   145  91 R/S
027  91 R/S   059  11  A    088  91 R/S   117  99 PRT   146  00  0
028  76 LBL   060  67  EQ   089  76 LBL   118  98 ADV   147  00  0
029  17  B'
030  67  EQ
031  14  D
```

Enter in sequence the numbers (= "partial quotients") of the CF of $\sqrt{X}$, pressing after each of the first five entries one of E, A',B',A or B (in that order).Next alternate A & B. For approximations of X enter 0 and repeat the last keystroke.

hence $(X - 1)(X + 1) = X$, ie, $x^2 - x - 1 = 0$
Of this equation

$$X = \sqrt{5/2} + 1/2 \simeq 1.62$$

is the relevant root, since $X > 1$. Many will recognise this equation as the one for the famous 'Golden Section', which defines a rectangle with sides 1 and $\simeq 1.62$ respectively, and that the so-called 'convergents' of [1;1], ie, 1/1, 2/1, 3/2, 5/3, 8/5, contain the well-known Fibonacci numbers. (This example also shows that there are periodic CFs which are not just the square root of an integer.)

Having loaded the CF-program into the TI-59, any *real* number can also be entered — eg, π^2 (with $\pi \simeq 3.141592654$), which gives the CF of $\sqrt{\pi^2}$ = CF of π = [3;7,15,1,292,1,1,1,2,1,· · · ·] accurately to 10 places. Although unending, no periods or regularities have been discovered among the first several thousand partial quotients of this CF, nor in any other irrational reals excepting square roots *and* the Euler number e = INV ln 1 and some simple arithmetical formulas based on these two exceptions. (Enter e^2 and discover a 'regular' non-periodic infinite CF!)

The CF of another Euler number called γ (gamma) = the limit (as $n \to \infty$) of $(1 + 1/2 + 1/3 + \ldots + 1/n - \ln n) \simeq 0.577\ldots$ has also been calculated to several thousand digits without finding any regularities. This makes it likely by unproven that this number is not rational, but here is one of the famous unsolved problems of mathematics, namely whether γ (gamma) is the root of some algebraic equation or is transcendental like e and π , or is rational after all.

Now to use the inverse CF-program: Enter in sequence the partial quotients of some CF by pressing after each of the first five the keys E,A',B',A,B, respectively, then follow further entries by alternating between keys A and B. After any entry and appropriate key stroke the corresponding convergent is displayed, first its numerator, then the denominator. After the first two entries (E and A'), whenever zero is entered and followed by the keystroke which was used last, the decimal value of the convergent reached so far is displayed and the program is reset.

Examples

a) $\pi \simeq$ [3;7,. .].
Enter 3,E; display 3.
enter 7,A';display 22(PAU/PRT)7
enter 0,A';display 3.142857143

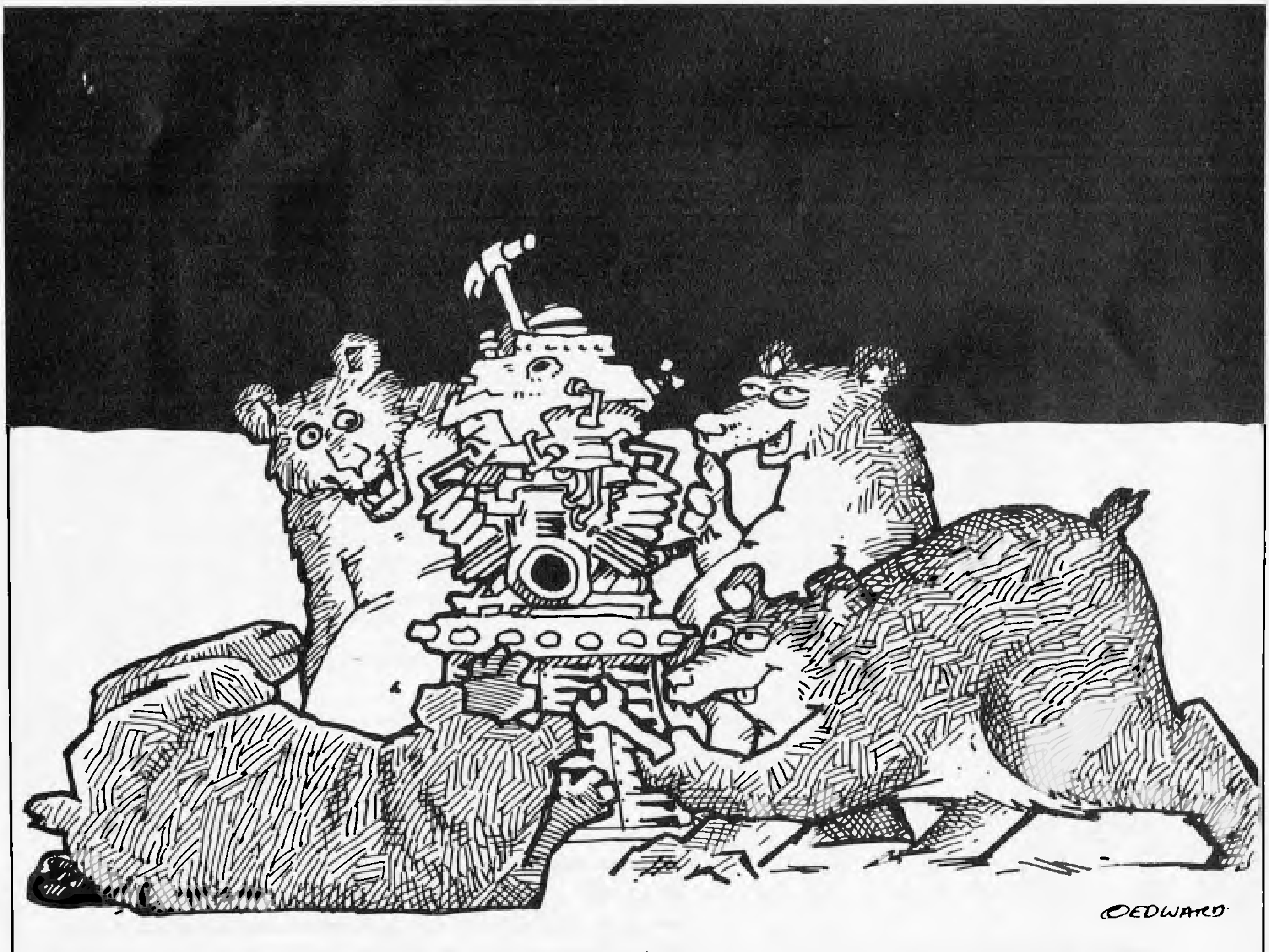
b) $\pi \simeq$ [3;7,15,1,292,. . .]
Enter 3,E; display 3.
enter 7,A';display 22(PAU/PRT) 7
enter 15,B'; display 333(PAU/PRT)106
enter 1,A; display 355(PAU/PRT)113
enter 0,A; display 3.14159292

It is noteworthy that the approximation $\pi \simeq 355/113$, known already in China in antiquity, which is accurate to 2.7×10^{-7} is followed by the unusually large partial quotient 292. Such large PQs in CFs often give a clue to hidden and obscure interrelationships (Churchhouse, 1973).

Regarding the (so far unending) CF of γ (gamma) it is — as for the CF of π — not even known whether the partial quotients have an upper bound, but that they are unbounded for e was already known to Euler (1701-1783). Finally, the convergents of $\sqrt{N}$ readily supply integer solutions of the famous PELL equation $X^2 - N.Y^2 = 1$ (Beiler, 1964) — but that is another story.

References

Beiler, A H: *Recreations in the Theory of Numbers* Dover Publications, Inc., New York, 1964.
Churchhouse RF: *JIMA, 1973,9,17*
Patz W *Tafel der regelmassigen Kettenbruche,* Becker & Erler, Leipzig, 1941.



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Micros can be habit forming

Should computers carry a government mental health warning? David Tebbutt discusses the dangers to which over-conscientious programmers are exposed.

Have you ever met an obsessive programmer? If you're in the computer industry, you can hardly miss them. They spend so much time at the keyboard, they're sometimes referred to as 'terminal junkies'. The description is a light-hearted one, but the truth is a little less palatable.

I don't have masses of statistics to support this, but I think that the computing business produces more than its fair share of mental casualties. I have been involved with programming for around 17 years, and during that time, I have seen several people crack up under the strain. Like most of us, I have conveniently pushed such things to the back of my mind but, now that so many people are coming into computing, I feel the subject deserves an airing. In this way we may be able to save some of our colleagues – and ourselves – from an unplanned stay in a mental hospital.

AMATEUR PSYCHOLOGY

Programmers who work nine to five and then go off to the pub have probably got very little to worry about. Even if they're conscientious workers during the day, they're obviously not going to let the current project get in the way of the important things in life.

No, the people who are at risk are those who take their deadlines very seriously and take an almost too responsible attitude to work. Sadly, these are the very qualities that most managers desire in their staff. So enthralled are the bosses at people working long hours to meet targets, they tend to forget that programmers have some sort of life outside work and that perhaps they should be forced to stop work early from time to time to go out and enjoy themselves and make some human contact.

Unfortunately, these types of programmers usually get intense intellectual satisfaction from their work, and so have almost no motivation to leave it. If they are dragged down to the pub, they will simply sit there in a trance, trying mentally to trace their latest bug. They will almost certainly have a model of the program in their short-term memory and daren't talk seriously to anyone for risk of losing it and having to spend an hour or two picking up the threads during the next session.

Most programmers I talked to say that their programming speed picks up the longer they spend at the machine. One claimed that by mid-evening he can be belting along at ten times normal speed. And then when they go home to bed, many of them dream that they are the computer or the program and often wake up in the morning with a clear vision of where to find yesterday's elusive bug. None of this is too alarming and it certainly doesn't mean that they're going round the bend, although they could be heading in that direction.

If the behaviour becomes more bizarre, then the programmer *is* at risk. They work even more hours, usually 24 hours a day apart from catnaps on and off through the night. They become obsessive and antisocial, rejecting everyone and everything that is not part of the project. They will start neglecting themselves, often by completely forgetting to eat. Their 'I am a computer' fantasies may start to intrude on their waking time and at this point they are usually aware that something is wrong, but don't know what to do about it. The program has become their life, the deadline all-important and they cannot see any sensible way out of the loop. If rescued at this point, a few weeks holiday is probably all that's needed to put them back on their feet. If left alone, the only thing that can rescue them is if the project is completed or abandoned.

When people drive themselves at this sort of pace, they are probably quite incapable of handling any additional external pressure without it accelerating their demise. Family problems, sometimes brought about by their eccentric behaviour, are quite often the final straw for such people.

Some programs are so complex that the brain cannot hold all the relevant details at once. Under these circumstances it is very easy to go round and round in circles. Since the project needs to be completed there seems to be no way out and the programmer enters a downhill spiral of despair.

ABNORMAL BEHAVIOUR

What happens next must depend on the individual but I do know of two cases where they ended up having conversations with the radio or television. One told me that every broadcast seemed to be aimed directly at him and no matter which way he turned, he was always the centre of attention.

No doubt different people will react in different ways, but their behaviour will be measurably abnormal and, if things reach this stage, professional help will be long overdue.

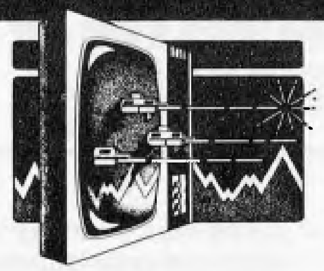
The people I know who went to mental hospitals came out after a few months of doing nothing and, as far as I know, are wiser but none the worse for the experience. At first they said they were very happy doing nothing but then they started to get bored. At this point they were on the mend and they are now both back in the industry but taking things a little less seriously than before.

As I said earlier, that is a composite description of the sort of path a programmer may take to a nervous breakdown. The first critical point is when they start to neglect themselves and work literally all hours. The second is when their brain goes into a loop from which it is difficult to escape. Anything could happen next, but behaviour will become measurably abnormal.

Anyone responsible for programmers should encourage their confidence, listen to what they have to say and act if there is any sign of impending problem. The action could be to stretch the deadline, to give the programmer a break, to cancel the project or perhaps to get someone else involved. END

SCREENPLAY

Dick Olney looks at games for the Tandy Color Computer.



The TRS-80 Color Computer has been around for about a year now – in fact Steve Withers Benchtested one of the first few available machines in the November '81 issue of *APC*. The system I used included 16k RAM and extended Basic (which is essential for all the cassette games); this sells for $549 including sales tax. All of Tandy's proprietary games come as plug-in ROM packs, but for all the others you'll need a good cassette deck. In addition many of the games use joysticks, which cost around $40 a pair.

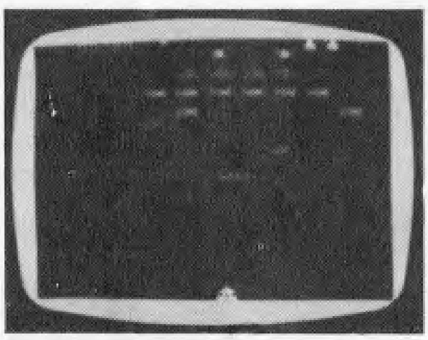
The computer itself is a pleasant looking machine with the standard Radio Shack grey plastic casing. It has a calculator style keyboard whose keys give a reassuring click when depressed. Tandy Extended Colour Basic has four graphics modes and can produce eight different colours. Only four colours can be used at any one time, however, since the two relevant graphics modes operate under either one of two different colour sets. In addition, the highest resolution mode is two-colour only (black/green or black/buff). The powerful 6809 processor is certainly under-utilised in a system of this size, but the Color Computer can be expanded to 32k RAM and will take up to four mini-disk drives (153k each).

The worst aspect of this otherwise attractive set-up is the Japanese joysticks. The fire buttons rely on a thin metal disk of a shape designed to complete a connection when pressure is applied. This disk is constantly losing its shape and hence its spring, rendering the button permanently active. The problem can be temporarily alleviated by carefully disassembling the whole unit and bending the metal back into an appropriate shape, but it re-occurs with relentless insistence. With a bit of imagination some other small metal object might prove more effective than the disk, but I can't help feeling that Tandy should have come to that conclusion already and acted upon it.

As if this weren't bad enough, I managed to shear the stick itself away from its screw mounting whilst engrossed in one of the games. I admit that it is easy to be inadvertently heavy-handed on such occasions, but I've used a good many different joysticks over the past year and have never broken one before.

I should mention that I also got to borrow one of Tandy's new four colour plotters, designed to be used with this machine. Using a rotating barrel containing black, blue, red and green pens to produce text or graphics, it can easily be accessed with a Basic program to describe figures and diagrams on hard copy, with the only notable omission being a circle function.

On the whole the TRS-80 Color is a well designed machine with plenty of attention given to minor essentials (like a long video lead). It's a pity that Tandy itself hasn't done more to encourage external software in this country (like stock it in their shops!), especially as I gather there's so much of it available Stateside.



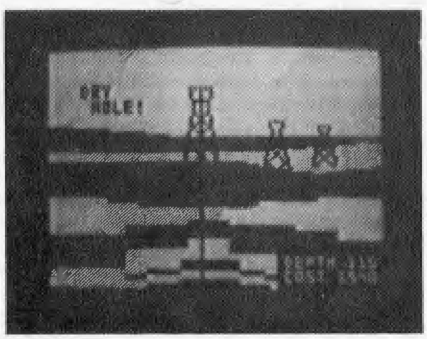
Game: **Galax Attack**
Supplier: **Spectral Associates**
Price: **$39.95**

This is, of course, yet another version of that infamous arcade game Galaxian. Four rows of three different shaped aliens sit above you Space Invaders style and swoop down in small groups; the titles are in colour and the actual play in black and white. The game is for one player who uses the right joystick for movement and firing. Personally I would have found the keyboard easier and I'm surprised that this isn't given as an option.

There is the opportunity to enter three initials at the outset of each game and the top five scores are displayed at the end. There is no skill level option, but play is fast and smooth and should present a challenge to the most enthusiastic Galaxian freak.

Unfortunately the shoddy Tandy fire button is rather inadequate for a rapid fire game of this type and needs constant adjustment, which is very irritating. Nevertheless this is a reasonable copy of a classic game.

Use of graphics	■■■■■□□□
Response speed	■■■■■■□□
Value for money	■■■□□□□□
Addictive quality	■■■■□□□□



Game: **Wildcatting**
Supplier: **Tandy**
Price: **$39.95**

With Tandy's headquarters being in the heart of Texas, it's not altogether surprising that this new management game is based on the oil business. Up to four players can take part with their names being entered at the outset. As in all good games of this type each turn consists of several phases. First you choose where to drill your well by moving the cursor around a blank dark green screen. Movement can be achieved either by using the joysticks or with the cursor control keys (you specify which at the beginning). Having chosen a likely spot (by pressing the fire button/space bar) you are presented with a surveyor's report, giving you the probability of striking oil, the cost of drilling per metre and the taxes you will pay each week (ie, turn).

At this point you must balance up the available information to decide probability, the site may turn out to be a dry hole – and since a well will only produce income greater than its taxes for a limited period of time even a costly successful drilling can easily result in a significant loss. Choosing not to drill costs you nothing, but then you'll not make anything either.

If you decide to go ahead you are presented with a simple but impressive picture of an oil tower, and a shaft driven into the ground by repeated depression of the fire button. Striking oil results in a roaring gusher, while

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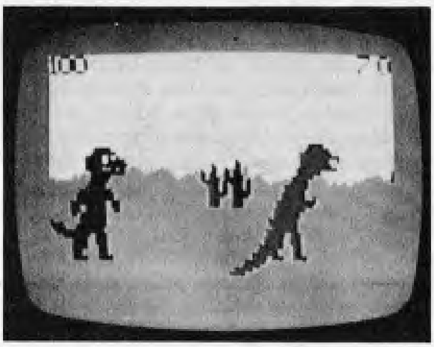
failure is rewarded with a deep buzz. In the final phase you are shown a list of all the sites you have investigated with details of their original cost, weekly tax and projected earnings before the next turn. Those mines which you own are marked with a coloured square, and can be sold for one half of their original cost. The idea is to sell each mine before its income falls below the level of tax, and then hopefully end up with a net profit . . .

Each site which has been investigated appears on the initial map as a square whose colour represents the oil probability. Since these colours tend to form a concentric pattern the most fruitful areas become more apparent as the game progresses. A game lasts for 13 turns (or weeks), at the end of which the entire map is displayed along with each player's balance sheet.

It is possible to accumulate scores (that is, game profit or loss) after several games, making for quite a lengthy competition. Wildcatting is not as complicated as it sounds though it is well thought out and could provide hours of entertainment for the right audience; that being children of around seven to ten years old. Most adults would, I feel, tire of it quite quickly since it involves neither co-ordination nor any real intellectual challenge.

Presentation	■■■■■□□□
Addictive quality	■■□□□□□□
Use of graphics	■■■■□□□□
Value for money	■■■□□□□□



Game: Dino Wars
Supplier: Tandy
Price: $39.95

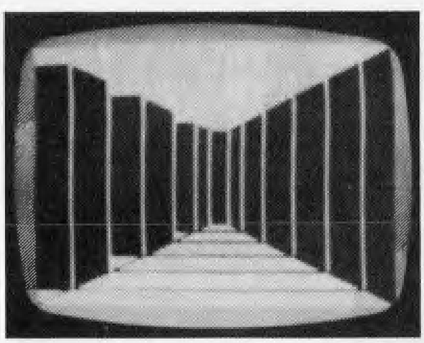
I couldn't resist reviewing this one, even though it's been around for some time now and I'm sure many readers have already seen it at exhibitions, etc, or own a copy if they happen to be Tandy users. Joysticks are essentail for this game, which is for two players. Each controls a dinosaur whose goal is to bite his opponent on the back of the neck. The dinosaurs roam a rather barren landscape with the odd cactus thrown in.

The creatures are brilliantly portrayed, though rather cumbersome to manipulate (added realism?), especially as it takes quite a while to get used to the perspective. When you have steered your dinosaur into a good position to attack, you press the fire button causing the beast's mouth to open (with a loud bloodcurdling roar). A successfully chewed victim falls to the ground with a few whimpers and a not particularly sickening thud.

Each player starts with 100 points and loses 20 for each wound received. Walking into a cactus also knocks five points from your score. The playing area continues off the screen with a wrap-around effect, and it is quite possible to do battle when neither dinosaur is actually visible! The cacti make this manoeuvre dangerous, however, since clearly it is impossible to avoid them.

When a player has no points left, his dinosaur retreats into the distance whimpering pathetically, and the game ends. Dino Wars has good graphics and excellent sound effects. It is hardly the most complex or stimulating of games, but is nevertheless an inspired piece of lunacy which will appeal to anyone with a sense of humour. I'm not sure, however, whether that appeal would be lasting enough to warrant paying out the forty dollars it will cost you.

Presentation	■■■□□□□□
Use of graphics	■■■■■□□□
Addictive quality	■■□□□□□□
Value for money	■■□□□□□□



Game: Escape
Supplier: Tandy

The blurb about this game describes it as a 3D maze adventure and it is just that. The maze represents the top floor of a building on which you are trapped, and is depicted in classic 3D maze style – remember it's the graphics that are 3D *not* the maze itself. Colour is used well here to produce the most convincing maze graphics that I've seen, with movement and turning being dealt with particularly well (the latter executed through the cursor control keys).

The only way to escape from the maze and thus solve the adventure is via an elevator, but attempts to use this without the right key result your plummeting to certain death. Your task, therefore, is to investigate the various rooms and derive the necessary key from the clues contained therein. Most of these are presented as obscure riddles which should keep you guessing for many a long hour.

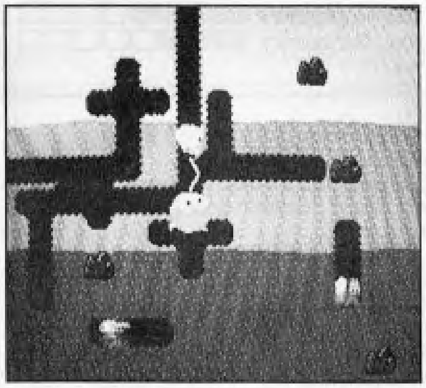
I have to admit I was sent the solution, which will shortly be made available to those who feel they would otherwise remain trapped forever. Without giving too much away I would offer a brief clue and a snippet of advice. Firstly remember that Microdeal is merely licensed to distribute this game, which was originally written by Colorsoft in the States. You should try to visit *all* the rooms before giving too much thought to the clues, since several of them rely on each other for their meaning.

This is in a different format to the usual adventure, with no monsters to kill and no treasure or useful objects to pick up, and is of a type which I can see becoming immensely popular. Though one could hardly describe it as a 'graphics adventure' the incorporation of a maze is an excellent way to present this particular puzzle (it also has a very interesting use of sound). You'll need a bit of patience to find the solution, though there are a few fairly easy clues to quell your frustration. Bear in mind, however, that the game is rendered worthless as soon as you've convinced the elevator to work and thus – as with other adventures – it's difficult to assess the value for money of this game.

Presentation	■■■■■□□□
Use of graphics	■■■■□□□□
Complexity	■■■■■□□□
Value for money	■■■■□□□□

'It used to be notes up the chimney asking for train sets — now it's all printouts requesting expansion interfaces and floppy disk drives.'

ARCADE ACE



Atari struck gold with Pac-Man and is doing its best to make sure that nobody else gets a slice of the cake. The many imitators of that game could learn much from Atari's latest arcade success, Dig-Dug, which shows how popular principles can be developed into entirely new games with their own unique appeal. Using a chunky four-way joystick you control a cute little character who spends his time excavating tunnels underneath the ground. The aim is to kill the other inhabitants of this world, of which there are two species; Pooka and Fygar.

The Pooka are like little red balloons with white bibs, while Fygar are fire-breathing green dragons and, consequently, more dangerous. These creatures begin the game in their own short tunnels, and are unable to burrow. Eventually, however, they turn into ghouls and migrate through the earth into whatever section of the tunnel you are in at the time. If any of them catch you, or if Fygar breathe in your direction, you lose a man, of which you are allowed the standard three.

Your defence against these fearsome creatures is twofold. Dig-Dug is supplied with a pump (an air pump I assume) with which to fill them with air, whereupon they fill out and eventually explode. It takes some time to actually kill the creatures and only one can be kept at bay at any time, so if you're being chased by two or more its best to give quick bursts of the pump. This merely stuns your foe leaving you plenty of time to escape.

The other way to kill Pooka and Fygar (which yields high points) is to dislodge one of the rocks embedded in the ground in such a way that it falls through a vertical tunnel onto their heads. This is quite tricky since the rock should not fall onto your own head, and the victims must be led into the appropriate tunnel at exactly the right time.

As I implied at the outset Dig-Dug is clearly a Pac-Man derivative (note the bonus fruit which occasionally appears in the central tunnel) but it is a novel adaptation with a strong appeal in its own right. The graphics and sound are of extremely high quality, and although the game is superficially simple it is challenging enough to keep you hooked. END

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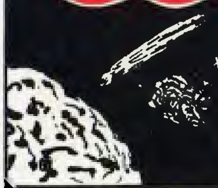

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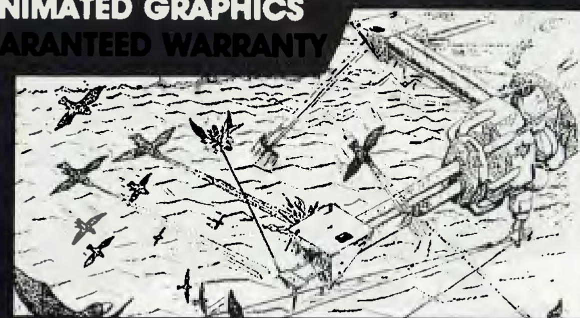

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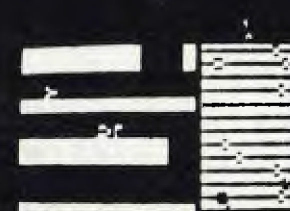

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Slow reflexes

We were rather disturbed to see the position of the Sirius on your benchmark timings comparison in the November issue, so we decided to check your figures, which puts us in position number 5.

Your figures were as follows:

BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	AVERAGE
1.0	7.4	17.0	17.50	19.8	35.4	55.9	4.3	24.8

Our actual figures were as follows:

BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	AVERAGE
1.5	3.0	11	11	13	24	37	2.8	16.3

These figures were achieved using Microsoft's Basic interpreter, the same one as used for your figures.

We suggest you invest in some new stopwatches.

Greg Johnstone,
Barson Computers.

Fastest machine on the block

I should like to take this opportunity to congratulate you on the excellent standard of editorial matter in *Australian Personal Computer.* The recent series of benchmark tests published is a good case in point.

For your interest I enclose an augmented list of benchmark timings in which we have taken the data published in *APC* and run some in-house tests of our own, using the SORD M23 equipped with the optional Arithmetic Processing Unit (APU). This device is a specialised co-processor which is addressed by the M23's Z80A CPU, when arithmetic functions are required. It is a low cost option, ($240, including retrofitting fee). As you will see from the list of timings, the APU has a dramatic effect on efficiency in arithmetical intense applications.

Whilst we agree that benchmarks of the type applied (BM1 through BM8), tell only part of the story when assessing the overall performance of a computer, nonetheless the M23 with APU shows an increase in arithmetical efficiency better than 3 to 1 over the machine heading the list published in *APC.*

SORD M23 with APU (Compiler Basic)

BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8(X10)	AVERAGE
0.6	0.7	1.4	1.5	1.5	5.0	7.8	1.1	3.7 sec.

OLIVETTI M20

1.3	4.0	8.1	8.5	9.6	17.4	26.7	1.6	11.5 sec.

I trust that this information will be of interest to yourself and your readers.

Tom McCarthy,
Marketing Manager,
Mitsui Computer Systems (Australasia) Pty Ltd.

P for Pathetic?

I was interested to read the Benchmark article 'The Ultimate Test' in the October *APC.* It confirms my view that 'P is anything but Perfect' due to its being excruciatingly slow. I use a Pascal compiler called PRO Pascal written by Prospero Software which just beats the best of the compilers (of any language on an 8-bit machine) listed in the original *Byte* article. The 10 iterations time on a 4MHz Z80 system for the standard Pascal version of the published benchmark was just less than the 14 seconds of the *Byte* best. Using non-standard features the time is 121.7 seconds. This is more than 20 times as fast as the UCSD p-code version running on a similar machine according to *Byte* while the standard version is nearly 20 times faster than the version using only standard Pascal cited in the *APC* article.

The faults with p-code are shared nearly equally between the compilation and the interpretation of it on the host machine as can be seen by considering the times given in the original article for the Pascal Microengine which has p-code as its machine code. It is 4.5 times as slow as the best (8-bit machine) listed even though it is nominally a 16-bit machine. This indicates that the compilation to p-code itself is a source of inefficiency as no interpretation is involved in this case.

I accept that the UCSD operating system is a pleasure to use but heaven preserve us from their compilers. It appears to me that the portability provided by p-code is dearly bought and the only beneficiaries are Softech.

One further point may be gained from the original article in that it provides a time for Z80 assembly language implementation of the benchmark which is only 1.7 times as fast as the PRO Pascal indicating that there is little room for further improvement with the Z80.

Timings for PRO Pascal were obtained on two Apple systems and they were confirmed by Prospero Software (with whom I have no other relationship than that of a well pleased customer) on a 4MHz system.

The first used a Microsoft Softcard. (The Z80 runs at 2.041 MHz with this card) and an Axlon Ramdisk. The Axlon was configured as a single 320k drive allowing an automatic compile and link for the PRO-Pascal system. Drive time is negligible with this arrangement.

The second used an Appli-Card with the Z80 running at 6MHz which of course gave me times half as fast again which I scaled down for comparisons. As I am not yet able to link the Appli-Card system to the Axlon due to all too typical manual problems, I used Apple drives. It appears to me that a moderately enhanced Apple II and a good compiler of standard Pascal (probably with the addition of an overlaying linker) provides a setup that is hard to beat.

John Crookes

Book boob

The recent article on Ada by Mike Parr contained a serious omission.

In the list of books recommended as further reading he omitted the bestseller on the subject – *Programming in Ada* by John Barnes, published by Addison-Wesley at $17.95.

Would you kindly bring this fact to the attention of your readers.

Peter Hoenisberg,
Managing Director,
Addison-Wesley Publishers Ltd

Cheap C

I was interested to read in November's 'DOS battle" references to the C programming language. Yes it is a nice language but compilers do not start at $600! True, a complete implementation of C under Unix 7 will cost around that figure but there are a number of versions (with some of the more esoteric features missing, admittedly) available for much less. I have a BD Software Compiler (available from Lifeboat) which cost $234. The main omission from this is that floating point is not directly implemented, although there is a package of routines which goes some way to alleviating the problem. Otherwise, it's a lovely piece of software.

Robin Jones

The long way round

How do I get a Basic program to run on my Osborne? The only way I've found is to create the program using Wordstar using the 'non-document' option; call this program "PROG.BAS" and save it with KX. Now put the disk with the Basic compiler and interpreter and type what is underlined:

B>A:BASIC B:PROG.

This method works but I'm sure there must be a better way, because I'm sure that I've lost the advantages of compilation.

R Emerson

There certainly is a simpler way because you're going all around the houses. A lot of people do use Wordstar to edit Basic programs; however there is no need to learn Wordstar just for that

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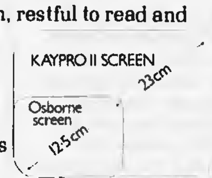

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purpose. Just type MBASIC and you will enter the Basic interpreter, now you can simply type in your Basic program, line by line. Consult your MBasic manual for instructions on editing. When you have completed it you can test the program with RUN. To save a copy of the program just type SAVE "PROG". A. Once you are totally satisfied that it works correctly then you can use the Basic compiler and compile your program. The speed advantages of a compiler will only be noticeable if you have optimised the writing of the interpreted version; for example, used integer variables wherever possible, avoided unnecessary calculations, etc. In a program that is I/O bound you will not notice much of a speed improvement I'm afraid.

Sheridan Williams

Horses for courses

From magazines such as your own, and from books, I have learned a lot about hardware, packaged software, and how a computer operates. However, a gaping hole in my knowledge is languages.

I have used a ZX81, and discovered the extreme disadvantages of Basic. Consequently I would like to upgrade both my language and my hardware.

Which high-level language should I choose from the vast range which includes Pascal, Comal, Forth, Cobol, Logo, Algol, Lisp, Pilot, APL, PLI, Fortran, etc?

Are we working towards a 'universal' language, or a series of languages tailor-made for each application? Will the language we learn tomorrow be out-dated in six months' time?

A L Taylor

I fear there would not be room in Communications for the table you envisage, but I will give thought to putting it together, in case the Editor would consider an article on this subject appropriate.

Personally, I do not expect to see a 'universal' high-level computer language adopted, if only because it would have to be very complex and hence cumbersome to use if it could cope well with all applications. Having said this, I must also add that the USA military have been hard at work on just such a language for some years, under the name of Ada.

The nearest to a 'universal' language is Cobol, which is very, very widely used for commercial data-processing applications on mainframes (there are also micro versions).

On microcomputers the closest approach to a 'universal' language is in fact Basic! Despite your comments, and Basic's many detractors, a good implementation of this language copes very well with most programming applications, and is much used by professional programmers. The more generally available versions on microcomputers tend to suffer from poor string and file handling, but this problem is not irretrievably built into the language. The other problem with micro Basics is slow execution, due to the infrequent use of compiled versions. A good implementation of Basic, with matrix operators, long variable names, good string and file handling, and a compiler is an excellent programming tool. Ideally, you should aim for the ability to develop programs using an interpreted version, and then be able to compile the finished, debugged program for fast operation. Basic is one of the few languages in which this can be done.

Pascal (and Comal) are of great interest to the academic world, for their use fosters good programming habits. They are not much used commercially because this very feature makes them inflexible. Pascal does seem to be making some headway of late as a commercial programming language for microcomputer applications.

Nonetheless, it is very much a question of 'horses for courses'. In the mainframe world Cobol still reigns supreme for commercial applications, and Fortran for technical and scientific applications. For 'real-time' 'interactive' (eg, via VDUs) applications Basic and APL are the leaders, with Ada intended to take over at some time. PLI was a deliberate hybrid of Cobol and Fortran, which has not found a lot of supporters, while Lisp was specifically developed for 'artificial intelligence' applications, and Forth for the control of equipment. Comal, Logo and Pilot all started out for various teaching applications.

So, how to resolve your dilemma? My recommendation would be to ensure that your new hardware does not have any high-level language 'built-in', but is able to load any you like, either from disk (which gives you an effectively limited range) or from ROM cartridges which at the present time will probably limit you to three or four languages on any one machine).

If you are lucky enough not to be too worried over the cost I would go for a disk-based machine using CP/M (such as the Osborne 1). Otherwise choose a machine which offers the possibility of expansion to disks running under CP/M.

Why CP/M? Quite simply because this will give you the widest range of high-level language interpreters and compilers commercially available. Don't be put off by all the sniping at CP/M . . . it's not nearly as bad as it's painted, and is very powerful. Anyway, it is now possible to get a program which will add most of the advantages of Unix to CP/M, without adding Unix's major disadvantages.

P L McIlmoyle

Computergook

With reference to the answer in the November issue of *APC* regarding CP/M Auto-Start, I would have thought that the latter was a sufficiently simple concept for it to be explained in one column of your estimable publication, with references to further reading elsewhere, and without the use of the quite unnecessarily artificial computergook, which makes the answer incomprehensible to all but the ardent enthusiast.

J Carey

It may surprise you to know that I agree with much of what you say. If only the 'computergook' (it sounds even more appropriate if you don't pronounce the 'k'!) were mine – then it would be easy to ignore or dismiss it. Unfortunately, it comes from the writers of CP/M, and more particularly, from the writers of the CP/M manuals. I fear it is largely the lack of clarity of the latter which has earned CP/M the bad name it has in some quarters. As an operating system, while it certainly has some faults, it is good, and certainly easier to use than others of comparable power. And now quite a few of the better aspects of Unix can be added to CP/M with 'Microshell.

In my earlier reply I was attempting to explain to someone familiar with CP/M, but not expert in it, who might not be able easily to get hold of the various books and articles in question, just how to use the SUBMIT facility for program auto-start. Thus it was necessary to go into some depth of technicalities.

However, in an attempt to sum up the whole auto-start discussion, and to show that good, plain English is possible when writing about CP/M, I would comment that:

Programs can be made to run automatically on start-up under CP/M by two main methods. In the first, the CP/M BIOS is altered by inserting the name of the program to be run (eg. BASIC MYPROG) in the appropriate place on the disk. As soon as CP/M is loaded these programs will be run. (See: 'The CP/M Handbook' by Rodnay Zaks, pp 203, 2060),

The alternative is to make a special file, (with an extension of .SUB) containing the name(s) of the program(s) to be run, and also, if needed, other commands or data. Typing SUBMIT Filename would then cause these programs to be run. (See Zaks' 'CP/M Handbook' pp 79, 81 and 'Osborne CP/M User Guide' by Thom Hogan, pp 107, 110). – Ed.

Memory refreshment

Can you explain how 'bank switching' of memory works? Does the normal Z80 refresh system function over the whole of the bank switched memory?

G Barbier

In 'bank switching' the RAM memory of the computer is arranged in blocks (or 'banks') of (typically) 64k, and at any one moment only one bank is connected to the processor's data bus, as 8-bit processor's can only address a maximum of 64k at any one time. The other banks are likely to contain data, and if they are dynamic rather than static RAM will need refreshing. This can be done by the main Z80 without difficulty.

Switching from one bank to another is done under software control, and it is essential that the memory cards used are equipped with an appropriate control line for this purpose. Thus, if you have an S100 machine you cannot necessarily just slot in some more memory cards. You must make sure that the cards are equipped with a bank-switching control line, that your S100 bus also supports this, and that your operating system software also does so. The newer S100 systems meeting the IEEE S100 spec do support bank-switching.

P L McIlmoyle

Not funny

I object to the sexist report that appeared on page 5 of the November issue of *APC*. To recompense I demand that you publish a photograph of a male laboratory technician showing his sexual prowess with a computer.

Nonetheless I choose to continue my subscription and hope that such hiccups will be tempered in the cause of MICROSENSE.

D Schulberg

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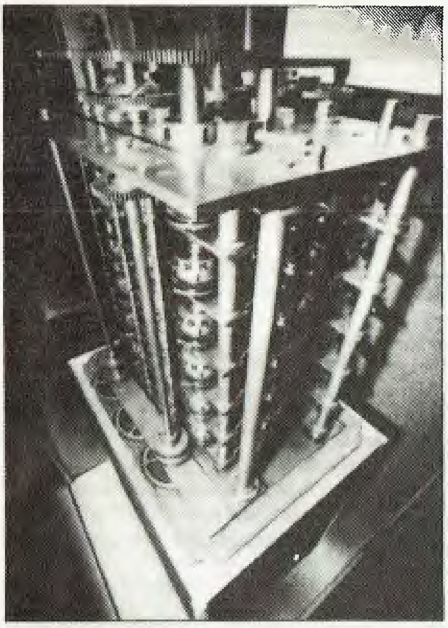
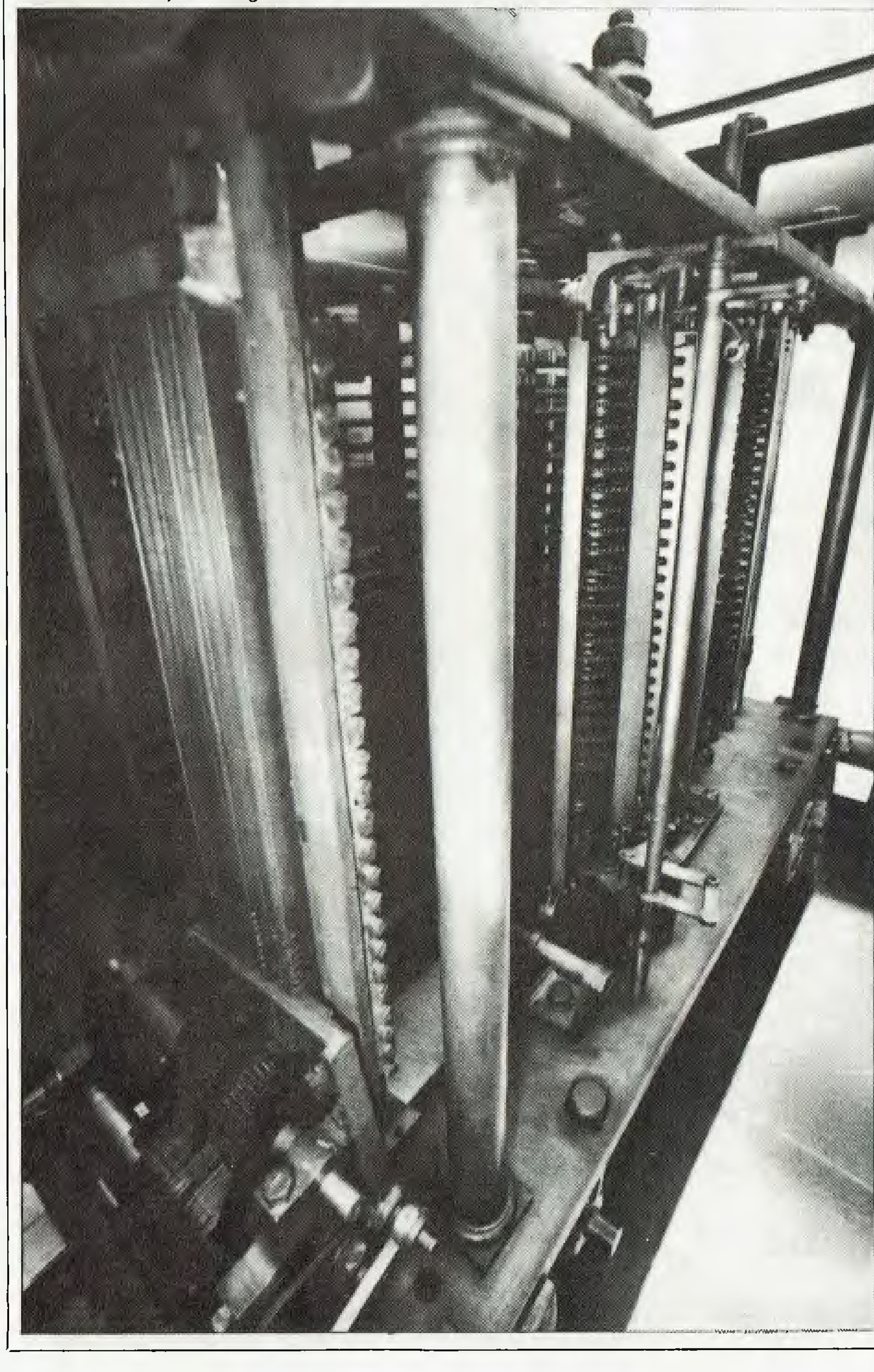


Above: The Difference Engine.
Below: The Analytical Engine's Rack.



THE NEARLY MAN

Charles Babbage is remembered as the man who nearly invented the digital computer. Working in a pre-electronic age he nevertheless discovered principles which were not put into practice until Von Neumamin in the 1940's. His mechanical computer was defeated by the lack of precise enough manufacturing techniques. Nigel Holder tells the story.

This is an account of the work of the pioneer of automatic calculating machines, Charles Babbage. His Difference Engine and Analytical Engine will be discussed. The emphasis is mainly historical, and as such there will be no detailed descriptions of how the machines work. A general overview of the calculating machines is given, as well as a description of the problems that Babbage faced.

With the advances in technology towards the end of the eighteenth century, mathematical tables assumed an increasing importance as an aid to calculation. These tables were more often than not riddled with errors, introduced either during the original computation or at the typesetting stage.

The Difference Engine

The method used to calculate the tables was the 'method of differences'. This had the advantage of using addition only in calculating the next value of a function, even if the function was very complex. This simplified the task of the computers (the name given at the time to the human evaluators), and reduced the risk of error since addition is easier to perform than multiplication. Another great asset of this method is that each result obtained relies on the previous result. Therefore, if the hundredth result is correct then it is almost certain that all of the previous results are also correct.

The method of differences work as follows (see *APC* Dec page 25):

If a function such as $F(x) = 3x + 7$ is evaluated for successive values of x, the difference between adjacent values of F(x) is found to be constant.

For $F(x) = 3x + 7$

x	$F(x)$	D^2
0	7	
1	10	3
2	13	3
3	16	3
4	19	3

For $F(x) = x^2$

x	$F(x)$	D^2	D^2
0	0		
1	1	1	2
2	4	3	2
3	9	5	2
4	16	7	2
5	25	9	2

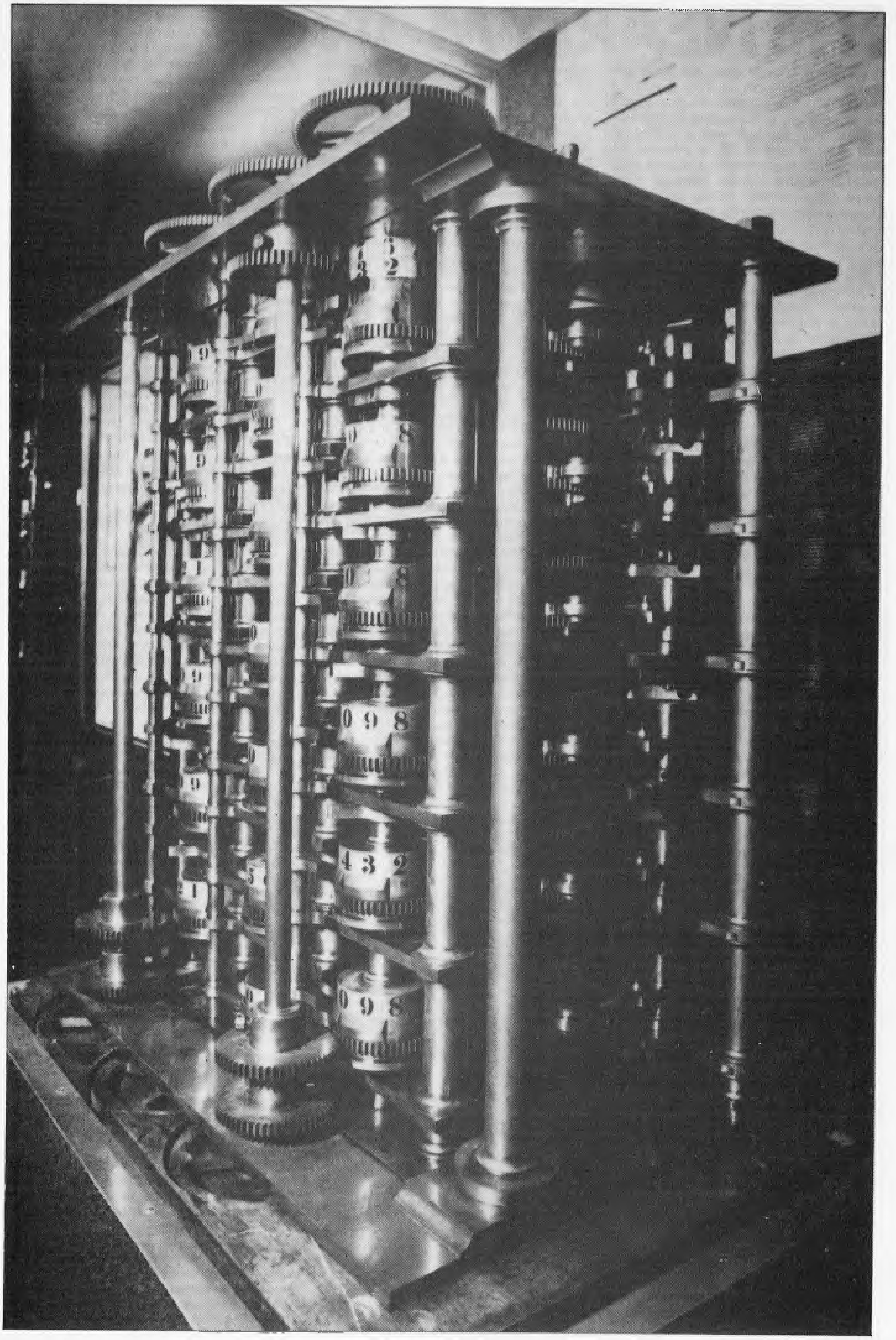
D^2, the second difference, is constant in case of $F(x) = x^2$.

In general, for a polynomial of degree n (x^n), the nth difference will be constant.

Although all polynomials have a constant difference, functions of much greater interest, such as logarithms and trigonometric functions, do not in general have a constant difference.

In order to produce tables for these functions by using the method of differences, it is necessary to divide the function into sections which may be approximated by suitable polynomials.

In 1820 Charles Babbage, aware of the problems inherent in producing tables (he had already produced a few of his own), decided to design and construct a machine which would compute and typeset mathematical tables — a Difference Engine. By



1822, after devoting a great deal of his time towards the project, he had a working model which was capable of working with 6-digit numbers to a constant second difference. This machine was a prototype, built to show what could be achieved. In order to finance a project to construct a full scale Difference Engine, Babbage petitioned the government of the day for aid. The government asked the Royal Society to prepare a report on the project's viability; they replied that, in their opinion, Babbage's work should be aided where possible.

The government agreed to advance £1500 towards the project; Babbage agreed to provide between £3000 and £5000. This would, in Babbage's opinion, provide sufficient resources to construct the Difference Engine (presumably based on his experience with the prototype), in two to three years, at which time he hoped that the government would reimburse his financial outlay.

But Babbage discovered that a full scale Difference Engine was a great deal more complicated to construct than a prototype. The machine was larger and more complex, and thus required finer tolerances of components. He also found that the state of engineering at the time was not sufficiently developed to construct his Difference Engine. Babbage therefore decided to devote the first few years of the project to advancing the art of mechanical construction. This involved designing a part and then designing a tool for making the part. During this process, an alternative and often simpler method would sometimes appear — the whole process of design and construction would then be repeated. Although this was a costly and time consuming process, Babbage's work advanced the state of engineering in Britain by many years.

Due to the project taking longer and costing a great deal more than originally anticipated, Babbage frequently found himself asking the government for more money; he had the Royal Society audit his accounts to prove that the money was being spent on the project. Unfortunately, the audit and the government's deliberations on the future of the project meant a delay each time (up to four years in some cases) before Babbage received any money. During this time, work on the project all but stopped; most of the engineers working for Babbage were disbanded (however, this helped to spread Babbage's engineering advances throughout Britain) — each time the money was received Babbage had to hire and train new engineers before work could commence on the project.

It was during one of these enforced breaks in production, in 1833, that Babbage had a disagreement with his chief mechanic (Joseph Clement, who had always stayed with Babbage — even during the breaks in construction). This was never settled and, under British law, mechanics possess the right of property of all tools that they have constructed, even if construction was paid for by their employers. This right was exercised, and the plans to the Difference Engine were also taken, although they were later returned. This would have considerably delayed the project if it had continued, since all of the tools would have had to have been constructed again; this, however, was not the case.

During this time Babbage, while attempting another modification to the design, conceived the idea of the Analytical Engine. This would need a much more sophisticated arithmetic mechanism than that currently employed in the Difference Engine — he therefore set about designing one. After over 20 different designs, he produced one which he considered could not be improved. He decided that this new improved design should be incorporated in his Difference Engine, and informed the government that, in his opinion, it would be quicker and cheaper to incorporate his new design into the Difference Engine than to complete the old one. The government was dismayed at the thought of yet another redesign after nine years of delay (and a change of government) and in 1842 informed Babbage that they would not continue financing the project. The government offered to let Babbage keep everything, but Babbage, remembering the original terms of the agreement, said that the machine's future was in the government's hands — the Difference Engine now resides at the Science Museum in London.

In all, Babbage had spent £17,000 of government money, and it is estimated that he spent a further £20,000 of his own personal fortune. The Difference Engine that Babbage had constructed at the collapse of the project was a working model which had a constant third difference, and handled 6-digit numbers.

Had it been fully completed, the Difference Engine would have been approximately 10 feet high, 10 feet wide and five feet deep. It was to have worked to a constant sixth difference, handling integer numbers to a precision of eighteen digits. Babbage had realised that truncation could lead to errors when accumulating results; he therefore devised a rounding mechanism to round off the eighteenth digit correctly.

Once the initial values had been loaded (set up) into the machine, the machine would have operated as follows:

A cycle would consist of two steps —

Step 1 : Add ODD differences to EVEN differences

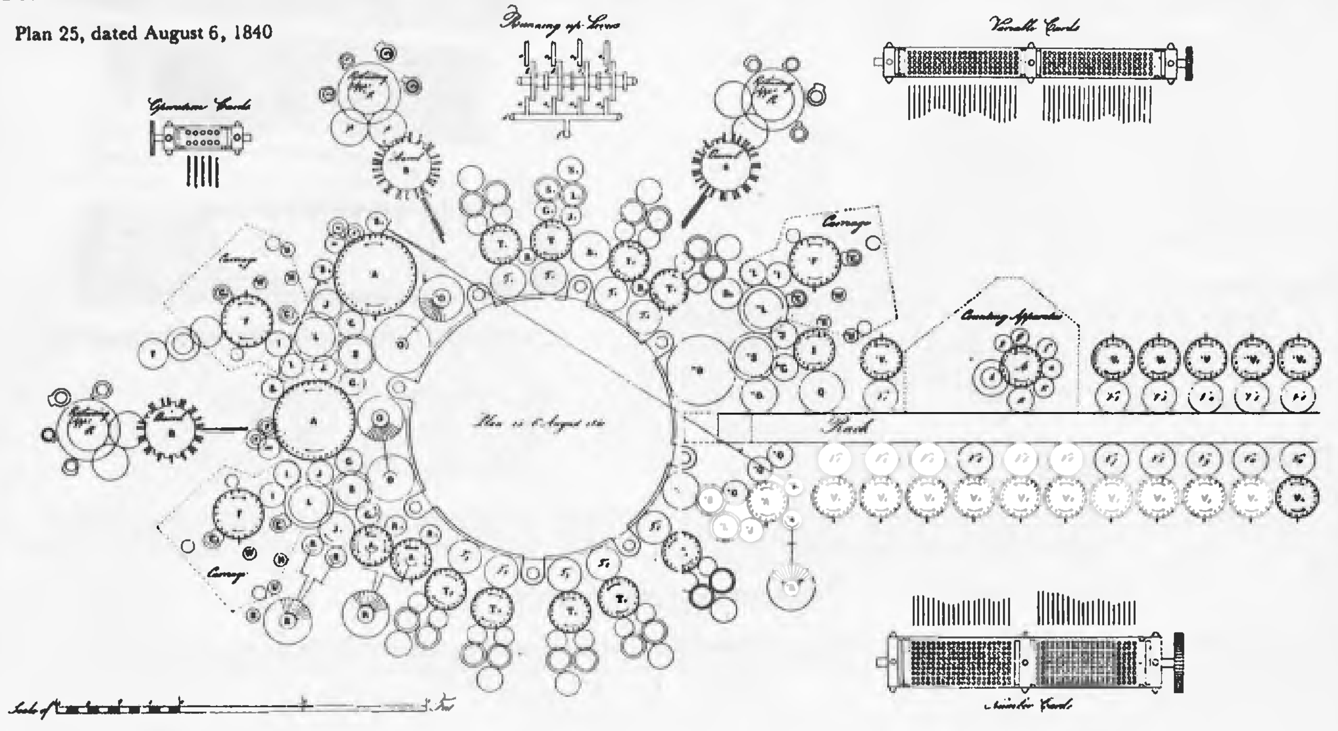
Step 2 : Add EVEN differences to ODD differences

The result of the next value is now obtained. For successive results, repeat steps 1 and 2. Each step consists of two parts since after addition any carries generated had to be added, allowing them to 'ripple through'. Each step consisted of turning the operating lever half a turn backward (producing the addition), followed by half a turn forward (addition of any carries generated). The words 'Calculation Complete' would be displayed at the end of each cycle.

The Analytical Engine

In 1833, Charles Babbage began work on what turned out to be the most ambitious project of his life's work: the Analytical

Plan 25, dated August 6, 1840



Plan of the Analytical Engine

VECTOR 4

VECTOR 4 SPECIFICATIONS

Central Processing Unit:

Processors:	8-bit Z-80B* and 16-bit 8088 (single or multiprocessor operation)
Clock Speed:	5.1 MHz
Memory:	128K Dynamic RAM Standard Expandable to 256K

Video Display:

Screen:	12 inch high contrast green phosphor 20 KHz Horizontal, 60 Hz Vertical
Alphanumeric:	24 Lines x 80 characters High resolution 16 x 13 dot matrix
High Resolution Graphics:	640h x 312v pixels (B/W)
Gray Scale Graphics:	160h x 312v pixels, 16 levels of gray 320h x 312v pixels, 4 levels of gray
Color Graphics:	External RGB Monitor 160h x 312v pixels, 8 colors 320h x 312v pixels, 4 of 8 colors

Keyboard:

Detached, with 8035 auxiliary processor. Capacitance keyswitch with 91 keys, including 15 programmable special function keys, cursor control keys, and 10-key numeric pad for rapid data entry.
Coiled cable with Interface

Input/Output:

Serial Keyboard
Centronics Parallel Interface
Qume/NEC Parallel Interface
RS-232 Serial Printer Interface
RS-232 Communications Interface
RGB color signals
Programmable Tone Generators and Speaker
S-100 expansion slots

Disk Drives:

Type of Disk:	5¼" Floppy	5¼" Winchester
Total Capacity:	630 Kilobytes	5 Megabytes
Transfer Rate:	250 Kilobytes/sec	5 Megabytes/sec
Rotation Speed:	300 RPM	3600 RPM

Configurations:

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Model 4/30	One floppy drive and one Winchester hard disk drive

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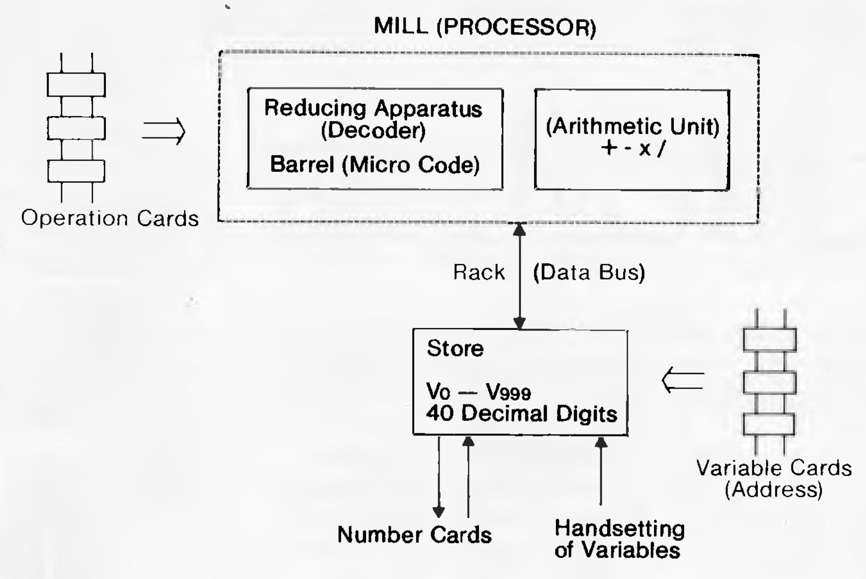
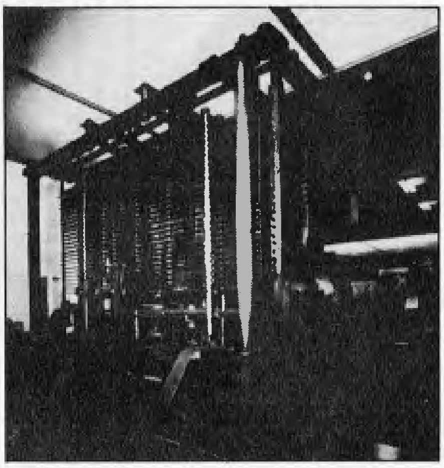


Fig 2 Diagrammatic representation of the Analytical Engine



The Rack is equivalent to a data -Bus

Engine. This machine was strikingly similar in concept to computers of today, although it was never completed. During the many years devoted to the project, many excellent engineering drawings were made of parts of the Analytical Engine; work had in fact started on constructing the machine before Babbage's death in 1871 — at his own expense since there were no means of raising financial aid after the collapse of his Difference Engine project.

The Analytical Engine would have been the first general purpose automatic calculating machine. It was to be capable of doing virtually any mathematical operation. It would follow the instructions programmed into it by its operators, and even go on to make decisions about which instructions to follow next, based on the results of its own computations. Both the instructions and data were to be entered separately on punched cards designed by Babbage. The cards themselves were strung together with narrow ribbons — this enabled the cards to read sequentially in either direction. Following the instructions, a processing unit called the 'mill' by Babbage performed operations on the data and returned the results to the 'store'. The final results were to be printed out or automatically set in type.

The Analytical Engine was conceived to be on a massive scale. It was to be powered by steam and was capable of storing up to a thousand 40-digit numbers; it would have been about the same size and weight as a small railway locomotive. Whenever it required additional values for a calculation it was working on it could signal to its operators that it needed additional values by ringing a bell.

The Analytical Engine was a decimal machine which used sign and magnitude representation for the numbers. A decimal number base was used since, unlike electrical circuits, in a mechanical device it is just as easy to represent ten states as it is two states; the decimal system is man's 'natural' number system. A sign and magnitude representation was chosen since it simplifies input/output and the examination of internal states of the machine. It also simplifies multiplication and division. Throughout the machine numbers are represented by the positions of wheels (each holding a digit), rotating about a vertical axis.

As previously mentioned, the basic theory of design of the Analytical Engine is remarkedly similar to that of modern computers. To show this, Figure 2 shows, in a diagrammatic form, the main architectural features of the Analytical Engine with modern names in brackets. Figure 1 shows Babbage's General Plan 25, which is the general configuration of the Analytical Engine. In contrast to his Difference Engine, Babbage has distinctly separated the Store from the Arithmetic Unit.

The basic four arithmetic operations are provided — addition, subtraction, multiplication and division. Two variations on the above are also provided — multiplication and division with limited precision. These operations are provided for when the full 40 digits of accuracy are not required or when the speed of computation is important. Since the operations are mechanical, a multiplication/division would take about four minutes.

A major innovation was the use of a barrel for control of complex operations such as multiplication and division. The barrel would have studs around the outside, against which levers would rest (with as many as 70 'rings' to a barrel, each ring containing up to 80 studs). As the barrel revolved, whenever a stud touched a lever the lever would move. By use of many levers, the operation would take place synchronously for one revolution of the barrel. Today, exactly the same concept is used in computers, known as micro code (or micro programming). Another great innovation was the advent of a 'look ahead carry' mechanism. Since there were 40 digits to a number, the process of allowing the carry to 'ripple through' would take a great deal longer than the addition itself required. Babbage realised this and developed the technique of 'look ahead carry' (which he called 'anticipatory carry'), allowing an addition to take place in one operation as the carry would be pre-determined. This technique proved the most difficult for Babbage, and he spent a great deal of time perfecting this technique.

Babbage spent most of his time on the project in designing and redesigning parts of the Analytical Engine. He appeared to find great satisfaction with the intellectual stimulus of theoretical design (perhaps it was because he realised that the machine would probably never be built — at least in his lifetime, anyway).

The reading of numbers from the store had a destructive effect in that, once read, the value was no longer held in the store (compare with the destructive read of 'core store' memory on early electronic computers) — if the number was required for further calculation, it had to be written back into the store.

As far as programming the Analytical Engine was concerned, Babbage did not have a very clear idea of how this would be achieved; it was as if this was a secondary consideration — he was concerned mainly with the mechanical working of the machine. The store could be accessed only by specifying the location in the instruction itself; there was no true variable address concept that would allow the store to be accessed as an array or vector. This is not really a criticism of Babbage himself, since the early electronic computers also lacked this ability until John von Neumann proposed it in 1945. The Analytical Engine possessed what is known today as the 'three address system', in which two addresses specify the operands to be used, and the third specifies where the result is to be placed.

It is perhaps a shame that Charles Babbage had so many great ideas, but was never able to realise them fully. If he had successfully completed the Difference Engine, he would have probably been granted financial aid for the Analytical Engine — it is just possible that, given enough time, the engineering technology of the day would have permitted the Analytical Engine to have been constructed. It is ironic that Babbage himself was the prime cause of his failures; he was always updating and modifying his designs — if he had kept to a single design throughout he would have probably completed the Difference Engine. His work was not in vain, though, for it stimulated others into designing and constructing their own Difference Engines, as well as advancing the state of engineering by many years.

It is not known exactly to what extent Babbage's work affected the design of early electronic computers, although it is thought to be only superficial — in which case it is remarkable that Babbage's concepts are so similar to those of modern computers. It is almost certain that computers would have evolved earlier if the Analytical Engine had been built. It is a shame that Babbage is mostly remembered for his failures; he was a brilliant mathematician and design engineer, years ahead of his time.

For anyone interested in early mechanical and electronic computing, an excellent book to start with is *The Origins of Digital Computers,* edited by Brian Randell and published by Speinger-Verlag. The ISBN is 0-387-11319-3. This book contains selected papers, and for the really keen person, the bibliography contains over 850 items. END

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THE HEAPSORT

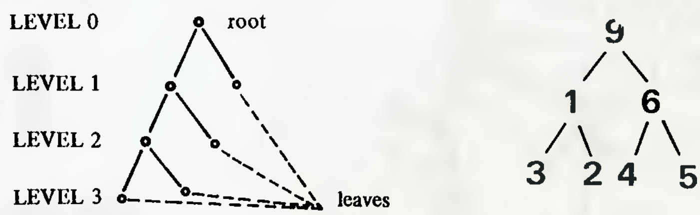
Earl Chew discusses the merits of an efficient sorting method known as the Heapsort and provides an introductory Pascal program.

During the last two years I have come across two letters in *APC* asking for advice on which type of sorting algorithms would be more efficient (read faster) than the one they were currently using. On both occasions the new and better algorithm suggested was the quicksort.

Now on the average, the quicksort requires approximately 2n(log n) comparisons to sort a list. The time taken to sort a list is proportional to n(log n) and it can be proved that there is no algorithm that is substantially better. However, there is another that is just as good. Given a list to be sorted one simply throws it into a heap.

HEAPS

The heap has its roots in the binary tree. In fact every heap is a binary tree, but not every binary tree is a heap. A binary tree consists of a set of nodes. There is a distinguished node called the root. The rest of the binary tree is divided into two subsets; the left subtree and the right subtree. Each subtree is itself a binary tree. Each node can be linked to zero, one or two nodes further down the tree. These nodes are known as the children and the original node known as the parent. A node which does not possess any children is known as a leaf. A node which has one or two children is known as an internal node. The level of the root is zero (although in some publications the level of the root is said to be one, this is not crucial) and the level of any other node is one plus the level of its parent. The depth of a binary tree is the maximum level of the leaves. (See Figure 1).



Binary Tree Structure

Binary Tree with keys at nodes

Figure 1

A heap is a binary tree with two special properties.

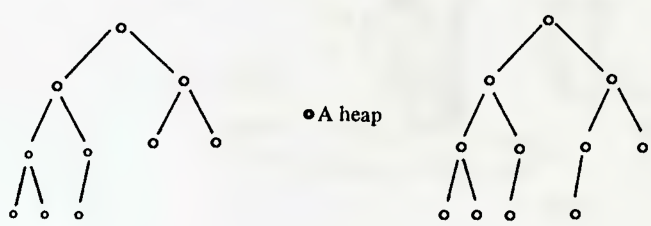
1. All internal nodes (with one possible exception) have two children. At level depth-1 all the leaves, if any, are to the right of the internal nodes and the rightmost internal node at that level may have one child.
2. The value of the key at each node is greater than those of its children, if any.

It is important that the properties of the heap be clearly understood for they are fundamental to the heapsort algorithm.

PICKING THE FRUIT

Since the key of any node in the heap is larger than those of its children, all the nodes at a given level, L say, will have keys greater than those of their children at level L+1. Thus the key at the root will be the largest of the entire heap.

This, then, is the basic principle behind the heapsort. By repeatedly picking off the root of the heap, then reconstructing the heap from the remaining nodes we can form a sorted list since each successive key picked off will be smaller than its predecessor.



A heap

Not a heap

Figure 2

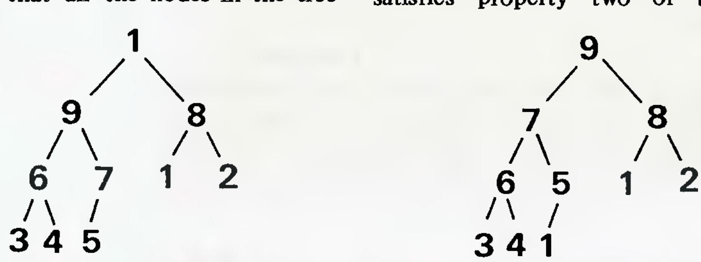
HEAPING IT UP

The basic algorithm of the heapsort is now clear. We take the items to be sorted and build a heap. Then by repeated deletions of the root we form our sorted list. However, the manner in which we are to go about building a heap is not obvious. This, in fact, appears to be a great problem.

Assume that we have a binary tree which satisfies property one of the heap structure and that the left and right subtrees of this binary tree happen to be heaps. It is apparent after a little thought that all the nodes in the tree except the root satisfy property two of the heap structure. So to make a heap out of this binary tree we must let the key at the root filter down the tree to its correct position, ie, a position where the value of the key is greater than those of its children.

Let K be the key at the root of this binary tree. We compare K with its largest child. If K has no children then the process is complete and the tree is now a heap. If the largest child is greater than K then the two are swapped; K is moved to the child's position and the child is moved to K's position. The comparison step is then repeated for K in its new position. If K is greater than or equal to the child then K is in its proper place and the binary tree is now a heap. (See Figure 3).

If we now use this procedure and the fact that for any binary tree which satisfies property two of the heap



Before adjustment

After adjustment

Figure 3

structure the subtrees which have the leaves of the binary tree as their roots are heaps, we can transform the tree into a heap by building small heaps then combining them. We apply this to each subtree beginning at the last internal node and working back up the root.

PRUNING THE ROOT

When we delete the root while constructing our sorted list, our binary tree ceases to be a heap. A second problem is that we then also have a vacant node, the root. This latter problem can be easily solved by taking the rightmost leaf at the bottom of the heap (ie, the maximum level) and moving it to the root. We then have a binary tree whose left and right subtrees are heaps. By letting the key at the root filter down to its correct position as described above, we again have a heap.

LINKS AND POINTERS

The surprising thing about the heapsort is that it can be carried out in place, unlike the quicksort.

Binary trees usually have two pointers at each node; one pointing to the right-child and one to the left-child. In addition there usually is another pointer which points to the root of the tree. However because of property one of the heap, it is possible for the position of each node to be easily calculated if the heap is stored in a linear array in the following manner. The nodes are stored left to right, level by level starting from the root. Thus the root would be stored in the first position of the array and the rightmost leaf on the maximum level would occupy the n-th position of the array where n is the number of nodes in the heap. Thus for a node in the k-th position of the array:

Left child = 2k
Right child = 2k + 1
Parent = k/2 , if k is even
(k-1)/2, if k is odd

```
    9
   / \
  7   8
 /\   /
6  5 1
```

Original

```
    1
   / \
  7   8
 /\
6  5
```

Root pruned and rightmost leaf moved

```
    8
   / \
  7   1
 /\
6  5
```

Tree adjusted to become a heap

Figure 4

In conclusion here is a Pascal procedure which will sort into ascending order an array of type 'key' which contains 'n' items.

```
procedure heapsort (var item : array [1..n] of key);
var
  last_internal_node,last_node : 1..n;
  pointer : 1..n;
  root : key;

procedure fixheap (root_pointer : 1..n);
var
  reinsert : key;
  pointer,biggest_child : integer;

begin
  reinsert := item[root_pointer];
  pointer := root_pointer;
  biggest_child := pointer;

  while (biggest_child = pointer) and
 (pointer <= last_internal_node) do begin
 biggest_child := pointer * 2;
 if biggest_child < last_node then
 if item[biggest_child + 1] > item[biggest_child] then
   biggest_child := biggest_child + 1;
 if reinsert < item[biggest_child] then begin
   item[pointer] := item[biggest_child];
   pointer := biggest_child
 end
   end;

   item[pointer] := reinsert
 end;

 begin
   last_node := n;
   last_internal_node := last_node div 2;

   for pointer := last_internal_node downto 1 do
     fixheap(pointer);

   for last_node := n - 1 downto 1 do begin
     root := item[1];
     item[1] := item[last_node + 1];
     item[last_node + 1] := root;
     last_internal_node := last_node div 2;
     fixheap(1)
   end
 end; (* heapsort *)
```

'I programmed it to show company profits for the next twelve months, and it turned itself off!'

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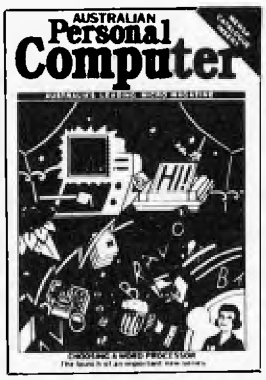

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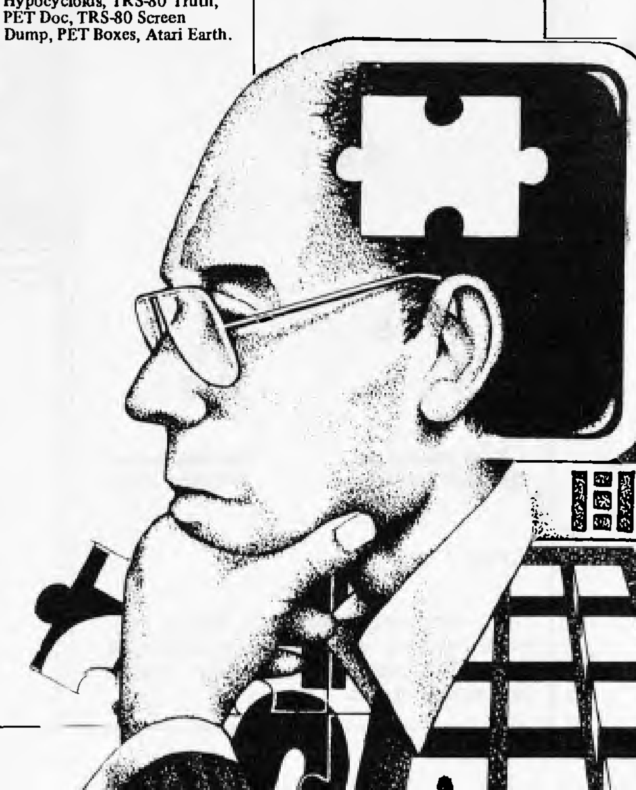

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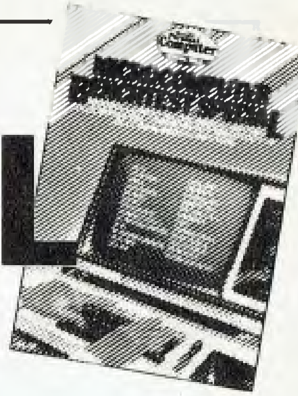

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EXPERT SYSTEMS

Robin Webster investigates the 'expert system', which offers advice plus an intelligible explanation of its decisions.

Normally, if you ask the question 'why' too many times you'll get a slap around the face — expert systems, though, are much more polite.

Whatever the field of expertise in which an expert system is supposed to operate, it can, on demand, provide the user with a justification of any conclusion it comes to.

It all has to do with the following premise: human experts use sets of knowledge-based rules to solve problems — discover these rules, code them up in a form that can be understood by a computer, and you have a machine that can act as a consultant — or at least as an intelligent reference tool.

But whereas the human consultant cannot always explain why he/she made a particular decision, the expert system can be asked to explain itself in a form intelligible to humans. Generally, this will be achieved by having the system display or print out the selection of rules it used in making a particular decision. Sometimes it is also valuable to ask it for the rules it considered, but rejected, during a session.

The trend is to predict that one day there will be hand-held expert systems which can be used in the office or home to work out tax or accounting problems or to care for your car or houseplants.

Right now, that's not feasible — although there are some micro-expert systems running on machines such as the Sirius and IBM Personal Computer (the second part of this article will look at a couple of packages in detail).

Application areas can be large or small, trivial or dramatic.

On the large and dramatic side there is one US-developed system called Prospector, which is designed to be of use in geological exploration. Last year, Prospector came into the limelight because it made a prediction that stopped more than a few geologists in their tracks.

Prospector was given the same field study data about an area in Washington State in the US as that used by experts employed by a mining company and came up with the conclusion that there were deposits of a metal ore called molybdenum over an extended region. The geologists disagreed and said the molybdenum was present in a much more restricted area.

Shortly after exploratory drilling had commenced, Prospector was found to be correct.

To explain why it's so difficult to put really useful expert systems onto micros, it should be made clear that Prospector is written in a dialect of Lisp called Interlisp and program listings run to more than 300 pages of source code. The whole thing needs a Digital Equipment mainframe to turn it over.

Faced with this, most micros would curl up and die.

There are some hopeful signs, however. What about a Sinclair ZX81 being turned into a medical expert system? Some practitioners of homeopathy (the technique of taking minute doses of poisons as a cure or prevention of ills) have already taken the machine and PROMmed it full of homeopathetic wisdom in the form of knowledge-based rules. No longer able to play ZX Invaders, the reworked machine is committed to being a homeopathic advisor.

On the grand scale, companies such as IBM, DEC, Texas Instruments, and Fairchild have set up special groups to carry out research in the US. And a far different project is a joint venture between Stanford University and IBM in the US called Dart — for 'Diagnosis, Assistance, Reference Tool'. The Dart project team is attempting to tackle the thorny problem of how to give a computer some knowledge about its own functions — its physiology, so to speak. The next step is to then give it the ability to reason about that physiology.

'If I ask a computer how it is expected to work I want to get an answer somewhat like the answer I would get from the designer of that system,' said Mike Genesereth, who is participating in the Dart project for Stanford. 'What is the expected behaviour of the system and why is it expected?

'To achieve this goal, we have a knowledge base in which we write down assertions about the structure of the machine — very high level assertions such as what the CPU does. Once we have that design model built in, we make a set of rules that access it and take a fault as input . . . We get it to do some reasoning about that fault and then conclude which part is suspect."

Another implication of this work is that it becomes feasible to develop intelligent operating system interfaces, as Genesereth explains.

'We are finding that as computers become more and more complicated they become more difficult to use, so, apart from the Dart project, we are working on ways in which it will be easier for users to get access to systems. The idea is to have what we are calling an "intelligent agent" in each machine, one that knows about its machine and how to achieve a user's goals.'

Heurisko is a fairly recent expert system developed by Doug Lenat, another Stanford man who regularly consults on expert systems for Rand and Xerox.

Lenat has applied Heurisko to two very different problems — the design of 3D semiconductors and playing a sophisticated war-game.

Earlier this year, Heurisko was set the task of seeing whether or not it could come up with a successful method of designing chips in three dimensions instead of just the usual two dimensions. According to Lenat, the results surprised even him.

'The system is based on an earlier expert system that I developed called AM,' he said. 'AM was designed to take fundamental mathematical ideas and go off by itself to see if it could discover new rules. It really worked quite well for a time, but it began to get interested in really trivial things and wouldn't let go — it essentially ran out of steam. With Heurisko I've made some changes so that this kind of thing can't happen.

'About six months ago Heurisko came up with a discovery that looked promising in terms of 3D chip design. Just as the fundamental device in 2D chips is the gate, which handles one function at a time, Heurisko found another device structure that could simultaneously handle the two functions AND/OR.'

Lenat wouldn't give full details of the device, but said that the 3D design work was proceeding under the name XMOS (Cross MOS) because of the shape of the new computing device.

'The rules responsible for Heurisko's discovery are only at an elementary maths level,' said Menat. 'In fact, the one that provided the new design essentially said "If you have a device that works well, make it more symmetrical and see what happens."

What is even more interesting, claims Lenat, is that the integrated expert working on the 3D project took the new design away and actually fabricated a working example

Illustration by Peter Benton

in six months. It is said to be no larger than a conventional 2D gate, but since it is somehow able to compute both the AND/OR functions simultaneously (one pre sumes not on the same piece of data) less devices are needed per chip, and 3D chips should prove to be very compact if they are ever produced commercially.

Apart from such practical pursuits, Lenat has also used Heurisko to help make him something of a war-game champion. For the last two years, he has entered and won the Trillion Credit Squadron competition organised in the US by the Game Designers Workshop.

Essentially, competitors must design a fleet of sea and spacegoing ships that are invincible. The rules for the game run to several books published by the organisers. Each fleet designer has a theoretical limit of a Trillion Credits to fund his work.

Lenat has applied Heurisko's technique — ie taking a given design and 'mutating' it in all manner of ways — to the war-game.

'The resolution of any confrontation between fleets can be worked out fairly easily,' said Lenat, 'but the rules of design are very, very detailed. For example, there are maybe 100 to 200 ships of all types in the fleet and any design must take account of 100 or so different parameters. For example, if you want to increase the power of a particular engine, you have to be aware that it will be more expensive and that you may have to strengthen many other related parts of the ship. Or maybe you want to have thicker armour plating than usual — this will obviously increase the weight and result in a slower, less manoeuverable ship.'

After hundreds of hours of computer time, Lenat managed to give Heurisko the rules of the game in a form it could use. For many nights he simply set the system loose on design work and came in the next morning to look at the results.

'The key thing is that Heurisko is able to mutate a design by making a large collection of small changes to a ship and then assessing the quality of that new design,' he said. 'I've won the competition for the last two years and hope to do so again in 1983, but it is probably going to get harder. It is becoming clearer that more and more computer science people are getting involved, and expert system techniques are ideal for this environment.'

END

NEWCOMERS START HERE

This is our unique quick-reference guide, reprinted every month to help our readers pick their way through the most important pieces of (necessary) jargon found in APC. While it's in no way totally comprehensive, we trust you'll find it a useful introduction. Happy microcomputing!

Welcome to the confusing world of the microcomputer. First of all, don't be fooled; there's nothing complicated about this business, it's just that we're surrounded by an immense amount of necessary jargon. Imagine if we had to continually say 'numbering system with a radix of 16 in which the letters A to F represent the values tén to 15' when instead we can simply say 'hex'. No doubt soon many of the words and phrases we are about to explain will eventually fall into common English usage. Until that time, APC will be publishing this guide — every month.

We'll start by considering a microcomputer's functions and then examine the physical components necessary to implement these functions.

The microcomputer is capable of receiving information, **processing** it, storing the results or sending them somewhere else. All this information is called **data** and it comprises numbers, letters and special symbols which can be read by humans. Although the data is accepted and output by the computer in 'human' form, inside it's a different story — it must be held in the form of an electronic code. This code is called **binary** — a system of numbering which uses only 0s and 1s. Thus in most micros each character, number or symbol is represented by eight binary digits or **bits** as they are called, ranging from 00000000 to 11111111.

To simplify communication between computers, several standard coding systems exist, the most common being **ASCII** (American Standard Code for Information Interchange). As an example of this standard, the number five is represented as 00110101 — complicated for humans, but easy for the computer! This collection of eight bits is called a **byte** and computer freaks who spend a lot of time messing around with bits and bytes use a half-way human representation called **hex**. The hex equivalent of a byte is obtained by giving each half a single character code (0—9, A—F): 0=0000, 1=0001, 2=0010, 3=0011, 4=0100, 5=0101 .... E=1110 and F=1111. Our example of 5 is therefore 35 in hex. This makes it easier for humans to handle complicated collections of 0s and 1s. The machine detects these 0s and 1s by recognising different voltage levels.

The computer processes data by reshuffling, performing arithmetic on, or by comparing it with other data. It's the latter function that gives a computer its apparent 'intelligence' — the ability to make decisions and to act upon them. It has to be given a set of rules in order to do this and, once again, these rules are stored in **memory** as bytes. The rules are called **programs** and while they can be input in binary or hex (**machine code** programming), the usual method is to have a special program which translates English or near-English into machine code. This speeds programming considerably; the nearer the **programming language** is to English, the faster the programming time. On the other hand, program execution speed tends to be slower.

The most common microcomputer language is **Basic**. Program instructions are typed in at the keyboard, to be coded and stored in the computer's memory. To **run** such a program the computer uses an **interpreter** which picks up each English-type **instruction**, translates it into machine code and then feeds it into the **processor** for execution. It has to do this each time the same instruction has to be executed.

Two strange words you will hear in connection with Basic are **PEEK** and **POKE**. They give the programmer access to the memory of the machine. It's possible to read (PEEK) the contents of a byte in the computer and to modify a byte (POKE).

Moving on to **hardware**, this means the physical components of a computer system as opposed to **software** — the programs needed to make the system work.

At the heart of a microcomputer system is the central processing unit (**CPU**), a single microprocessor chip with supporting devices such as **buffers**, which 'amplify' the CPU's signals for use by other components in the system. The packaged chips are either soldered directly to a printed circuit board (**PCB**) or are mounted in sockets.

In some microcomputers, the entire system is mounted on a single, large, PCB; in others a **bus system** is used, comprising a long PCB holding a number of interconnected sockets. Plugged into these are several smaller PCBs, each with a specific function — for instance, one card would hold the CPU and its support chips. The most widely-used bus system is called the **S100**.

The CPU needs memory in which to keep programs and data. Microcomputers generally have two types of memory, **RAM** (Random Access Memory) and **ROM** (Read Only Memory). The CPU can read information stored in RAM — and also put information into RAM. Two types of RAM exist — **static** and **dynamic**; all you really need know is that dynamic RAM uses less power and is less expensive than static, but it requires additional, complex, circuitry to make it work. Both types of RAM lose their contents when power is switched off, whereas ROM retains its contents permanently. Not surprisingly, manufacturers often store interpreters and the like in ROM. The CPU can only read the ROM's contents and cannot alter them in any way. You can buy special ROMs called **PROMs** (Programmable ROMs) and **EPROMs** (Eraseable PROMs) which can be programmed using a special device; EPROMs can be erased using ultra-violet light.

Because RAM loses its contents when power is switched off, **cassettes** and **floppy disks** are used to save programs and data for later use. Audio-type tape recorders are often used by converting data to a series of audio tones and recording them; later the computer can listen to these same tones and re-convert them into data. Various methods are used for this, so a cassette recorded by one make of computer won't necessarily work on another make. It takes a long time to record and play back information and it's difficult to locate one specific item among a whole mass of information on a cassette; therefore, to overcome these problems, **floppy disks** are used on more sophisticated systems.

A floppy disk is made of thin plastic, coated with a magnetic recording surface rather like that used on tape. The disk, in its protective envelope, is placed in a disk drive which rotates it and moves a **read/write head** across the disk's surface. The disk is divided into concentric rings called **tracks**, each of which is in turn subdivided into **sectors**. Using a program called a **disk operating system**, the computer keeps track of exactly where information is on the disk and it can get to any item of data by moving the head to the appropriate track and then waiting for the right sector to come round. Two methods are used to tell the computer where on a track each sector starts: **soft sectoring** where special signals are recorded on the surface and **hard sectoring** where holes are punched through the disk around the central hole, one per sector.

Half-way between cassettes and disks is the **stringy floppy** — a miniature continuous loop tape cartridge, faster than a cassette but cheaper than a disk system. **Hard disk** systems are also available for micro-computers; they store more information than floppy disks, are more reliable and information can be transferred to and from them much more quickly.

You, the user, must be able to communicate with the computer and the generally accepted minimum for this is the visual display unit (**VDU**), which looks like a TV screen with a typewriter-style **keyboard**; sometimes these are built into the system, sometimes they're separate. If you want a written record (**hard copy**) of the computer's output, you'll need a **printer**.

The computer can send out and receive information in two forms — **parallel** and **serial**. Parallel input/output (**I/O**) requires a series of wires to connect the computer to another device, such as a printer, and it sends out data a byte at a time, with a separate wire carrying each bit. Serial I/O involves sending data one bit at a time along a single piece of wire, with extra bits added to tell the receiving device when a byte is about to start and when it has finished. The speed that data is transmitted is referred to as the **baud rate** and, very roughly, the baud rate divided by ten equals the number of bytes being sent per second.

To ensure that both receiver and transmitter link up without any electrical horrors, standards exist for serial interfaces; the most common is **RS232** (or **V24**) while, for parallel interfaces to printers, the **Centronics** standard is popular.

Finally, a **modem** connects a computer, via a serial interface, to the telephone sytem allowing two computers with modems to exchange information. A modem must be wired into the telephone system and you need Telecom's permission; instead you could use an **acoustic coupler**, which has two obscene-looking rubber cups into which the handset fits, and which has no electrical connection with the phone system — Telecom isn't so uppity about the use of these.

WARNIER-ORR TECHNIQUES FOR PROGRAM DESIGN

Paul Overaa gives further advice on using this powerful technique.

Assembly language programming is prone to difficulties that are not generally in higher level languages. One major factor is that assembler programs are notoriously difficult to read, and thus difficult to understand. Such difficulties make progress in writing low level language routines slow compared with equivalent progress in high level languages. As the size of programs increases the difficulties become more apparent, with the result that developing even moderate size assembler programs becomes a major undertaking.

The pioneering work of Professor Warnier in France and the subsequent work of Keneth T Orr in the USA has resulted in an approach to designing and writing programs that is now beginning to be considered as one of the most important advances in program design made to date. The techniques emphasise the role of finding the logical solution to a problem in terms of the program before such considerations as language and coding are dealt with. Because of this the techniques are essentially language independent and are therefore applicable to all types of programming problems.

Resultant programs are logically correct before they are coded and inevitably work 'first time' bar any typing errors from those of us that suffer from keyboard dyslexia. As as example of the technique in use, I have selected a relatively short utility subroutine called DUMP whose purpose is to dump the contents of a selected page of memory in hex form and in printable characters form.

To print the contents of 256 bytes (ie, one page) using 16 lines of 16 bytes, the format to be used is as follows: the starting address of each line is given, followed by the hexadecimal contents of the 16 bytes and secondly by the character representation of those same bytes. Non-printing characters (ie, control characters) must be printed as a period. Figure 1 shows an example of the required format.

Steps in program design

Having described in words what we want our program to do we now attempt to express this in terms of a Warnier-Orr diagram. Figure 2 is such a diagram and contains the bare essentials of our problem. If you are not familiar with the basic concepts then a previous article in *APC* (January 1982) will be of use. I will restate the essential conventions. The diagrams are sets of hierarchical square brackets that are read downwards within each bracket. The brackets contain statements of what actions are to occur and statements of what decisions are required at certain stages of the program. A statement with a bar written over it signifies the logical opposite — ie, in Figure 2 there is a statement '16 lines printed' which is interpreted as the logical opposite — '16 lines have *not* been printed'. Statements that are mutually exclusive are written with a ⊕ sign separating them. Such statements infer that only one of the actions will be performed. When the word 'SKIP' is written in a bracket it means that no actions are associated with the bracket. If a bracket to the right of a statement does itself contain further statements then these are actions to be performed if the higher level statement has been performed.

Figure 2 tells us that we are dealing with a routine that is called 'DUMP' and that it has some form of beginning block and another as yet unspecified 'END' block. Two mutually exclusive options exist depending on whether or not 16 lines have been printed. While 16 lines have not been printed we perform an action called 'PRINT LINE'. If 16 lines have been printed, then, since there are no corresponding actions within the bracket on the right, we skip the bracket and perform the 'END' block.

Notice that we have not specified how to print a line or how we start or finish our routine. We are only interested initially in attempting to create on paper some form of basic structure consistent with the essential details of our problem.

The next stage in the design process is one of 'iterative refinement' — ie, we look at our problem and attempt to find areas that we can specify in greater detail. In this case our original problem specification indicates that we can add more detail to the 'PRINT LINE' bracket since we have specified that we wish to print the contents of 16 bytes on each line. Figure 3 is the diagram showing this.

Notice that we add to our initial diagram by progressive expansion rather than by altering the basic structure.

Our problem tells us how we are to print each line and we can expand Figure 3 to show that we are to print the contents of each line of 16 bytes in hexadecimal form and then in ASCII character form. Figure 4 reflects this and also introduces statements that indicate we will be using some means of counting how many lines we have printed and how many bytes of current line have been printed.

This process of 'iterative refinement' can

```
AA00H   29 0E 00 00 00 53 C3 41 AA 60 AA F5 88 43 B9 21     )....S.A.`...C.!
AA10H   1A AA 06 00 09 4E C3 21 B7 00 03 06 09 0C 0F 02     .....N.!........
AA20H   05 08 0B 0E 01 04 07 0A 0D 10 14 1A 06 0C 12 18     ................
AA30H   04 0A 10 16 00 00 00 00 00 00 10 1F 03 07 47 B0     ..............G.
AA40H   04 EB 22 0A AC 21 09 AC 71 21 00 00 39 22 0E AC     .."..!..q!..9"..
AA50H   31 40 AC CD D3 83 2A 0E AC F9 2A 0C AC 7D 44 C9     1@....*...*..}D.
AA50H   21 A4 AA CD 7B AA FE 03 CA 00 00 C9 21 AF AA C3     !...{.......!...
AA70H   75 AA 21 B6 AA CD 7B AA C3 00 00 E5 CD 53 AB 3A     u.!...{......S.:
AA90H   08 AC C6 41 32 A0 AA 01 94 AA CD 5D AB C1 CD 5D     ...A2......]...]
AA90H   AB C3 BA AA 42 44 4F 53 20 45 52 52 20 4F 4E 20     ....BDOS ERR ON
AAA0H   20 3A 20 24 42 41 44 20 53 45 43 54 4F 52 24 53      : $BAD SECTOR$S
AAB0H   45 4C 45 43 54 24 52 2F 4F 24 21 07 AC 7E 36 00     ELECT$R/O$!...6.
AAC0H   B7 C0 C3 09 B7 CD BA AA CD D3 AA D8 F5 4F CD 3A     .............O.:
AAD0H   AB F1 C9 FE 0D C8 FE 0A C8 FE 09 C8 FE 20 C9 3A     ............. .:
AAE0H   07 AC B7 C2 01 AB CD 06 B7 E6 01 C8 CD 09 B7 FE     ................
AAF0H   13 C2 FE AA CD 09 B7 FE 03 CA 00 00 AF C9 32 07     ..............2.
```

Fig 1

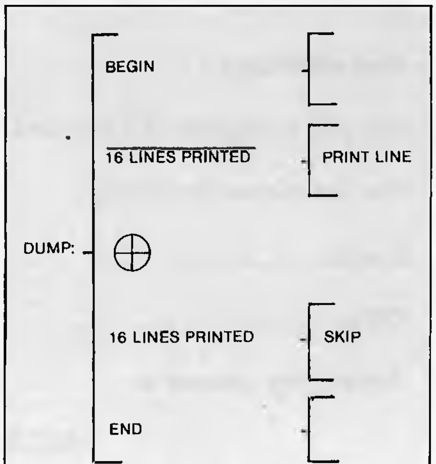

Fig 2

be continued because we also know from our original specification of the problem that having printed the hexadecimal form of our 16 byte line we print the ASCII form of the same bytes. *But*. . . if the character is non-printing then we must print a 'period' instead. These additional restraints are shown in Figure 5 as an expansion of the Figure 4 statement 'PRINT SAME 16 BYTES AS ASCII FORM'.

Notice that as we expand the statement bracket we do not alter any of the other parts of the diagram. The diagram as it 'evolved' is separating the problem into distinct separate logical entities and it is this effect of the design technique that is particularly significant.

At this stage I would mention that these diagrams evolve very quickly once you are used to the technique and as they do they formalise the 'logic' of the problem in a way that is obviously language-independent.

Since the problem we are dealing with is simple it is instructive to combine Figures 4 and 5 to show the complete representation that, as you will see, is the solution in terms of the program design.

Figure 6 is then the combined diagrams of Figures 4 and 5. It represents the logical statement of our problem and it is the logical solution to the associated problem of designing the program. It is possible to continue the process of iterative refinement to any level that is desired, but for the purposes of this example I now wish to consider the transition from our Warnier-Orr diagram to the coding of an 8085 assembly language program. The coding was written for a CP/M environment utility subroutine

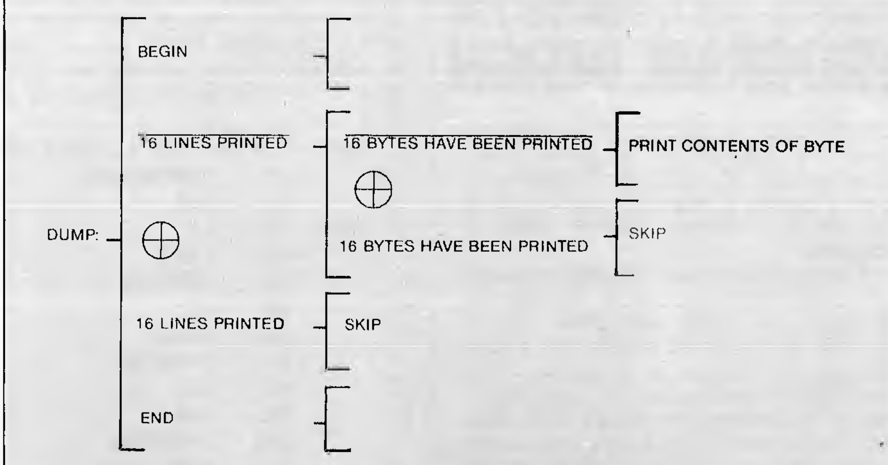

Fig 3

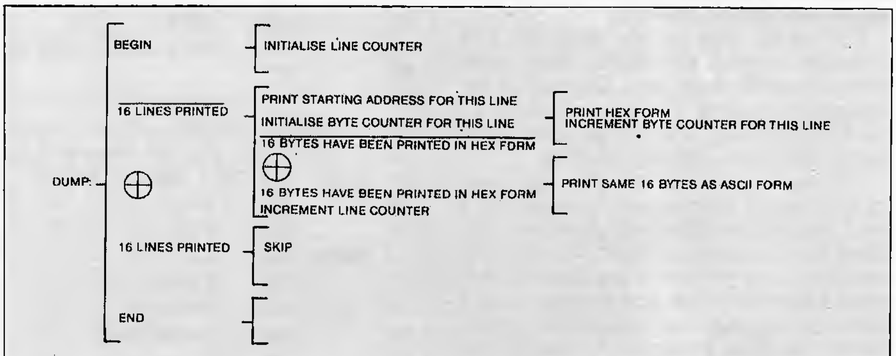

Fig 4

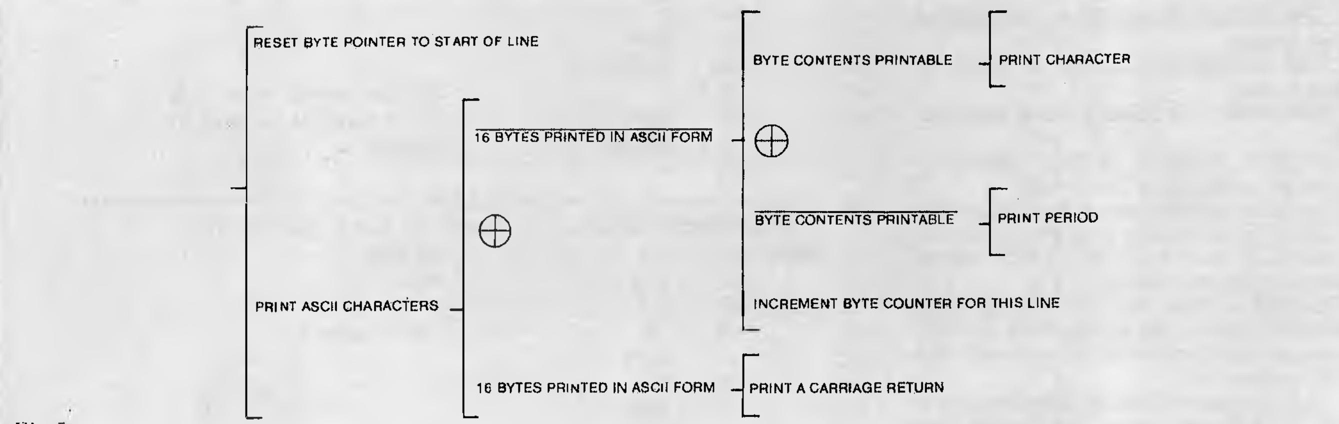

Fig 5

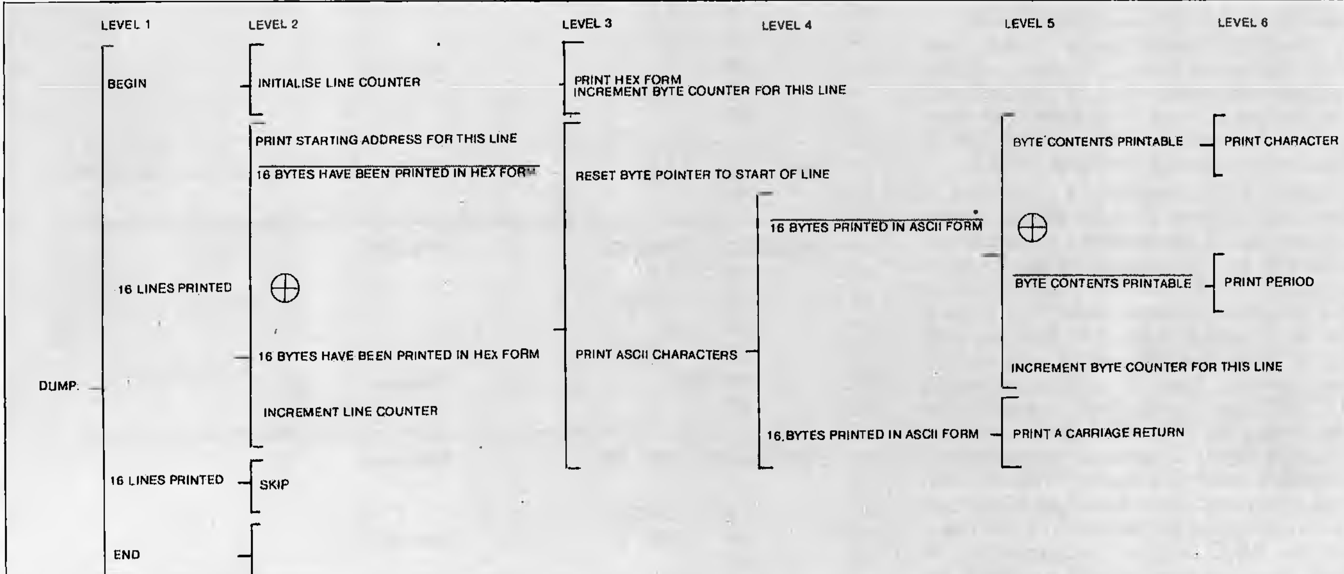

Fig 6

WARNIER-ORR TECHNIQUES FOR PROGRAM DESIGN

used to dump, at the line printer, selected pages of applications programs under development. To facilitate discussion of such diagrams I frequently identify along the top of a diagram various 'levels of brackets'.

The transition is accomplished in general by treating the brackets in the Warnier-Orr diagrams as called subroutines. Occasionally the first or last statement of a bracket may be included in the coding of the next highest level bracket, but this is often a matter of personal preference. The ideas are best explained by referring to the example of coding provided. I have numbered the lines of the assembler program for ease of reference and have placed plenty of remarks within each of the routines.

The basic core of the program will reference several subroutines that come without modification from a library of my assembler routines. The example itself, ie, the DUMP utility, has proved quite useful and is also now a library program.

The names that are used to call these various library subroutines together with a brief description of their functions are now listed for convenience. Since DUMP is not expected to be resident in any finished program I have not made any attempt to save bytes. It is my personal opinion that in most cases it is more important for routines to map directly to their design layouts since this facilitates maintenance in large programs.

L$PRINT$BC Prints BC register pair at line printer
L$PRINT$SPACE Prints a space at line printer
L$PRINT$TAB Prints a tab at line printer
L$CRLF Prints a carriage return — linefeed sequence at line printer
The above routines use another subroutine L$OUCH to actually print the characters. L$OUCH uses a CP/M 'BDOS' call to handle character output.
BIN$HEX This converts a single byte number held in the accumulator into the hexadecimal form which is returned in the BC register pair.

Let us examine first the initial section of the DUMP subroutine. This is shown as lines 6-23 and corresponds to the first or highest level bracket (this is the one containing the BEGIN and END blocks).

The BEGIN block is in fact lines 6, 7 and 8 of the source listing. We push existing register values onto the stack, load HL with the starting address of the page to be dumped and initialise a line counter (the D register) by placing the value 16 in it.

Lines 9-21 constitute a loop that is executed 16 times. First the starting address of each line of information is to be printed, followed by the contents of the 16 bytes starting from this address. Lines 9-11 print the H register contents. Lines 12-14 repeat for the L register. Lines 15-17 simply print an 'H' character followed by a tab for format spacing. Line 18 calls a subroutine DUMP2, and this label was inserted before the coding for DUMP2 had been written. Line 19 prints a carriage return-linefeed sequence ready for dealing with the next line of printing. Once these operations have been performed we decrease the line counter (ie, the D register) and providing 16 lines have not been printed we repeat the loop. Lines 22 and 23 constitute the END

```
 1: * ==========================================================================
 2: * LIBRARY SOURCE PROGRAM ......... DUMP.LIB
 3: * Purpose: To dump selected page of memory in hex. and character form at printer
 4: *          The address is passed via an EQU pseudo-op named DUMP$ADDRESS
 5: * --------------------------------------------------------------------------
 6: DUMP:   PUSH PSW ! PUSH B ! PUSH D ! PUSH H     ;Preserve
 7:         LXI     H,DUMP$ADDRESS          ;Address of page to be dumped
 8:         MVI     D,16                    ;Counter 16 lines of 16 bytes per line
 9: DUMP1:  MOV     A,H                     ;Print address in hex form
10:         CALL    BIN$HEX                 ;Library routine
11:         CALL    L$PRINT$BC
12:         MOV     A,L
13:         CALL    BIN$HEX
14:         CALL    L$PRINT$BC
15:         MVI     A,72                    ;ASCII "H" character
16:         CALL    L$OUCH
17:         CALL    L$PRINT$TAB             ;TAB on printer
18:         CALL    DUMP2                   ;Prints 16 Hex contents after location
19:         CALL    L$CRLF
20:         DCR     D                       ;Decrement counter
21:         JNZ     DUMP1
22:         POP H ! POP D ! POP B ! POP PSW         ;Restore
23:         RET
24: * ==========================================================================
25: * PRINT$LINE ROUTINE... Prints starting location and contents of 16 bytes
26: * This routine does NOT preserve HL but leaves pointing to next location !!!
27: DUMP2:  PUSH PSW ! PUSH D ! PUSH H      ;Preserve
28:         MVI     D,0                     ;Counter
29:         MVI     E,16                    ;Max to exit
30: DUMP3:  MOV     A,M                     ;Contents of memory byte for printing
31:         CALL    BIN$HEX
32:         CALL    L$PRINT$BC
33:         CALL    L$PRINT$SPACE
34:         INR     D                       ;Increment counter
35:         MOV     A,D
36:         CMP     E
37:         INX     H
38:         JNZ     DUMP3
39:         CALL    L$PRINT$TAB
40:         POP H                           ;Restore original value to HL
41:         CALL    DUMP4                   ;Print same data in character form
42:         POP D ! POP PSW                 ;Restore
43:         RET
44: * ==========================================================================
45: * PRINT$CHARACTER ROUTINE ....... Prints the data in character form
46: DUMP4:  MVI     D,0                     ;Counter
47:         MVI     E,16                    ;Max
48: DUMP5:  MOV     A,M
49:         CPI     126                     ;126 or above ?
50:         CP      DUMP6
51:         CPI     32
52:         CM      DUMP6
53:         CALL    L$OUCH
54:         INR     D
55:         MOV     A,D
56:         CMP     E
57:         INX     H                       ;Next byte
58:         JNZ     DUMP5
59:         RET
60: * --------------------------------------------------------------------------
61: DUMP6:  MVI     A,46                    ;Period replaces all non printing characters
62:         RET
63: * ==========================================================================
64: L$PRINT$BC:     PUSH PSW                ;Preserve
65:         MOV     A,B
66:         CALL    L$OUCH
67:         MOV     A,C
68:         CALL    L$OUCH
69:         POP PSW                         ;Restore
70:         RET
71: * ==========================================================================
72: L$PRINT$SPACE:  PUSH PSW                ;Preserve
73:         MVI     A,32
74:         CALL    L$OUCH
75:         POP     PSW                     ;Restore
76:         RET
77: * ==========================================================================
```

```
78:  L$PRINT$TAB:   PUSH    PSW                 ;Preserve
79:          MVI    A,9
80:          CALL   L$OUCH
81:          POP    PSW                 ;Restore
82:          RET
83:  * ======================================================================
84:  * ASSEMBLER SOURCE LIBRARY ......... L$OUCH.LIB
85:  * PURPOSE: TO OUTPUT A CHARACTER TO PRINTER VIA BDOS CALL.CHARACTER MUST BE PRESENT
86:  *          IN ACCUMULATOR BEFORE CALLING
87:  * ----------------------------------------------------------------------
88:  L$OUCH: PUSH PSW ! PUSH B ! PUSH D ! PUSH H     ;SAVE REGISTERS
89:                 MVI     C,5         ;WRITE LINEPRINTER CODE
90:                 MOV     E,A         ;TRANSFER TO BDOS IS VIA E REGISTER
91:                 CALL    BDOS        ;MUST BE PREVIOUSLY DEFINED
92:          POP H ! POP D ! POP B ! POP PSW ;RESTORE REGISTERS
93:                 RET
94:  * ======================================================================
95:  * ASSEMBLER SOURCE LIBRARY ......... L$CRLF.LIB
96:  * PURPOSE: TO OUTPUT TO PRINTER A CARRIAGE RETURN-LINE FEED COMBINATION
97:  *          USING THE ACCUMULATOR.
98:  * ----------------------------------------------------------------------
99:  L$CRLF:        PUSH PSW            ;SAVE REGISTERS
100:                MVI     A,CR        ;CR MUST BE DEFINED
101:                CALL    L$OUCH      ;LIBRARY UTILITY PROGRAM
102:                MVI     A,LF        ;LF MUST BE DEFINED
103:                CALL    L$OUCH
104:                POP PSW             ;RESTORE REGISTERS
105:                RET
106: * ======================================================================
107: * ASSEMBLER SOURCE LIBRARY ...... BIN$HEX.LIB
108: * PURPOSE:TO CONVERT A BINARY NUMBER PASSED VIA THE ACCUMULATOR INTO THE HEX
109: *         FORM WHICH IS OUTPUT TO THE PRINTER USING L$OUCH (LIBRARY PROG.)
110: *         THE HEX VALUE AS TWO PRINTABLE CHARACTERS IS RETURNED IN BC PAIR
111: * ----------------------------------------------------------------------
112: BIN$HEX:       PUSH    PSW                 ;PRESERVE
113:               MOV     C,A                 ;SAVE VALUE
114:               ANI     00F0H               ;MASK OUT LSB'S
115:               RRC
116:               RRC
117:               RRC
118:               RRC                         ;SHIFT TO LSB'S POSITION
119:               CALL    BIN$HEX1
120:               MOV     B,A                 ;READY FOR OUTPUT !!
121:               MOV     A,C
122:               ANI     000FH               ;MASK OUT MSB'S
123:               CALL    BIN$HEX1
124:               MOV     C,A                 ;READY FOR OUTPUT !!
125:               POP     PSW                 ;RESTORE
126:               RET
127: * ----------------------------------------------------------------------
128: BIN$HEX1:      ADI     48                  ;THIS ENSURES THAT THE EQUIVALENT
129:               CPI     58                  ;ASCII NUMBER IS PRINTED IF 0-9
130:               CP      BIN$HEX2
131:               RET
132: * ----------------------------------------------------------------------
133: BIN$HEX2:      ADI     7                   ;ENSURES THAT ASCII LETTER IS
134:               RET                         ;OBTAINED
135: * ======================================================================
```

block. We simply return the original values to the internal registers and execute a return from the subroutine.

The coding for the initial section was completed first, but as well as referencing some of the library subroutines we placed a reference to CALL DUMP2. This was in effect a 'dummy' label placed into the initial section so we could complete the coding for this section without having to worry about more detailed problems — such as are involved with the printing of each line of information.

The next stage in the development of the coded solution was to write the subroutine corresponding to the label DUMP2 whose purpose is to print the contents of the 16 bytes that constitute a line. The starting address for the line is held in the HL register pair. The following notes apply to lines 27-43 of the source code.

First we save all registers by pushing onto the stack, then as before we set up a loop using a simple counter. This loop will as before be executed 16 times. Using a MOV A,M instruction we place each of the sixteen memory location contents into the accumulator and then print them by using calls to subroutines BINHEX, LPRINT$BC and L$PRINT$SPACE. As we step through the loop we use a INX H instruction to point HL to the next location to be examined.

In this way we are able to deal with printing the hex form of a Line. Our Warnier-Orr diagram tells us that having done this we must print the same bytes in ASCII character form. The solution is simple. . . we reset the HL memory pointer by POP H (which restores the original values) and then we write another subroutine call using a further 'dummy label'.

In this case the dummy label is DUMP4 and it corresponds to the statement in Figure 6 of 'PRINT ASCII CHARACTERS'. Since the diagram indicates that no further actions are required to complete this 'bracket' we simply restore the registers that have still to be returned to their original state and return from the subroutine.

The general pattern for the translation of the Warnier-Orr representation to the final coding should be becoming clear. Once you have a completed diagram to the level of detail required to formalise the logic of the problem you start coding 'level by level'. If you reach a point where some required action involves more coding than can comfortably be written in a few lines than you place a call to another level of subroutines using a 'dummy label'. By doing this you will be able to complete the routine you are currently working on without getting involved with details on a lower level. Having then coded one particular level you can in a similar fashion concentrate your attention on writing the subroutines for the next level down — ie, the ones you used the 'dummy labels' for. This technique is used at all levels until all the 'brackets' in the Warnier-Orr diagram have been translated.

The subroutine DUMP4 — ie, lines 46-59 — uses a simple loop counter as in previous routines to print the contents of the 16 bytes. Since DUMP4 is now dealing with the ASCII forms it is necessary to check that the character is printable, ie, has an ASCII code between 32 and 126. You will see from the coding that cases where this is not true result in a period being printed rather than the character itself.

I have tried to provide sufficient detail of all the stages in the development of the example to enable the technique to be tried on your own programming problems using whatever hardware/software combinations you have.

The essential points to bear in mind are:

1. Express your problem in terms of ordinary language.
2. Draw an elementary Warnier-Orr diagram that is consistent with the most fundamental aspects of the problem as stated.
3. Iteratively refine the diagram by examining areas that you can define more exactly. As the diagram grows it will be formalising the logic of your problem and in fact solving the design problem as well.
4. Choose whatever programming language you feel is appropriate and then code the solution 'level by level' using 'dummy calls' for statements that involve complex brackets — ie, brackets which you feel may involve more than just straightforward coding.
5. Continue level by level until you have completed the lowest levels of subroutines.

To conclude, we can do little better than restate what we have indicated by example to be the main advantages of the technique. We define a problem and by using Warnier-Orr techniques we logically describe the problem and at the same time solve the associated program design problem. We also end up with a logically structured program together with a diagram formally documenting the structure of the problem and the final coding. Because of this, such programs suffer far less from debugging problems and are very easy to maintain since the 'logical independence' of the various sections is accomplished readily with the 'nested subroutine' type of development.

END

TJ's WORKSHOP

Our monthly pot-pourri of hardware and software tips for the popular micros. If you have a favourite tip to pass on, send it to: 'TJ's Workshop', APC, P.O. Box 280, Hawthorn, Vic 3122. Please keep your contributions as concise as possible. We will pay $10–$30 for any tips we publish from now on.

PET MOVEMENT

Nearly all PET 'movement' games which I have seen published in your magazine in the past two years use a method of movement a great deal slower than the method I use, which to my knowledge I invented!

This makes use of PEEK (515), which gives the current key pressed and an array and can be adapted for various types of movement — and no doubt for other machines also.

T. Ley

```
1 PRINT"♥":POKE33333,214
5 G=33333:X=0
10 DIMA(255)
20 A(50)=-40:A(18)=40:A(42)=1:A(41)=-1:R=515
30 REM BASIC)1:A(184)=-40:A(178)=40:A(180)=-1:A(182)=1:R=151
35 REM +++ SET UP THE SCREEN +++
40 FORT=1TO40:POKE32767+T,224:POKE33727+T,224:NEXT
50 FORT=0TO960STEP40:POKE32768+T,224:POKE32807+T,224:NEXT
60 REM MOVEMENT
70 X=A(PEEK(R)):IFPEEK(C+X)()32THEN70
80 POKEC,32:C=C+X:POKEC,214:GOTO70
```

SHARP CHARACTERS

The Sharp PC-1500 is pretty remote (ouch) from being a terminal, but it is still good TJ fodder. I have been delving into the inner workings of the machine, and have found a lot of interesting goodies. Here is a program to illustrate one of the most useful.

The Sharp generates displayed characters by software, and so the character generator is accessible to programs. It starts at 64672 (&FCA0) with the entry for the space character. Each entry consists of five bytes of dot column image which can be passed to GPRINT. The sixth column is always blank and consequently does not appear in the table.

With a bit of manipulation it is possible to print characters upside-down or back-to-front, but the most useful application of the table is for for printing double-width characters, as in this demonstration program.

```
5 REM    DOUBLE WIDTH CHARS
1Ø WAIT Ø
2Ø INPUT "STRING? ";A£
3Ø FOR  I=1  TO  LENA£
4Ø A=ASC(MID£(A£,I,1))*5+&FCØØ
5Ø FOR J=Ø  TO 4
6Ø B=PEEK(A+J)
7Ø GPRINT B;B;
8Ø NEXT J
9Ø GPRINT "ØØØØ";
1ØØ NEXT  I
11Ø PAUSE
12Ø GOTO 2Ø
```

The display annunciators (BUSY, RUN, etc) are memory mapped and appear at &764E and &764F. Sorting out which bit belongs to which symbol is left as an exercise for the reader, but beware — there is a surprise in store!

By the way, does anyone know what the OPN instruction does?

M. Ray

VIC TIP

Here's a useful tip for the Vic-20. Many Vic-20 owners will by now be familiar with the problems of using hi-res graphics with the 8k cartridge. Basic has to be shifted from $1200 to $2000 to make room for the user-defined graphics.

This is quite a simple operation if you know how to do it, but for the average user with only the Inane Computer Guide to consult, like myself a few months ago, it can seem like a formidable problem.

Here are the necessary commands:

```
POKE 32*256,0
POKE 44,32
NEW
```

The last line is very important as it saves you the bother of changing all the variable pointers just after 44 in the zero page.

Once you have typed in the commands, you will have about 8000 bytes left for Basic programs, which you can type in and save as normal.

Substituting a lower number for 32 in lines 1 and 2 will give you more memory for Basic and less for graphics.

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NEC 526.

SYSTEM 80 LOWER CASE

Users of the System 80 will know how it signs up with 'READY?' instead of the more usual 'MEMORY SIZE' question. Also the screen scrolls 26 times instead of giving the message 'RADIO SHACK LEVEL II BASIC' which is usual with the TRS-80. A special message or owner's name could replace the second message – possibly for security.

System 80 owners will know that even if their machine has the hardware mod for lower case they still have to load a lower case driver, or call the driver in the extra ROM at 3000H. Embedded in the print routines in the System 80 ROM there is a test for lower case characters; lower case characters sent to the ROM print routines are automatically converted to upper case before being displayed. If this test could be removed then upper and lower case could both be displayed without another VDU driver.

There is no control key on either the TRS-80 or System 80 however the SHIFT ↓ keys may be used as an alternative, but there is a problem. Every time SHIFT ↓ is pressed CHR$ (26) is generated before the required SHIFT ↓ generates control-Z on its own. In the ROM there is a table of ASCII values for the non-alphanumeric keys such as BREAK, CLEAR, ↓ , etc. In the table the value for SHIFT ↓ is 1AH or 26 (ie, control-Z) – if this were changed to OOH (ASCII null) then the erronous control-Z would not occur.

All of the above modifications require changes to the first ROM (0000H – 0FFFH); this may be done by replacing it with an appropriately programmed 4k EPROM (eg 2732 or 2532). Some EPROMs are not pin for pin compatible with the ROMs fitted, and in this case one or two address lines may have to be moved.

Below is a table of the locations that require alteration.

M J Tubby

Table of alterations to System 80 ROM 1

```
                                   ;Old location's contents
0059 1A                            ;ASCII value used for SHIFT
                                   ;
0105 52                            ;'R'
0106 45                            ;'E'
0107 41                            ;'A'
0108 44                            ;'D'
0109 59                            ;'Y'
010A 00                            ;Null characters
010B 00                            ;
010C 00                            ;
010D 00                            ;
010E 00                            ;
010F 00                            ;
0110 00                            ;Message terminator
0111 0D                            ;Sign up message 26 times carriage return
0112 0D                            ; or 'RADIO SHACK LEVEL II BASIC'
 '                                 ;on TRS-80
 '
 '
012A 0D                            ;Last of message characters
012B 0D                            ;Carriage return
012C 00                            ;Message terminator
                                   ;
0471 FE 40      CP 'A'             ;Test with letter A
0473 38 08      JR C,047DH         ;jump to print if not alphabetic
0475 D6 40      SUB 40H            ;subtract 64, make alpha in range 0-26
0477 FE 20      CP 20H             ;test if lower case
0479 38 02      JR C,047DH         ;jump to print if upper case
047B D6 20      SUB 20H            ;convert lower case to upper case
047D CD 41 05   CALL 0541H         ;print next character on VDU

                                   ;New contents
0059 00                            ;ASCII Value for null

0105 - 010F  inclusive             ;message 'Memory size'
0110 00                            ;message terminator
0111 - 012A  inclusive             ;message '    EG3008-11 Basic L2
                                   ;or any message upto 26 characters long
                                   ;e.g.    Name & Telephone no.
012B 0D                            ;Carriage return
012C 00                            ;message terminator
                                   ;
0471 00         NOP                ;No operation, i.e. ignore lower case conversion
0472 00         NOP                ;
0473 00         NOP                ;
 '
 '
047C 00         NOP                ;
047D CD 41 05   CALL 0541H         ;print next character on VDU
```

PET DO-UNTIL

Most programmers are concerned about making well-structured programs. In Basic, structuring is very difficult as the language lacks the required control commands. This program for the PET with Basic 3.0 gives a DO/UNTIL structure. It resides in the second cassette buffer and has full error checking. DO/UNTIL may be nested to any degree so long as there is sufficient space on the stack.

To enter the program, type SYS 1024 to get into the monitor, then type, after the full stop prompt, code in Table 1. After the colon there is a double space, but all the other spaces are single.

The code may be saved on tape using a save command in the form S"DO/UNTIL",01, 033A, 03FA. To initialise the routine, type: 0079 4C 3A 03 — not forgetting the double space after the colon. To disable the routine use: 0079 C9 3A B0.

Using the structure is simple. Its basic form is DO: (instructions): UNTIL (number). The instructions are carried out at least once, but are repeated if the number after UNTIL is zero. The number may be a constant, variable, function or condition.

Remember that a condition that is true returns -1, and one that is false returns zero. An example of a condition in a DO/UNTIL loop is DO: GET A$: UNTIL A$="X". The action is obvious from reading the code.

So much for DO/UNTIL — but has anyone got a routine for a propert IF/THEN/ELSE?

J D Slodznik

:	033A	C9	44	F0	16	C9	55	F0	12
:	0342	C9	3A	B0	0A	C9	20	F0	4C
:	034A	38	E9	30	38	E9	D0	60	4C
:	0352	70	00	BA	BC	01	01	00	F9
:	035A	D0	E6	C9	55	F0	2D	A0	01
:	0362	B1	77	C9	4F	F0	04	A9	44
:	036A	D0	D6	A9	03	20	1B	C3	68
:	0372	A9	F9	48	A5	79	48	A5	77
:	037A	48	A5	37	48	A5	36	48	A9
:	0382	85	48	20	70	00	20	70	00
:	038A	4C	FA	C6	BA	BD	03	01	C9
:	0392	85	D0	45	A0	04	B1	77	D9
:	039A	CA	03	D0	A4	88	D0	F6	A0
:	03A2	05	20	70	00	88	D0	FA	20
:	03AA	9F	CC	68	68	68	A5	5E	F0
:	03B2	07	68	68	68	68	4C	0E	C8
:	03BA	77	68	85	78	4C	53	03	3F
:	03C2	77	68	85	78	4C	54	03	3F
:	03CA	55	4E	54	49	4C	20	57	49
:	03D2	54	48	4F	55	54	20	44	4F
:	03DA	46	0D	A5	0E	F0	07	20	CC
:	03E2	FF	A9	00	85	0E	20	E2	C9
:	03EA	A2	00	BD	C9	03	20	45	CA
:	03F2	E8	E0	11	D0	F5	45	77	C3

VIC IN HIGH-RES

Here is a tip for anybody with a VIC computer who wishes it had high resolution graphics. The solution to this problem is to redefine the character set to include the patterns required. Normally, the character definition table is held in ROM, and consists of 256 8-byte entries (one for each character), each bit corresponding to one pixel in an 8 by 8 grid. The best way to explain this is by using an example: let's take a Space Invaders character. This fits on to the grid as shown.

Thus the code for this character is: 60.126.219,255.102,60, 66.129

Of course, this wouldn't help much, except that by poking location 36869 (one of the registers in the VIC chip), the computer can be made to expect the character table to be in RAM. The precise details are:

CONTENTS OF LOCATION 36869
252
253
254
255
ADDRESS OF CHARACTER TABLE IN RAM
4096
5120
6144
7168 *special setting*

TJ's WORKSHOP

The address shown is the starting address of the table, which in the first three cases would be 2k long. The value 255 is a special setting which allows the first 128 characters to be defined by the user, but which keeps characters 128 to 255 as the usual first 128 characters (ie character 128 is '@', character 129 is 'A', etc).

So, to set up your own character set, POKE the table into memory at one of the above addresses, then POKE the location 36869 with the correct value, and afterwards the new characters can be printed just as if they were the originals.

BYTE	BIT 7	6	5	4	3	2	1	0	
1			*	*	*	*			00111100 binary = 60 decimal
2		*	*	*	*	*	*		01111110 binary = 126 decimal
3	*	*		*	*		*	*	11011011 binary = 219 decimal
4	*	*	*	*	*	*	*	*	11111111 binary = 255 decimal
5		*	*			*	*		01100110 binary = 102 decimal
6			*	*	*	*			00111100 binary = 60 decimal
7		*					*		01000010 binary = 66 decimal
8	*							*	10000001 binary = 129 decimal

This is the trick by which all the fancy VIC games provide such good graphics, and I hope that *APC* readers will find it just as effective.

Nicolas Weeds

BBC RESTARTER

Although the BBC micro has no equivalent of the Microsoft command CONT, restarting a program which has been halted (eg, by accidentally hitting the 'escape' key) can be achieved by using GOTO.

I do not know what restrictions apply to this, but certainly if only the variables A% through Z% are used there is no reason why it should not work. Indeed I have experienced no problems in restarting programs using other variables; however I do not know how lucky I have been in this.

Nicholas Phizackerley

PET TO REAL-ASCII

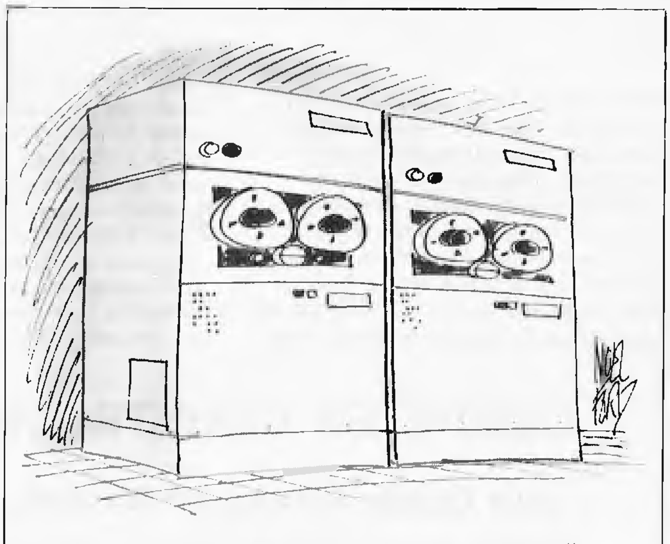
For Old ROM PET 2001, this machine-code converts PET ASCII to real-ASCII if characters have to be sent to a printer (device nr 4).

When printing to the screen nothing is changed. Strings in PET are never changed. The program was developed to be able to print lower case characters on an ASCII printer (Epson MX 80 with a standard IEEE-interface). When loaded any PRINT statement can be replaced by
SYS (826)A$
SYS (826)A$(X,Y)
SYS (826)A
SYS (826)A(X,Y)
SYS (826)any expression.

Robert de Rooij

```
100 REM CONVERTS PET-ASCII TO REAL ASCII
110 REM FOR PET 2001 OLD ROM TO EPSON MX80
120 POKE 59468,14
130 REM AUTHOR R DE ROOIJ
140 REM MELIS STOKESTR 35, 5013 BK TILBURG/HOLLAND
160 REM IDEA DERIVED FROM A PROGRAM
170 REM ON PAGE 143 BEST OF UK COMMODORE PET NEWSLETTER
180 REM IN STEAD OF 'PRINT A$' TYPE 'SYS(826)A$'
190 REM AFTER EACH SYS-COMMAND YOU HAVE TO TYPE :PRINT, AS NO
210 REM CARRIAGE-RETURN IS GENERATED.
220 REM PROGRAM WORKS FOR ALL EXPRESSIONS (NUMEROUS AS WELL
    AS STRINGS).
230 REM IT WORKS FOR SIMPLE VARIABLES AND ARRAYS.
240 REM SET PRINTER ON-LINE WITH OPEN4,4:CMD4
250 REM ALL ASCII-VALUES, HIGHER THEN
260 REM 191 ARE DECREASED BY 96.
270 REM ATTENTION: DEVICENUMBER MUST BE '4'.
280 REM STRINGS IN PET ITSELF ARE NOT BEING CHANGED.
300 REM ON THE SCREEN YOU ALSO CAN PRINT BY TYPING THE COMMAND
310 REM SYS(826)A$ INSTEAD OF PRINT A$.
320 REM WHEN LOADED THIS SMALL MACHINE-CODE IN THE CASS.BUFFER
330 REM YOU CAN, AT ANY TIME, CALL FOR SYS(826)
340 REM DURING PROGR.MODE AS WELL AS IN DIRECT MODE.
350 REM THE CODE IS FULLY RELOCATABLE WITH ONE EXCEPTION.
360 REM YOU MUST CHANGE THE UNCONDITIONAL JUMP IN LINE 858.
380 REM SEE DISSASSEMBLER LISTING.
390 REM THESE ARE THE BYTES 859/860.
450 FORR=826TO875
460 READ A:POKE R,A: NEXT
470 DATA  32,184,204, 36, 94, 48,  6, 32,175,220
480 DATA  32,107,211, 32,126,213,160,  0,170,240
490 DATA  28,177,113, 72,173,100,  2,201,  4,240
500 DATA   4,104, 76,100,  3,104,201,192,144,  2
510 DATA 233, 96, 32,210,255,200,202,208,228, 96
600 STOP
700 REM AN EXAMPLE
710 PRINT"This was printed by the command 'PRINT'"
720 SYS(826)"This was printed by command 'SYS(826)":PRINT:PRINT
725 PRINT"Printed by the command 'PRINT':":
730 PRINT"How much is 144^2*12/6? This is"144^2*12/6:PRINT
740 PRINT"Printed by command: SYS(826):"
750 SYS(826)"How much is 144^2*12/6? This is"
760 SYS(826)144^2*12/6:PRINT
770 Y=826:SYSY"In stead of 826 You may of course use a
    variable":PRINT
780 SYSY"And now open your ASCII-printer. Type 'RUN 700'"
READY.
```

```
DEC  HEX                        Hex                  DEC
826  33A   20 B8 CC  JSR   $CCB8                    52408
829  33D   24 5E     BIT   $5E                      94
831  33F   30 06     BMI   $347                     839
833  341   20 AF DC  JSR   $DCAF                    56495
836  344   20 6B D3  JSR   $D36B                    54123
839  347   20 7E D5  JSR   $D57E                    54654
842  34A   A0 00     LDY   #$00                     0
844  34C   AA        TAX                   0
845  34D   F0 1C     BEQ   $36B                     875
847  34F   B1 71     LDA   ($71),Y                  113
849  351   48        PHA                   0
850  352   AD 64 02  LDA   $0264                    612
853  355   C9 04     CMP   #$04                     4
855  357   F0 04     BEQ   $35D                     861
857  359   68        PLA                   0
858  35A   4C 64 03  JMP   $0364                    868
861  35D   68        PLA                   0
862  35E   C9 C0     CMP   #$C0                     192
864  360   90 02     BCC   $364                     868
866  362   E9 60     SBC   #$60                     96
868  364   20 D2 FF  JSR   $FFD2                    65490
871  367   C8        INY                   0
872  368   CA        DEX                   0
873  369   D0 E4     BNE   $34F                     847
875  36B   60        RTS                   0
```



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BANKS' STATEMENT

STAND IN LINE, GET YOUR PICTURE TOOK...

Photography. Now, there's a subject to contemplate. Like playing a guitar, it is something that is easy to do in a simple fashion, but it is almost impossible to become a master.

The world and his uncle has spent many joyous hours taking full-colour photographs of Aunt Ethel's knees (neatly exorcising thereby the part of Aunt Ethel that has always affronted a delicate set of eardrums). Pocket Instamatics can be seen distorting the careful tailoring of every other suit seen walking down Oxford Street. The other every-other-suit is only not being distorted because the Instamatic is in someone's hand, taking a glorious, full colour shot of the top half of the right-hand corner of Selfridges.

Yet, if it is done properly, photography can capture a mood or emotion — a nuance of the pain or happiness felt by a subject, an insight into the horror of war and the joy of laughter. A master with a camera can see and capture what most of us miss until the photograph gave us the time and space to observe.

So many things can be photographed it is hard to know where to start sometimes. Should the camera be pointed at people — old people that smile, young ladies with little on — or should it be pointed at the inanimate things of our world: cars, mountains, computers, telephones, data, plates of chips or. . ?

Data?

Yes, indeed, why not photograph data? In fact it is becoming eminently sensible to photograph data instead of carrying out all this silly nonsense about encoding it in magnetic flux.

In a few years time, and almost certainly before the end of this decade, it is reckoned that the majority of data storage in small systems will be photographic rather than magnetic. Who says so? Well, actually it's a Mr Bill Martin, who works for Control Data, planning that company's product and marketing strategy in storage peripherals. As an important sideline, of course, this means observing what IBM gets up to.

He has to watch this particular company because of its pre-eminent position in the computer business. Where IBM leads the others have to follow, and be damned quick about it. In fact they usually try to out-guess the Blue Giant, at least in terms of the general outline or configuration of an upcoming product.

This means that Bill Martin is well aware of not only the IBM marketplace, but also the technologies involved in all aspects of data storage. He is a wizz at magnetic storage techniques such as disks and tapes, and fully understands their advantages and disadvantages. He is also a reasonable wizz at photography and its implications.

To be fair, the photography in question is not the same as yer actual David Bailey (or Editor Howard, for that matter). No what this particular photography refers to is the optical disc.

This has enormous potential in the small computer systems market because of its truly staggering storage potential. Its use will require a rethink on how users store their data, and on the economics of storage, vis-a-vis existing techniques. It will also bring about an important development for the large numbers of first time users that will continue to make up the majority of the personal computer market for years to come. The development is that, for the first time, they will not be able to lose their data. . . ever.

First, however, some facts. Bill Martin is predicting that by the mid to late 'eighties, there will be optical disc storage systems available for small computers. He sees this marketplace being developed, quite possibly by IBM, before the mainframe market, if only because with applications like word processing and small business accounting the market itself is well defined.

The storage system will not be cheap to start with, probably around $10,000. It will

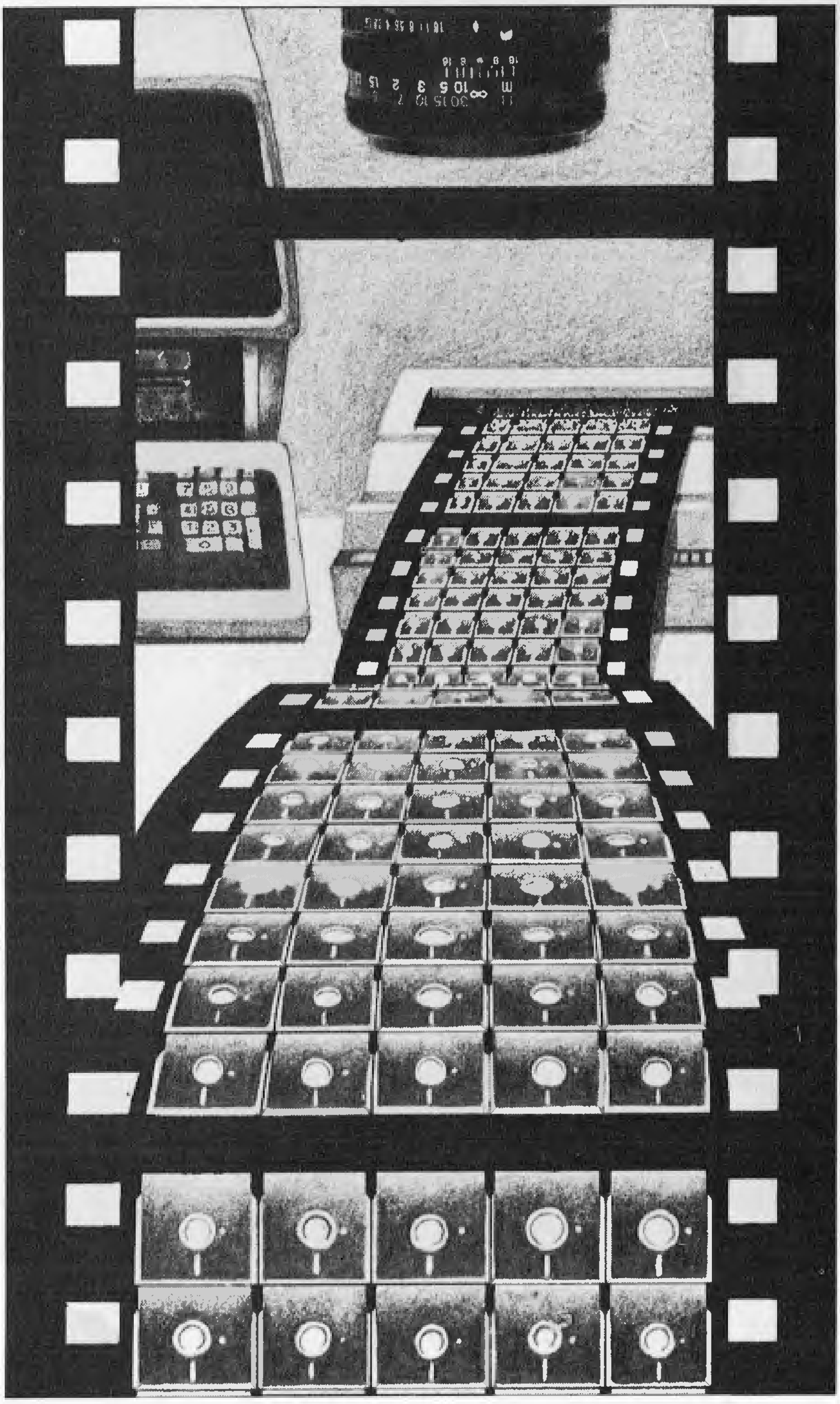


Illustration by Martin Ingley

appear firstly therefore on the bigger 'professional' systems. It would use a standard optical disc that is written to and read from by laser. Each of these would cost around $10.

This is where the fun starts. The capacity of each disc will be around 2,000 megabytes per side. Sounds a lot, doesn't it? Sit and think about it for a while. Modern minifloppies pack around a megabyte per disc. A mini-winnie crams maybe 50 megabytes. Each side of an optical disc will be the equivalent of a string of 80 mini-winnies. But the disc can be turned over and the other side can be used. This means that for around $10,010, 4,000 megabytes of storage will be available.

That starts to make nonsense of current data storage economics. For example, a mini-floppy storing 1 megabyte, and costing some $500, provide 2,500 bytes of on-line store for each dollar spent. The optical disc, though more expensive, will provide a staggering 20,000 bytes of on-line storage per dollar spent.

The change in the economics of data storage will bring with it changes in the way that storage is used. The relative cost, and more importantly the inconvenience, of magnetic disk storage means that it is against the user's interests to be profligate with storage resources. Floppy disks are inconvenient at times, hard disks need backing up and, because of its very nature, magnetic media can easily lose data.

Well, that's not entirely fair. It is not normally, the magnetic media itself that loses the data, it is usually the electronic systems and software that drives them that actually perpetrates the loss. And it is the inherent complexity of these elements — either externally so that the poor user barely understands how to operate them, or internally so that he can get at least some idea — that creates the well known situation of the user who pressed the *wrong* button and sent all his files to the great data-dump in the sky.

With optical disc this need not, indeed will not, happen. I will now expound on the reason why.

Like many people, the first time I considered the subject of optical discs as a storage medium I fell into a classic trap. 'Ah,' said I, 'they'll be okay for archival use — excellent in fact — but as there is no erase or over-writing function, they won't get used for on line storage.'

Wrong.

They will, and the reason is quite straightforward — brute capacity. At 2,000 megabytes per side a user can be as profligate with storage as it's possible to be. Should a disc ever become full (and that would take some doing) then all the user has to do is turn it over and start again. Should that side become full, well then, just spend $10 on another one.

If you let this attitude to data storage sink in, its implications become clearer. Optical disc systems no longer are seen as being just for archival use. It matters not that you can't erase data. In fact you shouldn't want to (in most cases anyway). Even in really profligate applications like word processing, which uses up storage like it's going out of fashion, there is really no need to erase or over-write files. It is an advantage not to have to.

As Bill Martin points out, the optical disc automatically produces father/son file structures, and gives an automatic 'audit trail' of those files. Because a file cannot be erased it can never be lost or erased accidentally. Any amendment or addition to a file will just produce another, latest, version of it. The original will still exist.

This has important implications for a variety of applications, of both textual and numeric types. The daily grind of backing up files will no longer always be necessary for the back-ups will already exist. The inherent father/son structure for creating files would seem to match the requirements of the accounting/data processing areas to a tee. It would also fit many of the requirements of the word or text processing environment.

Unfortunately, the one drawback of the early use of optical discs is going to be the cost. The hardware will cost considerably more than a domestic disc player because it will have to incorporate a 'write' as well as 'read' capability. In time, of course, the price will drop, and so will the price of the discs. Then the systems could prove to be unbeatable in terms of price and performance, instead of performance alone. At that time, maybe the magnetic era could come to a close.

And remember, all this refers to using optical discs in a predominantly conventional data processing manner, storing data as '1's and '0's. Even here it would seem to stand up well against magnetic media in all but initial purchase price. But this does not include the many other tricks that optical discs are capable of — the interleaving of data and audio/visual material, for example. There just have to be thousands of applications for that trick that no one has yet thought about. Try thinking — that's what Clive Sinclair did.

APC SUBSET

This is your chance to help build a library of general purpose routines, documented to the standards we have developed together in this series. You can contribute a Datasheet, improve one already printed or translate the implementation of a good idea from one processor to another. APC will pay for those contributions that achieve Datasheet status. Contributions (for any of the popular processors) should be sent to SUB SET, APC, P.O. Box 280, Hawthorn, Vic 3122.

Z80 anybase conversion

Last month we had the 6502 routine, XBIN, to convert an unsigned ASCII encoded number, in any base from 2 to 36, to a 32-bit binary number. This prompted me to fish out a set of routines in Z80 code, which I have had for some time, to do a similar conversion into the 16-bit HL register. These Z80 routines, ANYNO/CTON/DEXBC are from Jim Chance. In the input string, digits greater than 9 are represented by the characters A to Z. Note the meticulous validation of the ASCII encoded input.

Datasheet

```
;=ANYNO - gets base 2-36 number to HL
;/CLASS: 2
;/TIME CRITICAL? No
;/DESCRIPTION: Gets +ve number to binary in HL from digit
;/              strings at (DE) with base (eg, 2 for binary,
;/              16 for hex)in BC.
;/ACTION: Start at left digit, get to binary (F=15, G=16 etc),
;/        add to partial result. If more digits, multiply by
;/        base and loop for more digits.
;/SUBr DEPENDENCE: CTON, DEXBC (local)
;/INTERFACES: A byte in RAM, pointed to by IX, is used to hold
;/            the number of digits in the ASCII string and is
;/            reduced during the routine to zero.
;/INPUT: (IX)=number of digits, BC=number base, (DE)=left digit.
;/OUTPUT:  HL=binary number, NC=o.k. carry=error. (IX) AF,BC,DE
;/         destroyed.
;/REGs USED:  AF,BC,DE,HL,IX
;/STACK USE: 6
;/PROCESSOR: Z80
ANYNO: LD   HL,+0     ;zeroise result register.         21 00 00
AY1:   LD   A,(DE)    ;get ASCII digit.                 1A
       INC  DE        ;increment digit pointer.         13
       CALL CTON      ;convert chr to binary.           CD YY YY
       RET  C         ;return cy set if invalid.        D8
       CP   C         ;compare chr with base            B9
       CCF            ;and return with carry set        3F
       RET  C         ;if not less than base.           D8
       ADD  A,L       ;add                              85
       LD   L,A       ;digit                            6F
       LD   A,H       ;to                               7C
       ADC  A,+0      ;partial                          CE 00
       LD   H,A       ;result.                          67
       DEC  (IX+0)    ;adjust digits left to go.        DD 35 00
       RET  Z         ;return if zero,                  C8
       PUSH DE        ;else save digit pointer          D5
       PUSH BC        ;and base,                        C5
       EX   DE,HL     ;get partial result in DE &       EB
       CALL DEXBC     ;multiply it by base into HL.     CD YY YY
       POP  BC        ;restore base and                 C1
       POP  DE        ;digit pointer.                   D1
       JR   AY1       ;go back for next digit.          18 E3
;CTON character to binary number. Carry=invalid.
CTON:  SUB  30H       ;return with carry set            D6 30
       RET  C         ;if digit less than 0.            D8
       CP   +10       ;return with                      FE 0A
       CCF            ;carry clear if                   3F
       RET  NC        ;digit 0-9.                       D0
       SUB  +7        ;return with carry set            D6 07
       RET  C         ;if digit >9 and <A.              D8
       CP   "Z+1      ;return with carry clear if       FE 5B
       CCF            ;digit A-Z, else                  3F
       RET            ;return with carry set.           C9

;DEXBC 16-bit multiply HL=DE*BC. carry=overflow.
DEXBC: LD   A,+16     ;bit counter.                     3E 10
       LD   HL,+0     ;zero answer.                     21 00 00
HXBL:  SRL  B         ;                                 CB 38
       RR   C         ;gets 1s bit of multiplier.       CB 19
       JR   NC,HXB2 .;                                  30 02
       ADD  HL,DE     ;                                 19
       RET  C         ;overflow return.                 D8
HXB2:  EX   DE,HL     ;get multiplicand to HL.          EB
       ADD  HL,HL     ;double it.                       29
       EX   DE,HL     ;                                 EB
       RET  C         ;overfloqw return.                D8
       DEC  A         ;                                 3D
       JR   NZ,HXB1   ;loop for all bits.               20 F1
       RET            ;return.                          C9
```

Z80 square roots

Steven Weller's very fast square roots (September '82) have not gone unchallenged. Both K P Leary and John Kerr have sent amended versions and pointed out that, in Steven's versions, the correct remainder is not always returned. As KP puts it, since $(n+1)^2 - n^2 = 2n+1$, extracting a square root of k bits can leave a remainder of k+1 bits, since the largest remainder when extracting n is 2n. In other words, a 15 or 16 bit square can have a 9 bit remainder and a 31 or 32 bit square can have a 17 bit remainder.

In the original DSROOT the 17th bit of the remainder is in the carry flag, though this was not stated, but in SROOT the 9th bit of the remainder is actually set to zero.

There is very little to choose between the two corrected versions of the 16 bit routine so, to counter John's move to take over the whole of this issue's SUB SET, we give K P Leary's verion in Datasheet SQR15/16.

Datasheet

```
;=SQR15 - 15 bit square root. SQR16 - 16 bit square root.
;/CLASS: 2
;/TIME CRITICAL?: No
;/DESCRIPTION: SQR15 calculates square root of 15 bit 2s
;/             complement positive number.
;/             SQR16 calculates square root of 16 bit unsigned
;/             (assumed positive) number.
;/ACTION:  Shifts pairs of bits in A, L left through A, L, H.
;/         Trial subtraction from 4 times (last remainder in H)
;/         + next pair (in L). Subtrahend is 4 times (last part
;/         root in D) + 1. New part root = twice (old root)
;/         + 1 if subtraction, 0 if not.
;/SUBr DEPENDENCE: None
;/INTERFACE: None
;/INPUT: Number in HL
;/OUTPUT:  SQR15: If number -ve, NZ state, registers unchanged. Else
;/         SQR15 and SQR16: z state, 8 bit positive signed root
;/         in HL, 9 bit positive signed remainder in DE.
;/REGs USED: AF, B, DE, HL
;/STACK USE: Nil
;/LENGTH: 35
;/TIME STATES: 843 max.
;/PROCESSOR: Z80

SQR15:  BIT  7,H      ;test for negative number.        CB 7C
        RET  NZ       ;if so exit with Z flag unset.    C0
SQR16:  LD   DE,40H   ;set subtrahend to zero.          11 40 00
        LD   A,L      ;set up 24 bit accumulator        7D
        LD   L,H      ;in HL, A                         6C
        LD   H,D      ;high bits - 0.                   62
        LD   B,+8     ;set bit count.                   06 08
        OR   A        ;clear carry.                     B7
W:      SBC  HL,DE    ;trial subtraction.               ED 52
        JR   NC,X     ;jump if successful               30 01
        ADD  HL,DE    ;else add back.                   19
X:      CCF           ;switch carry to roll into        3F
        RL   D        ;subtrahend high bits in D.       CB 12
        ADD  A,A      ;shift up next bit pair           87
        ADC  HL,HL    ;in accumulator.                  ED 6A
        ADD  A,A      ;                                 87
        ADC  HL,HL    ;                                 ED 6A
        DJNZ W        ;jump if not done.                10 F0
        RLA           ;overflow of remainder to A.      17
        LD   L,D      ;root to HL.                      6A
        LD   E,H      ;remainder to E.                  5C
        LD   D,A      ;set remainder high bits.         57
        LD   H,B      ;set root high bits (=0)          60
        XOR  A        ;set Z state.                     AF
        RET           ;return.                          C9
```

KP also sent a corrected version of the 32 bit routine, appreciably faster than the original. But John Kerr's version is faster by just about the same amount again, so here it is in Datasheet DSRTZ. The essence of the improvement

hinges on the fact that the low order subtrahend, previously held in BC, never changes from its initial value of 4000 hexadecimal, so can enter the program as immediate data. This frees register pair BC and saves using the 'stacktop' and all those time consuming EX (SP),HLs.

Datasheet

```
;=DSRTZ - four byte integer square root
;/CLASS: 2 (does not preserve flags)
;/TIME CRITICAL?: No
;/DESCRIPTION: Calculates square root of non-negative 32-bit
;              2s complement binary number, giving remainder.
;/ACTION: Terminate if input is negative.
;/        Store input in four low order bytes of working accum.
;/        HL,A,C,IX; clear HL (high order accumulator word)
;/        Clear DE (high order subtrahend; accumulates answer).
;/        Take subtrahend from high order accum. HL,A,C
;/        If carry set (borrow required) add back in
;/        Invert carry status and rotate into DE
;/        Multiply working accumulator HL,A,C,IX by four
;/        Repeat to 16 times. Put remainder MSB into A.
;/SUBr DEPENDENCE: None
;/INTERFACES: None
;/INPUT: BC,DE contains input number (B is MSByte)
;/OUTPUT: Z flag cleared if input was negative; else
;/        BC,DE contains square root; remainder in A,HL
;/REGs USED: AF,BC,DE,HL
;/STACK USE: 2
;/LENGTH: 50
;/TIME STATES: 2792 max
;/PROCESSOR: Z80

DSRTZ:  BIT   7,B       ;find sign of input             CB 78
        RET   NZ        ;and exit if negative.          C0
        LD    A,B       ;high order input in A,C        78
        PUSH  DE        ;low order in IX; original      D5
        EX    (SP),IX   ;contents of IX saved.          DD E3
        LD    D,+0      ;clear high order               16 00
        LD    E,D       ;subtrahend                     5A
        LD    H,D       ;and top word of                62
        LD    L,D       ;working accumulator            6A
        LD    B,+16     ;B is loop counter.             06 10
DSR10:  SUB   40H       ;take subtrahend from           D6 40
        SBC   HL,DE     ;HL,A,C.                        ED 52
        JR    NC,DSR20  ;if no borrow required jump     30 04
        ADD   A,40H     ;else add back in.              C6 40
        ADC   HL,DE     ;                               ED 5A
DSR20:  CCF             ;invert carry status            3F
        RL    E         ;and rotate into answer,        CB 13
        RL    D         ;modifying subtrahend.          CB 12
        ADD   IX,IX     ;shift                          DD 29
        RL    C         ;working                        CB 11
        RLA             ;accumulator                    17
        ADC   HL,HL     ;two                            ED 6A
        ADD   IX,IX     ;bits                           DD 29
        RL    C         ;to                             CB 11
        RLA             ;the                            17
        ADC   HL,HL     ;left.                          ED 6A
        DJNZ  DSR10     ;do sixteen times.              10 E1
        RLA             ;remainder MSB into A.          17
        CP    A         ;set Z for valid result.        BF
        POP   IX        ;restore IX                     DD E1
        RET             ;return                         C9
```

Error flags

The error correction routine EFIX8 by John Kerr printed last month was the subject of a late amendment which unfortunately resulted in the documentation giving false information. The original version used the N flag to signal whether a correction had been made but the output state of the N flag is uncertain in the amended version. In all fairness to John, who did alter his documentation accordingly, I take full responsibility for not correcting this part of the Datasheet.

However, I do not feel particularly repentant as the incident does highlight the necessity of careful attention to flag conditions. The point I made last month about using any handy flag result to carry information out of, or indeed into, a routine was that it should be easy to test, perhaps of greater importance is that the exit flag conditions when used to pass information ought to be specifically set, and commented on. Relying on the happy accident that instructions immediately prior to exit produce useful flag results is risky when the slightest change to a routine could destroy the whole set-up.

6502 data protecting

The two Datasheets ECAL6 and EFIX6 are the 6502 versions of ECAL8 and EFIX8 printed last month and also sent by John Kerr.

To recap briefly on the method used by the routines, ECAL produces an error correction byte (ECB) for a data block up to 31 bytes in length. This can be appended to the data before its storage or transmission. On retrieving or receiving the data and ECB, EFIX calls ECAL to get a new ECB for the data block and compares it with the appended ECB. The difference between the two ECBs gives a correction code which is in effect an index to any single bit which may have suffered inversion during storage or transmission.

In order to calculate the ECB, a parity mask is formed. The highest 5 bits of this mask index the bytes not from the start of the data block but from the end. The lowest three bits index the bits within each byte. Eg, the parity mask for each bit in the byte that is 23rd from the end would be 10111XXX where the Xs would take values 111 down to 000 for bits 7 down to 0 in that byte.

The ECB is initially reset to 00000000 and each bit of the data block is checked in turn. If the bit is reset (0), no action is taken, but if it is set (1) then its unique parity mask is exclusive-ORd with the ECB. This inverts the bits of the ECB which are in the same position as the set bits of the parity mask.

The completed ECB is a collection of eight parity bits such that bit 0 of the ECB shows the parity of alternate data bits, bit 1 shows the parity of alternate pairs of data bits, bit 2 shows the parity of alternate groups of four data bits, and so on in a binary pattern. Any difference found between the stored and new ECB in EFIX will be a binary pattern representing the parity mask of one bit which, because of inversion of that bit, affected one ECB but not the other. As this correction code is exactly the same as the parity mask, EFIX can use the highest five bits to index the byte in which the error has occurred and the lowest three bits to create an inversion mask to re-invert the corrupt bit in that byte.

Datasheet

```
;/=ECAL6 - Calculate error correction byte
;/CLASS: 1
;/TIME CRITICAL?: No
;/DESCRIPTION: Calculates a one-bit error correction byte (ECB)
;/             to be appended to a data blowk of 1 to 31 bytcs and
;/             subsequently used by EFIX6.
;/ACTION: Abort if no of bytes = 0 or GTHAN 31
;/        Initialise mask to 8 * (no of bytes) +7
;/        Clear ECB
;/        For each byte in data block
;/            For each bit in current byte
;/               If bit is 1 then ECB   ECB   V mask
;/               Decrement mask
;/SUBr DEPENDENCE: None
;/INTERFACES: None
;/INPUT:  Y = no of bytes     M0,1 points to 1st byte
;/OUTPUT: Cy set:  abort
;/        Cy reset:X=ECB    Y,M0,M1 unchanged
;/REGs USED: X Y P M0 M1
;/STACK USE: 3
;/LENGTH: 60
;/TIME STATES: 63+175 per byte average
;/PROCESSOR: 6502

ECAL6:  CPY   £$20      ;terminate if no of bytes          C0 20
        BCS   EXIT2.    ;is greater than 31                B0 37
        PHA             ;save A and M2                     48
        LDA   M2        ;                                  A5 ZZ
        PHA             ;                                  48
        TYA             ;move block length to A and        98
        SEC             ;terminate with Cy set if          38
        BEQ   EXIT1     ;no of bytes = 0                   F0 2B
        ASL   A         ;move no of bytes                  0A
        ASL   A         ;into highest five bits of A and   0A
        ASL   A         ;set lowest three bits to get      0A
        ORA   £7        ;initial parity mask               09 07
        STA   M2        ;in M2                             85 ZZ
        LDA   M3        ;save M3                           A5 ZZ
        PHA             ;                                  48
        LDX   £0        ;clear inicial ECB                 A2 00
        LDY   £0        ;and byte pointer index            A0 00
ECLP1   LDA   (M0),Y    ;move byte from data block         B1 ZZ
        STA   M3        ;into M3                           85 ZZ
        TXA             ;ECB into A                        8A
        LDX   £8        ;set up bit count                  A2 08
ECLP2:  ASL   M3        ;move bit into Cy and              06 ZZ
        BCC   SKIP2     ;if it is '1'                      90 02
        EOR   M2        ;then ECB  ECB V mask              45 ZZ
SKIP2:  DEC   M2        ;next mask                         C6 ZZ
        DEX             ;decrement bit count and           CA
        BNE   ECLP2     ;repeat for all bits in byte       D0 F5
        INY             ;point to next byte                C8
        LDX   M2        ;check for end of block when       A6 ZZ
        CPX   £8        ;parity mask is 7                  E0 08
        TAX             ;ECB into X                        AA
```

'Have you anything just a wee bit fallible?'

APC SUBSET

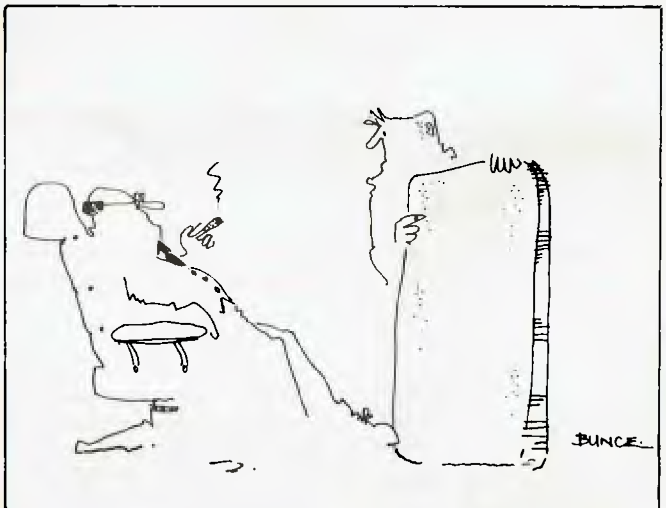
```
        BCS   ECLP1     ;repeat for all bytes in block        B0 E6
        PLA             ;restore M3                           68
        STA   M3        ;                                     85 ZZ
EXIT1:  PLA             ;restore M2                           68
        STA   M2        ;                                     85 ZZ
        PLA             ;restore A                            68
EXIT2:  RTS             ;                                     60
```

Datasheet

```
;=EFIX6 - Detect and correct a one-bit error in data block
;/CLASS: 1
;/TIME CRITICAL?: No
;/DESCRIPTION: Examines a 1 to 31 byte data block with appended
;/              ECB and corrects a singler bit error.
;/ACTION: Abort if no of byyes = 0 or GTHAN 31
;/        Calculate ECB of data block
;/        EOR with stored ECB
;/        If no error then terminate
;/            Else use highest 5 bits to point at corrupt byte
;/             terminating if error in ECB indicates corrupt
;/             byte outside block, lowest 3 bits to produce
;/             a bit inversion mask and invert corrupt bit.
;/SUBr DEPENDENCE: ECAL6 = calculate ECB
;/INTERFACES: None
;/INPUT:  Y = no of bytes excluding appended ECB
;/        M0,1 points to first byte
;/OUTPUT: Cy set:   abort
;/        Cy reset: no error found: Y = no of bytes
;/                  error found: Y = no of corrected byte -1
;/REGs USED: Y P M0 M1
;/STACK USE: 7 (including JSR ECAL6)
;/LENGTH: 53
;/TIME STATES: Average 192 + 175 per byte
;/PROCESSOR: 6502

EFIX6:  PHA             ;save A and X                          48
        TXA             ;                                      8A
        PHA             ;                                      48
        JSR   ECAL6     ;get new ECB of data block             20 XX XX
        BCS   EXIT4     ;terminating if ECAL6 aborted          B0 29
        LDA   M2        ;save M2                               A5 ZZ
        PHA             ;                                      48
        TXA             ;compare new and stored ECB            8A
        EOR   (M0),Y    ;terminating if correction             51 ZZ
        CMP   £8        ;code is too small to indicate         C9 08
        BCC   EXIT3     ;error in data block                   90 1C
        TAX             ;save correction code                  AA
        LSR   A         ;move highest 5 bits down to           4A
        LSR   A         ;give an index to corrupt byte         4A
        LSR   A         ;and test                              4A
```

```
        STA   M2        ;if position is greater than           85 ZZ
        CPY   M2        ;no of bytes in block, terminating     C4 ZZ
        BMI   EXIT3     ;with Cy reset if it is                30 12
        TYA             ;subtract index-from-end from          98
        SBC   M2        ;no of bytes to give                   E5 ZZ
        TAY             ;index-from-first-byte in Y            A8b
        TXA             ;make X a count to corrupt bit         8A
        AND   £7        ;using lowest 3 bits of                29 07
        TAX             ;correction code                       AA
        LDA   £0        ;move a '1' into A                     A9 00
EFLP1:  ROL   A         ;in the same position                  2A
        DEX             ;as the                                CA
        BPL   EFLP1     ;inverted bit                          10 FC
        EOR   (M0),Y    ;reinvert it and                       51 ZZ
        STA   (M0),Y    ;restore it to data                    91 ZZ
EXIT3:  PLA             ;restore M2                            68
        STA   M2        ;                                      85 ZZ
EXIT4:  PLA             ;restore X and A                       68
        TAX             ;                                      AA
        PLA             ;                                      68
        RTS             ;                                      60
```



'The biggest chip the world has ever seen, eh, Brian? I'm impressea but aren't we rather swimming against the tide a bit here?'

DIARY DATA

Readers are strongly advised to check details with exhibition organisers before making travel arrangements to avoid wasted journeys due to cancellations, printer's errors, etc. Organisers are requested to notify APC of forthcoming events well in advance to allow time for inclusion in 'Diary Data'.

Atlanta, Georgia	Southcon Electronics Show Contact: ECL (Exhibition Agencies) Ltd, 01-486-1951	January 18–20, 1983
San Francisco	CP/M '83, Moscone Centre, Contact: Northeast Expositions Inc, 824 Boylston St, Chestnut Hill, MA 02167 USA (617) 739 2000	January 21–23, 1983
Sydney	The 1st Australian Personal Computer Show, Centrepoint. Contact: Australian Exhibition Services	March 10–12, 1983

NETWORK NEWS

Here is a list of all Australian personal computer networks. As more networks appear – and as more facilities are added to existing ones – we'll report them in this section, which appears monthly.

The Australian Beginning. Operator: The Australian Beginning Pty. Ltd. 364 La Trobe Street, Melbourne. Tel: (03) 329 7998. Facilities: Information service, electronic mail, software storage, and software downloading. Hours: 24 hours/day, 7 days/week.

INFONET. Operator: Network Services Division of Computer Sciences of Australia Pty. Ltd., 460 Pacific Highway, St Leonards, NSW. Tel: (02) 439 0033. Facilities: Access to databases produced by the Australian Bureau of Statistics and the Institute of Economic and Social Research. Hours (E.S.T.): Monday to Friday (7am to 9pm), Saturday (8am to 5pm) and Sunday (8am to 11.30am).

AUSINET. Operator: ACI Computer Services, P.O. Box 42, Clayton, Victoria. Tel: (03) 544 8433. Facilities: Medium to databases whose subject coverage includes agriculture, education, energy, industry, public affairs, science and technology and an online Australian database directory. Hours: 8.30am to 9.00pm E.S.T. Monday to Friday.

IP Sharp Associates Network. Operator: IP Sharp Associates Pty. Ltd., 13th Floor, 175 Pitt Street, Sydney. Tel: (02) 232 6366. Facilities: The network is an international time sharing data processing network, the host computers being located in Toronto, Canada. Hours: 24 hours/day, 7 days/week.

USER GROUPS INDEX

Below is a complete list of user groups known to us in Australia and New Zealand. Users Groups' Secretaries are asked to provide us with alterations, additions and corrections as promptly as possible to avoid a longer than necessary delay before publication. During the next four months, these changes will be published and the next complete listing will appear in the June '83 issue of APC.

NEW SOUTH WALES

AUSTRALASIA ZX80 USERS GROUP
Anyone interested in the ZX80 may contact Tony Mowbray, 87 Murphys Avenue, Kieraville, 2500. Phone (042) 28 5296.

COMMODORE USER GROUP
For more details contact Mr John Guidice, C/- The Commodore Users Group, G.P.O. Box 4721, Sydney, 2001.

NEWCASTLE 80 MICRO USERS GROUP (NMUG)
Meetings are on the last Wednesday of each month at the hall on the corner of Fowler and Ogden Streets, Hamilton South, NSW. Contact, Dennis Jackson on (049) 68 1910.

COMPUCOLOR USERS GROUP
If you are interested, Andrew MacIntosh of 91 Regent Street, Chippendale, is the man to see.

80AT
Mail enquiries to 80AT, C/- Planet 3 Systems, 47 Birch Street, Bankstown, 2200.

SYDNEY PEACH USER GROUP
The contact address is 261 Northumberland Street, Liverpool, 2170. or, for more information, telephone Ben Sharif on (02) 707 2466 (BH), (02) 36 4825 (AH) or Esther on (02) 601 8493 (BH).

MEGS
The Microcomputer Enthusiasts Group meets on the third Monday each month at the Wireless Institute Australia Hall, 14 Atchison Street, St Leonards 7pm.

WOLLONGONG COMPUTER CLUB
For more information call Paul Janson, 14 Hoyward Street, Kanahooka, 2530, on 61 5451.

TI-99/4 HOME COMPUTER USER GROUP
Contact Brian Lewis, P.O. Box 149, Pennant Hills, NSW, 2120. Tel: John (Secretary) (02) 848 0956.

MACARTHUR COMPUTER USERS ASSOCIATION
This group has been formed for members of the Campbelltown and surrounding communities who are interested in computing whether on micros, minis or mainframes. They meet on the first Monday of each month. The President is Mr C. Wylie, 85 O'Sullivan Road, Leumeah, 2560. Tel (46) 26 1625.

NSW SORCERER USERS GROUP
The group has a new venue at Greenwich Community Centre, 46 Greenwich Road, Greenwich 2065 on the third Friday of each month at 8pm.

THE BLUE MOUNTAIN COMPUTER CLUB
Meetings are held at the Springwood Civic Centre on the last Friday of each month at 7.30pm. For further details contact Eric Lindsay, 6 Hill Crest Avenue, Gaulconbridge, Tel (047) 511 044 (BH) or Greg Baulman on (02) 648 5342.

ILLAWARRA SUPER 80 USERS GROUP
The group was formed in January of last year and meets on the first Monday of each month commencing at 5.30pm at the Australian Offices, 86 Market Street, Wollongong. The postal address of the group is P.O. Box 1775, Wollongong 2500.

APPLE USERS GROUP
The A.U.G. meets at the Sydney Grammar School Science Auditorium on the second Monday of every month at 6.30pm. The group maintains an expanding software library on disk and publishes a monthly newsletter called 'Applecations'.

Further enquiries to A.U.G. (Sydney) P.O. Box 505, Bankstown, NSW, 2200 or to the Secretary, Colin Rutherford, on (02) 520 0926.

VICTORIA

MICRO-80
A Special Interest Group of Melbourne's TRS-80 and System 80 Users' Group can be contacted by writing to Steve Buttery (MICOM Treasurer and Press Officer), MICOM, P.O. Box 60, Canterbury, 3126. The

group meets on the third Saturday of each month at the Burwood State College on Burwood Highway from 2 to 5pm.

GEELONG COMPUTER CLUB
Write to Geelong Computer Club, P.O. Box 6, Geelong, 3220.

KAOS
Contact Ian Eyles, 10 Forbes Street, Essendon, 3040. Tel (03) 375 3478 (AH).

FORTH INTEREST GROUP – AUSTRALIA
This club is the Australian chapter of the international FORTH Interest Group. Meetings are held on the first Friday of each month at 8pm. Contact the secretary on (03) 29 2600 or write to P.O. Box 103, Camberwell, 3124 for more information and a catalogue of FORTH books and software. To obtain a monthly newsletter from the Australian FORTH Interest Group (a separate organisation) send $10 to Richie Laird at 25 Gibsons Road, Sale Vic 3850.

EASTERN SUBURBS 80 USERS GROUP
The group meets on the fourth Wednesday of each month (except August) at Kingswood College, 355 Station Street, Box Hill, 3128. Starting time is 7pm For more information telephone Cameron McKern on (03) 288 1713 (AH) or via MCCKCH ESSURR on The Australian Beginning.

PEACH USERS GROUP
The group meets each alternate Friday, 8pm, at the Templestowe Technical College, Cyprus Avenue, Templestowe. For more information phone Greg Hudson on (03) 429 3216.

PENINSULA GROUP
This group meets at State College, Frankston, on the second Thursday of each month except during January. Those interested should contact M.G. Thompson on (03) 772 2674.

MICROBEE USERS GROUP
Meets on the second Wednesday of each month at the Burwood Teachers College, Building E. Further information, contact Grant Forest on (03) 879 2257 or write to 10 Sunbeam Avenue, Ringwood East 3135.

COMPUCOLOR USER GROUP
Meetings are held on the 2nd Wednesday of every month at Panatronics, 691 Whitehorse Road, Mont Albert. For further information contact Neil Brandy on (03) 890 0579.

AUSOM
Apple Users' Society of Melbourne can be contacted by writing to AUSOM, P.O. Box 43, Forest Hill, 3131.

S.M.U.G.
To find out more about this group of SORD M100 users, contact Mr Robin Miller, 60 Winmalee Drive, Glen Waverley, 3150.

S.C.U.A.
Sorcerer Computer Users (Australia). Further details can be obtained from the Secretary, S.C.U.A., P.O. Box 144, Doncaster. 3108.

VIC 20 MELBOURNE USER GROUP
Meetings are held on the 3rd Wednesday of every month at Panatronics, 691 Whitehorse Road, Mont Albert. For further information contact Neil Brandy on (03) 890 0579. Please 'Bring a Chair'.

THE NORTHER AND WESTERN SUBURBS COMPUTER USERS GROUP
Meetings are held at CP/M Data Systems, 284 Union Road, Moonee Ponds, every second Thursday at 7pm. Anyone interested can contact David Coupe on (03) 370 9590 or Clive Budd on (03) 370 2917.

NATIONAL SINCLAIR ZX80 USERS CLUB
Tips and discussions of ZX80, sample programs, programming tips, discussions and news of developments in the U.K. and U.S., and a market place for goods and facilities specially provided for ZX80. Write for free introductory newsletter: 24 Peel Street, Collingwood 2066.

BALLARAT COMPUTER USERS GROUP
Membership is $5.00 per annum to cover postage of newsletter. Meetings on the first Thursday of each month at the Hopetoun Street Community Education Centre in Ballarat. Interested persons can contact the Publicity Officer, John Preston on (053) 31 4363.

NATIONAL SINCLAIR ZX USERS GROUP
The group sends out a twelve page newsletter every month. Interested parties can obtain our introductory newsletter by sending a 27c stamp to P.O. Box 148, Glen Waverley, 3150.

OSBORNE USERS GROUP
Forty Osborne users attended the first Osborne users meeting held in Australia. Mr Steve Freeman, General Manager of President Computers in Melbourne conducted the meeting from President Computers' Showroom, Suite 1, 609 St Kilda Road, Melbourne. Those interested contact Roslyn Miller on (03) 529 1788.

QUEENSLAND

QUEENSLAND SORCERER USERS GROUP (QSUG)
Meetings are held on the last Sunday of each month at the Queensland University. Annual membership fee is $10. For more information contact G. Snell on (04) 205 1017.

TI-99/4 USER GROUP
Contact Alwyn Smith, 42 Palmtree Avenue, Scarborough, Qld. 4010. Tel (07) 203 7506.

BRISBANE YOUTH COMPUTER GROUP
Mr A Harrison, P.O. Box 396, Sunnybank, 4109, should be contacted for more information.

IREE MICROCOMPUTER INTEREST GRIUP
Details on club membership etc. may be obtained from The Secretary, N. Wilson, P.O. Box 81, Albion, 4010. Phone 356 6176.

APPLE-Q
User Group days are held every third Sunday of the month (December excluded) at the Hooper Education Centre, Kuran Street, Wavell Heights. The Centre is open from 8.30am until 4.30pm and members are encouraged to bring their Apple along. Bar-B-Que facilities are also available for members staying all day.

Those interested in becoming members of Apple-Q should forward $18.00 subscription fee to The Secretary, Apple-Q the Brisbane User Group, P.O. Box 721, South Brisbane, Qld. 4101.

Apple-Q is affiliated with Apple Core.

COMPUTER OWNERS GROUP (COG)
Formed for people on the northern side of Brisbane, CIG has an emphasis on computer use and programming, rather than on electronics. The group produces a small monthly newsletter called "Cog 'n' Speil" and meets on the second Wednesday of each month. For more information telephone Betty Adcock on (07) 263 4268.

OHIO SUPERBOARD USER GROUP
For membership and newsletter information, please send a large S.A.E. to Ed Richardson, 146 York Street, Nunday, 4012.

COMMODORE COMPUTER USERS GROUP OF QUEENSLAND
Meets on the first Tuesday of each month at Construction House, 130 Petrie Terrace, Brisbane, 7.30pm. For further information call Bill Brown on (07) 349 6612.

SOUTH AUSTRALIA

TRS-80 USERS GROUP
To obtain details contact Mr G. Stevenson of 36 Sturt Street, Adelaide, 5000.

S.A.A.U.C.
Contact The Secretary, S.A.A.U.C., C/- The Bookshelf, 169 Pirie Street, Adelaide, 5000

COMMODORE COMPUTER USERS ASSOCIATION OF S.A.
This group meets at 7.30pm on the first Tuesday of each month at the Adelaide University Union Building. Further information is available from Earle Rowan, Commodore Computer Users' Association of S.A. P.O. Box 60, Clarence Gardens, 5039.

COMMODORE VIC COMPUTER USERS ASSOCIATION
The club meets monthly and can be contacted at 13 Miranda Road, Paralowie, 5108, Attn: Eddie Hann, Secretary.

SORCERER USER GROUP OF SA (SUGSA)
Contact Jeremy Webster, Secretary, SUGSA, 22 Delange Avenue, Banksia Park, 5091. Meetings are held on the second Wednesday of every month on the first floor of the Commodities Exchange Building, 123 Pirrie Street, Adelaide.

S.A.M.G.
The South Australian Microprocessor Group meets at the Thebarton High School in Ashley Street. Contact can be made through P.O. Box 113, Plymouth, S.A. 5038, or by phoning (08) 278 7288.

TI-99/4 USER GROUP
Contact Ray Mountford, 7 Baker Street, Enfield, S.A. 5085 Tel (08) 260 6587.

TASMANIA

TASMANIA APPLE USERS CLUB
Meetings are held on the 3rd Tuesday of each month at various locations. New members are most welcome and enquiries may be made to Ray Williams, President/Secretary, P.O. Box 188, North Hobart, 7002. Tel (002) 34 1271.

TEMOS
All enquiries are welcome and may be directed to John Stephenson, President, 4 Melinga Place, Taroona, 7000. Phone 27 8770.

TI-99/4 USER GROUP
Contact Andrew Zagni, 161 Carella Street, Howrah, Tas. 7018. Tel (002) 47 8738.

A.C.T.

MICSIG
Contact the Registrar, MICSIG, C/- P.O. Box 446, Canberra City, 2601.

CANBERRA MICRO-80 USERS GROUP
For all owners and users of Z80-based computers. Exchange of programs and ideas; advice for beginners and enthusiasts. Meetings each month on the third Thursday. Contact Bill Cushing, Urambi Village, Crozier Circuit Kambah, 2902. Tel (062) 31 6399.

BBC USERS GROUP OF CANBERRA (BUCG)
Meets on the last Wednesday of each month and welcomes all interested in the BBC Computer. Membership is free and details may be obtained from Steve MacLeod (062) 58 7719 or John Toms (062) 58 4052.

★★WOMBAT★★

The world of computing is now available to everyone at very reasonable cost.
For parents who wish their children (and themselves) to learn programming, to utilise educational programs, or just to make use of some of the hundreds of programs available the WOMBAT is now released on the Australian market.

* BONUS —
For each WOMBAT sold before January 25th, a choice of any ten programs from the MECC Educational Library will be given free — valued at approx. $288!

Standard features:

* built-in floating-point BASIC;
* built-in disassembler;
* a ROM-based system control program;
* color graphics and sound capabilities;
* sockets for up to 48K bytes of user memory (RAM); 16K with the plug-in Language Card;
* cassette interface;
* game input/output connector, and two hand controls for games and other human-input applications;
* typewriter-style ASCII keyboard;
* high-efficiency switching power supply;
* eight accessory expansion slots;
* autostart monitor;
* upper/lower case function.

Inputs and Outputs:

* cassette interface (1500bps);
* game I/O: four analog to digital inputs, three TTL inputs and four TTL outputs.
* typewriter-style ASCII keyboard;
* 7 peripheral board connectors fully buffered, with interrupt and DMA priority structure;

NOTE: THE WOMBAT SOFTWARE IS COMPATIBLE WITH PROGRAMS FOR THE APPLE II

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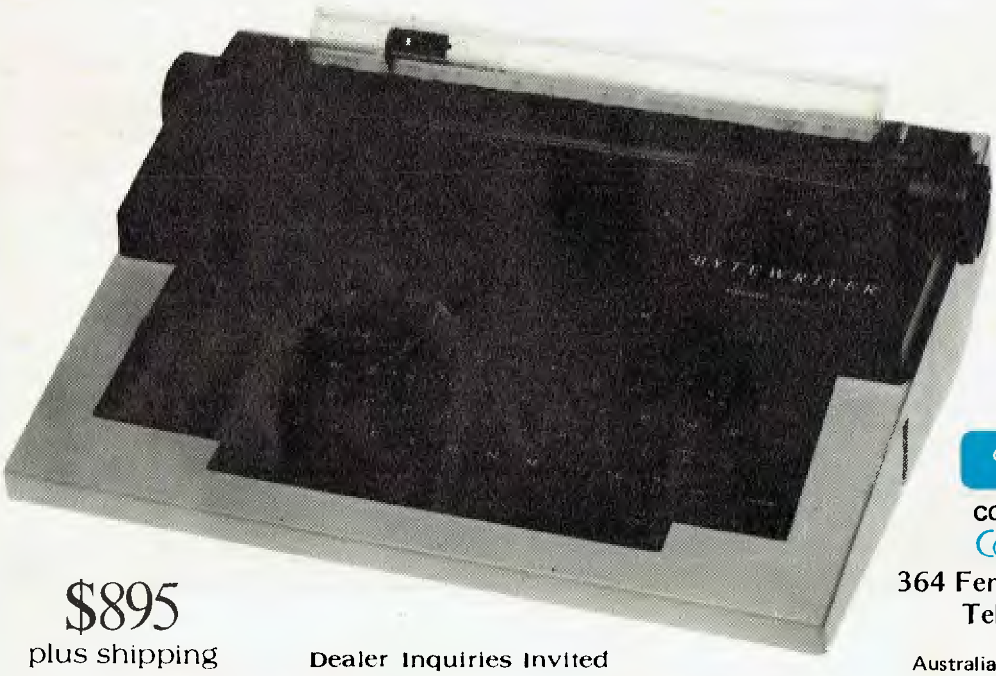

FEATURES

* *Underlining
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* *2nd keyboard with foreign grammar symbols switch selectable
* *Changeable type daisywheel
* *Centronics-compatible parallel input operates with TRS-80, Apple, Osborne, IBM and others
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BYTEWRITER

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This superb family of sophisticated floppy drives was designed and perfected by a team of industry-respected engineers expressly for Apple computer owners who have long been demanding more disk drive for their money.

Now they *have* a drive that makes an Apple perform the way it should. For example:

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Here's a tantalising taste of just how formidable your Apple can become.

Next to enormously increased disk space, Apple buyers are most excited about Rana's fingertip Write/Protect feature. A pushbutton on the LED-lit panel gives you a new measure of failsafe control.

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A specially programmed Rana utility disk assures you of far-reaching compatibility, and extra dimensions of business, leisure and learning applications with your Rana-enhanced Apple computer.

There are many, many more operating refinements: Uncanny head-positioning accuracy, 300% faster track-to-track speed, better operating economy, and gentler clamping action through an all-new diskette centering cone, to name just a few.

A disk drive package like this doesn't grow on trees, so write or call today for more information about the Elite Series.

ELITE 1	$640	(163kb)	with Controller	$790
ELITE 2	$830	(326kb)	with Controller	$990
ELITE 3	$1090	(652kb)	with Controller	$1250
CONTROLLER ONLY	$160			

(All prices include Sales Tax)

AMERICAN EXPRESS

DINERS CLUB

CONTACT: Computer Edge Pty. Ltd.
364 FERRARS STREET, ALBERT PARK, VIC 3206. Telephone: (03) 690 1477

USER GROUPS INDEX

ACTAPPLE
This Apple user group meets on the second Thursday of each month. For more information contact Jeff Brock, Secretary/Editor, P.O. Box 1231, Canberra City, 2601.

AUSTRALIAN ZX80 USERS ASSOCIATION
Contact can be made with the editor of the Club magazine, David Brudenall, 19 Godfrey Street, Campbell, ACT 2601.

SORCERER COMPUTER USERS OF AUSTRALIA (ACT BRANCH)
Interested persons may contact Mr G. T. Dick, 31 Creswell Street, Campbell, ACT 2601. Tel (062) 48 7793 for details of membership and information on forthcoming activities.

NEW ZEALAND

COMBINED MICROCOMPUTER USERS GROUP (CMUG)
This is an association of microcomputer clubs, groups, etc, formed to co-ordinate activities and to give a combined voice on topics concerning all micro users. Representation from ALL clubs and groups is welcomed to, CMUG, C/- P.O. Box 6210, Auckland.

AUCKLAND COMPUTER EDUCATION SOCIETY (ACES)
Ray Clarke, 1 Dundas Place, Henderson, Auckland, (09) 836 9734 (H)

HP41C USERS GROUP (AUCKLAND)
C/- Calculator Centre, P.O. Box 6044, Auckland, Grant Buchanan, (09) 790 328 (W). Meets 3rd Wednesday, 7pm at Centre Computers, 1 Great South Road, Epsom.

NZ TRS-80 MICROCOMPUTER CLUB
Olaf Skarsholt, 203a Godley Road, Titirangi, (09) 817 8689 (H). Meets 1st Tuesday, VHF Clubrooms, Hazel Avenue, Mt Roskill, Auckland.

OSI USERS GROUP (AK)
Vince Martin-Smith, 44 Murdoch Road, Grey Lynn, Auckland. Meets 3rd Tuesday, VHF Clubrooms, Hazel Avenue, Mt Roskill.

SYMPOOL (NZ SYM USER GROUP)
Mark Bennett, P.O. Box 651, Manurewa, (09) 266 6994 (H).

ATARI 400/800 USER CLUB
Dave Brown, P.O. Box 6053, Hamilton, (071) 54 692 (H).

GISBORNE MICROCOMPUTER GROUP
Ron Taylor, 17 Byron Street, Gisborne, (079) 81 450 (H).

ELECTRIC APPLE USER GROUP
Noel Bridgeman, P.O. Box 3105, Fitzroy, New Plymouth, (067) 720 432 (H).

MOTOROLA USER GROUP
Harry Wiggans, (ZL2BFR), P.O. Box 1718, Palmerston North, (063) 82 527) (H).

TARANAKI MICROCOMPUTER SOCIETY
P.O. Box 7003, Bell Block, New Plymouth: Francis Slater, (067) 84 514.

OSBORNE USER GROUP
Dr Jim Baltaxe, 18 Matipo Street, Palmerston North, (063) 64 411.

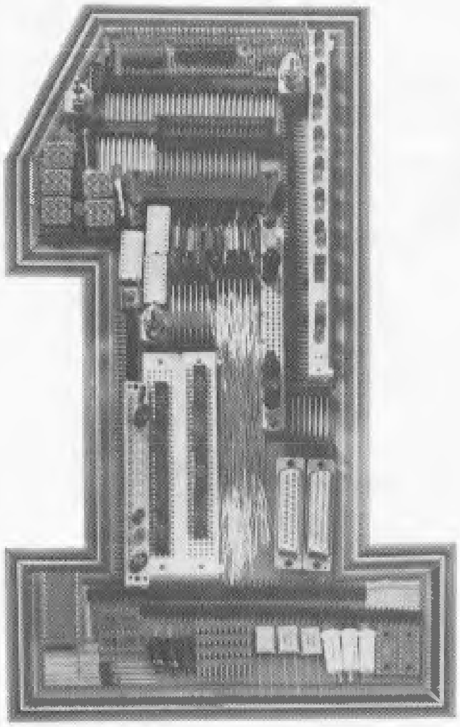
HAWKES BAY MICROCOMPUTER USERS GROUP
Bob Brady, Pirimai Pharmacy, Pirimai Plaza, Napier, (070) 439 016.

CHRISTCHURCH MICROPROCESSOR USERS GROUP
J D Mann, 330 Centaurus Road, Cashmere, Christchurch, (03) 325 652.

CHRISTCHURCH '80 USERS GROUP
David V Smith, P.O. Box 4118, Christchurch, (03) 63 111 (H).

CHRISTCHURCH PEGASUS USERS GROUP
Don Smith, 53 Farquhars Road, Redwood, Christchurch, (03) 526 994 (H), 64 544 (W) ZL3AFP.

END



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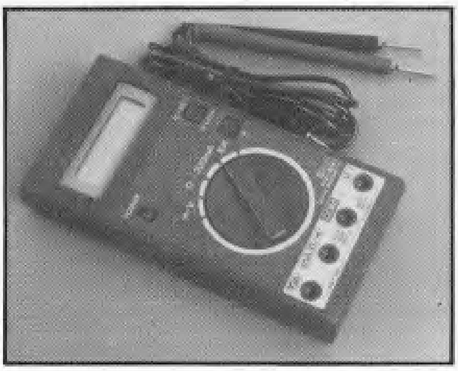

Digital Multimeter
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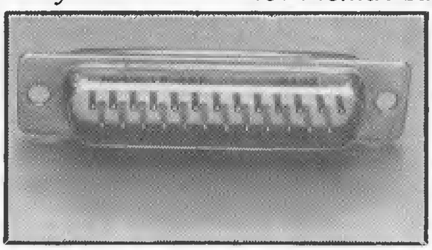

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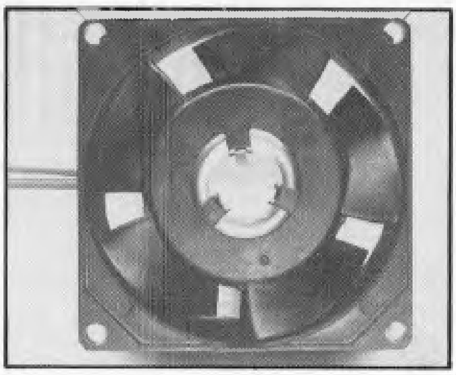

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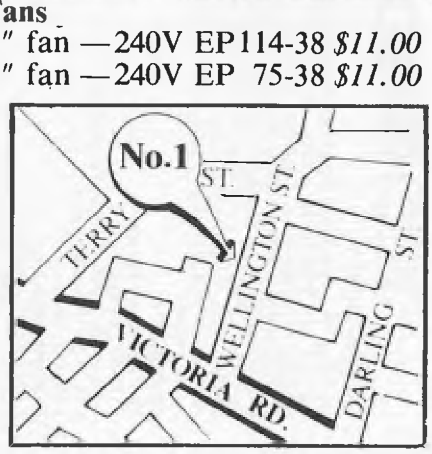

TECHSPECS

COMPACTOR 1

The Compactor I is a Memory Management Module that plugs, without modification, into the TRS-80 Model III Micro-computer. This module provides the capability of running CP/M (2.2) operating system and zero origin stand-alone CP/M application programs while still preserving the environment to run TRS-BASIC and TRSDOS. Once the module is installed, the user can select TRSDOS, TRS-BASIC, CP/M 2.2 or Hurricane Z80 Diagnostic Monitor as a mode of operation. When the user inserts a Hurricane Labs version of the CP/M 2.2 Diskette, the Compactor I Module will automatically switch to the CP/M 2.2 operating system.

FEATURES:

User Operating System
- TRSDOS Operating System
- TRS-BASIC & TRSDOS Application Programs
- CP/M 2.2 Operating System
- Diagnostic Monitor

Firmware Modules
- Menu/Dispatch Module
- CP/M 2.2 Turnkey Boot
- Hurricane Z80 Diagnostic Monitor

Software Modules
- Digital Research's CP/M 2.2 Operating System
- Copy All Program (For Duplicating Diskette Backups)
- Format Program (Formats Single 128 Bytes/Sector, 18 Sector and Double 256 Bytes/Sector, 18 Sector Density Floppy Diskettes)
- Digital Research's Utility Programs (e.g. ASM, DDT, DUMP, ED, STAT, SUBMIT, SYSGEN, XSUB, P.I.P. & LOAD)
- Will run IMS Ascent series Interactive Business Software

Hardware Modules
- Compactor I Memory Management Module
- Beeper Sub Assembly (Audible Signal Actuated by ASCII "CTRL G" Character)

$550

COMPACTOR IV

The Compactor IV is a dual purpose Video Display Module for the TRS-80 Model III Microcomputer. This module serves as an 80 x 24 video display and EIA Standard RS-232 Serial Interface. All necessary cables and instructions are included. The Compactor IV is powered by the internal power supplies of the TRS-80 Model III

FEATURES:

Video Display
- ADM3A Terminal Emulator
  - 80 x 24 Standard Video Format
  - 96 ASCII Character Set
  - Programmable Cursor Addressing
- Multi Character Attributes
  - Inverse Video
  - Underline
  - Blinking
- Data Communications
  - EIA Standard RS-232 Serial Interface
  - Programmable Configuration
    - Baud Rates
    - Parity
    - Word Lengths
    - Stop Bits
  - Full/Half Duplex Communications
  - Line/Local Mode

CP/M BIOS Drivers Supplies With Compactor I & IV
Sample I/O Programs for TRS-BASIC and TRSDOS

Constraints –
Requires a Floppy Disk Power Supply to be in machine

$595

TECHSPECS

COMPACTOR II

The COMPACTOR II is a memory expansion module for Radio Shack's popular TRS-80 Model III microcomputer which gives it the ability to run the CP/M (R) Ver. 2.2 operating system by Digital Research Corp. Hurricane's COMPACTOR II, with 64K of random access memory, 4MHz operation, a real-time clock/calendar, and a beeper, is for the Hurricane CP/M user who needs more than the basic capabilities supplied by the COMPACTOR I. The hardware and accompanying software give the user the power of a standard (0H origin) 64K CP/M operating system, allowing access to a wealth of business and scientific application programs. It also enables the user to execute extended CP/M application programs which requre up to 112K of Random Access Memory (RAM) with the built-in memory bank switching. All at 4MHz! The Compactor II provides these features without loss of TRS-80 capabilities. Whether CP/M or TRS-DOS, the operating system on the diskette is automatically loaded at Power-On or Reset. If, however TRS-BASIC or the special Hurricane firmware environments Diagnostics or Terminal are desired, the user may invoke them by pressing either the Break, "D" or "T" key, respectively, at that time.

SPECIAL FEATURES:

User Operating Systems:
- CP/M 2.2 or CP/M 3.0 (to be released)
- TRSDOS
- TRSDOS work-alikes

Firmware Modules:
- Menu/Dispatch Module
- Auto-Detect Turnkey Boot
- TRS-BASIC
- Hurricane's System Diagnostics
- Hurricane's Terminal Emulator (for use with RS-232 or COMPACTOR IV boards)

Software Modules:
- Digital Research's CP/M 2.2 operating system
- Memdisk (allows extra 48k to be used as a disk drive)
- Format Diskette Program
- Configure I/O System Program
- Modem Program (CP/M to CP/M Data Communications)
- Read Time of Day
- Set Time of Day
- Digital Research's Utility Programs — ASM, DDT, ED, STAT, LOAD, SUBMIT, TSYSGEN, XSUB, PIP.

Hardware Modules:
- Compactor II CP/M memory management
- 64K RAM (Random Access Memory)
- 4K ROM (Read Only Memory)
- Real Time Clock/Calendar with battery back-up
- Programmable CPU clock: 2MHz or 4MHz
- Audio Beeper
- Jumper option to allow TRS-80 RAMs to run at 4MHz without wait states if owner replaces the originals with 250 nsec parts

Disk Drive Support:
- Floppy disk drive tracks: 35, 40, 77 and 80
- Winchester 5, 10, 20 Mega byte disk drive
- Corvus System 5, 10, 20, 40 Mega byte disk drive
- Corvus Systems Contellation multiplexer
- Corvus System OminiNet (Networking Hardware)

Diskette Interchange Formats:
- OSBORNE-1
- Xerox 820
- Cromemco
- IBM Personal Computer (Single sided only)
- NEC PC-8000
- Omikron Mapper I
- Zenith (softsector only)
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SOUTH AUSTRALIA

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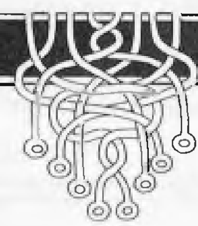

172 entries were received to October's puzzle – either the puzzles are just too easy or the readership is growing at an astonishing pace.

Anyway it was a fairly easy puzzle and the answer was 29031 – most readers got it right. The winner, chosen by a random number generator was entry number 93 which came from Stephen Tyler of Turramurra. Congratulations Stephen!

Quickie

There are two stalls in a market selling apples. Stall A sells them at three for 10c the other stall B at two for 10c. On Monday each stall sells 300 apples, therefore stall A collects $10 and stall B $15 – a total of $25.

On Tuesday each stall again has 300 apples, but both stalls decide to combine and sell at five for 20c. At the end of the day, however, they find that there is only $24 to be shared between them. What happened to the other $1?

Prize Puzzle

Runners in a marathon race are assigned consecutive numbers starting at one. One runner with a mathematical bent notices that the sum of the numbers less than his is equal to the sum of the numbers greater than this.

If there are more than 100 runners, but less than 1000, what number is he and how many runners are in the race?

BLUDNERS

If you believed December's contents page, you'd turn to page 91 to begin the article 'Writing The Small Print'. But that article actually starts on page 92 and ends on page 91. And that's the only major bludner we've spotted so far in that issue.

However, the gremlins had a field day in November programs and another error has been spotted: the last half of the instructions to "Moon Module" were left out and are presented below.

'amount of thrust given per unit of fuel and the gravitational constant. You can also create your own moon surfaces and save them onto disk. Moon module contains full instructions. The author suggests starting out with 0.7 for thrust/fuel and 0.08 for the gravitational constant.'

LIST

PROGRAMS

APC is interested in programs written in Basic, Pascal, Forth, Logo and Comal — all of which being languages we've covered in previous issues. Please supply your programs on disk or cassette with all necessary documentation (so we've got a good idea what it's about and how much memory it uses) and, if you can, a clear listing on plain white paper.

As all programs in APC are checked either by a referee or by one of the editorial staff, it can take some time for a program to actually appear. If you don't hear from us within two months or so, it usually means your contribution is in the referee pipeline. It's essential to ensure that your program is fully debugged before you send it in — get a friend to try it first — and all programs we publish are paid for at a regular rate. Send contributions to: APC Programs, P.O. Box 280, Hawthorn, Vic 3122 — and please enclose an SAE if you want material returned.

Getting competitive

This should keep you on your toes: to introduce a bit of healthy competition into 'Programs' a prize of $25 will be awarded to the writer of the 'Program of the Month'. This'll be on top of what would normally be paid for a program.

Any contribution sent in for 'Programs' will be eligible, including those I've had in the pipleine up to now. It'll be judged on several criteria — annotation, ideas and their implementation, use of a machine's facilities, user friendliness, originality and innovation.

From this issue onwards the masterpieces chosen will be specially marked and I'll give an explanation as to why each program is chosen. Length won't matter — unless your program is actually too long to fit in — and all programming languages normally accepted are eligible. So if you've lost interest in that program you've been bashing away at for the past few weeks/months/years, Program of the Month should prove incentive enough to get it finished.

Lastly, I'll here remind readers that no correspondence whatever will be entered into regarding *APC's* judgement on programs.

PET Search and Rescue

by Geoffrey Little & Michael Orton

This rather unusual game is based upon a helicopter sea rescue which operates from a lighthouse. Men are rescued from ships which are about to founder on rocks at the base of the lighthouse. The objective is to rescue as many men as possible and then to land safely when the helicopter's fuel runs out.

It runs in 13k on 4000 series PETs and omitting the instructions will halve its volume — which serves as an indication of how comprehensive they are.

The coding is heavily compressed and several points should be noted regarding it. Line 10 must remain in its present position as the first piece of code. This is because the string within it represents an approaching ship and the semicolons (men) are POKEd out of memory where line 10 is stored when the men are removed from the boat. The Boolean algebra used in the program is for checking and each expression returns values of −1 or 0 if a statement is true or false respectively. The waves are produced by randomly cutting a string of waves and printing the two parts in reverse order and the helicopter is decided by a set of three flags designating its rotor position, direction of travel and whether or not a passenger is being carried. These strings are positioned by DIMensioning arrays (A$(X) and D$(Y) which are the X and Y coordinates of the location required. Refuelling from the lighthouse is detected by negating a PEEK (152) which is −1 if the shift key is pressed and 0 otherwise.

As a game it's original and inventive. It's a change to see a game which involves saving people/beings rather than blasting them to bits, and as a program it makes the most of PET's limited graphics and uses Basic to the full.

```
10 B$="[illegible]          [illegible]L;;;;;[illegible] [illegible]"
14 :
15 REM*** RUNS IN 13K ***
16 :
20 DIMD$(25),HD$(1,1,1),A$(37),FO(7),L(4)
30 GOSUB920:GOSUB930
40 D$(0)="[illegible]":FORX=1TO25:D$(X)=D$(X-1)+"[illegible]":NEXTX
50 FORX=1TO37:A$(X)=A$(X-1)+"[illegible]":NEXTX
60 IFQ$="Y"THENGOSUB990
70 L$(0)="[illegible]":L$(1)="[illegible]"+L$(0)
80 FORX=2TO4:L$(X)=L$(0):NEXTX
```

```
90 H$(0,0,0)="—┬—▌▌▌▌┌ ▀/"
100 H$(1,0,0)=" ┬ ▌▌▌▌┌ ▀/"
110 H$(0,1,0)="—┬—▌▌▌▌\ ▀┌"
120 H$(1,1,0)=" ┬ ▌▌▌▌\ ▀┌"
130 H$(0,0,1)="—┬—▌▌▌▌┌ ▀/"
140 H$(1,0,1)=" ┬ ▌▌▌▌┌ ▀/"
150 H$(0,1,1)="—┬—▌▌▌▌\ ▀┌"
160 H$(1,1,1)=" ┬ ▌▌▌▌\ ▀┌"
170 F$=" ┌────────────────────┐"+A$(18)+" !THANKYOU FOR PLAYING!"+A$(18)
180 F$=F$+" └────────────────────┘":EM$="EMPTY2_"
190 DEFFNA(X)=32768+INT(X)*40+HP
200 DEFFNB(X)=PEEK(1+FNA(X))
210 DEFFNC(X)=PEEK(FNA(X+1)+2*(1-D))
220 DEFFND(X)=PEEK(FNA(X+1)+2*D)
230 DEFFNE(X)=X+(X<0)*X+(X>37)*(X-37)
240 DEFFNF(X)=PEEK(X)AND128
250 W$="‾‾__‾‾_‾‾‾__‾‾‾__‾_‾‾‾_‾‾‾_"
260 IFQ$="Y"THENGOSUB1180
270 F$(0)="":F$(1)=""
280 E$="    ▌▌▌▌    "
290 EX$="\↑/▌▌▌▌/V\▌▌▌▌ ┌┐ ▌▌▌▌ ▌▌▌▌"
300 C$="                                  "
310 C1$="  ▌▌       ▌▌   "
320 FB$="
330 FORX=1TO9:READHD(X),VD(X):NEXTX
340 FORX=0TO7:READFG(X):NEXTX
350 VV=0:HV=0:VP=6:HP=0:R=0:D=0:M=0:SC=0:FU=500:FH=0:LP=33249:FP=7:GOSUB830
360 I&Q$="Y"THENGOSUB1410
370 PRINT"":GOSUB 750
379 :
380 Q=PEEK(151)-48:Q1=(Q<10)*(Q>0)*Q:IFQ=-16THEN490
390 V=VV+VD(Q1):VV=V-.3*((V<-2.1)-(V>2.1)):V=HV+HD(Q1)
400 HV=V-.3*((V<-2.1)-(V>2.1)):FU=IN4((FU-ABS(HV)-ABS(VV+.2)-M)*.995)
410 PRINTD$(23)A$(28)""FU"▌ ";:IFFU<.1THENFU=0:GOTO610
420 D=-(HV<0):R=1-R:V=VP:H=HP
430 P=VP+VV:IFP>1THENIFP<22THENVP=P
440 P=HP+HV:IFP>0THENIFP<36THENHP=P
450 PRINTD$(V)A$(H)E$:IFFNC(VP)<>32ORFND(VP)<>32THEN650
460 PRINTD$(VP)A$(HP)H$(R,D,M)
470 IFINT(HP)=0THENIFINT(VP)=6THENIF-PEEK(152)THENGOSUB690
480 GOSUB 790:GOTO380
489 :
490 FU=FU-5:IF-MTHEN560
500 IFFNB(VP+2)<>32THEN390
510 FORP=VP+2TOVP+6:IFFNB(P)=32THENPRINTD$(P)A$(HP+1)" |";:NEXTP
520 IF(FNB(P)AND127)<>59THENM$=" |":GOTO540
530 POKE1056+(INT(HP)-INT(BP))+1,32:M$=":":M=1:PRINTD$(21)A$(BP)B$
540 FORP=P-1TOVP+2STEP-1:PRINTD$(P)A$(HP+1)M$;
550 N=20:GOSUB860:PRINT"▌ ":NEXTP:GOTO390
559 :
560 M=0:R=1-R:P=VP+2:PRINTD$(VP)A$(HP)H$(R,D,M)"▌▌▌";
570 IFFNB(P)=32THENPRINT"▌";:N=9:GOSUB860:PRINT" ▌";:P=P+1:GOTO570
580 IFP-VP>4ORFNB(P)<>102THENPRINT"SPLAT":N=200:GOSUB860:PRINT"      ":GOTO390
590 SC=SC+1:PRINTD$(23)A$(5)""SC"▌ ";:FORP=33568+HPTO33569STEP-1
600 POKEP,FNF(P)OR59:N=50:GOSUB860:POKEP,FNF(P)OR32:NEXTP:GOTO390
610 IFHP<9THENIFFNB(VP+2)<>32T(EN730
619 :
620 PRINTD$(VP)A$(HP)E$:VV=VV-.3*(VV<.7):VP=VP-VV*((VP+VV)>0):HV=HV*.9:HP=HP+HV
630 )FHP<0ORHP>37ORFNC(VP)<>32ORFND(VP)<>32THEN650
640 PRINTD$(VP)A$(HP)H$(R,D,M):N=20:GOSUB860:GOTO620
649 :
650 PRINTD$(VP)A$(FNE(INT(HP)));:FORX=1TO50:PRINTEX$;:NEXTX:PRINTE$
660 GOSUB750:GOSUB790
670 GOSUB790:GOSUB840:GETQ$:Q=(Q$="Y")+(Q$="N")*2:Q$="":ON1-QGOTO670,350
680 PRINTD$(11)A$(11)F$:END
689 :
690 IFPEEK(152)=0THENRETURN
700 PRINTD$(23)A$(28)FU"▌ ":IFFP=0THENFP=8:LP=LP+40
710 I&LP<33569THENFP=FP-1:FU=FU+36:POKELP,FG(FP):GOTO690
720 PRINTD$(13)A$(1)EM$:RETURN
729 :
730 PRIN4D$(VP)A$(FNE(HP))H$(R,D,M)
740 PRINTD$(15)A$(12)"YOU RAN OUT OF FUEL"A$(22)"BUT LANDED SAFELY":GOTO670
749 :
750 PRINT"                                        ";
760 PRINT"   ▌▌▌▌    ▌▌▌▌    ▌▌▌▌    ▌▌▌▌";
770 PRINT"    ▌▌▌▌   ▌▌▌▌   ▌▌▌▌    ▌▌▌▌            "
780 PRINTD$(23)"SCORE "SC"    HELICOPTER FUEL "FU"          ";
790 WP=INT(RND(1)*38)+1:PRINTD$(22)MID$(W$,WP)LEFT$(W$,WP-1);
800 BP=BP-RND(1)/3:IFBP<31THENPRINTD$(21)A$(BP)B$
810 PRINTD$(9)L$(L):L=L+1:L=-(L<5)*L:IFINT(BP)<>9THENRETURN
820 PRINTD$(21)A$(BP);:N=150:GOSUB860:P2INTC$;:GOSUB860:PRINTC1$
830 FORX=1057TO1061:POKEX,59:NEXTX:BP=INT(RND(1)*10+30):RETURN
839 :
840 PRINTD$(2)A$(12)"PRESS 'Y' TO RESTART":PRINTD$(4)A$(14)"PRESS 'N' TO STOP"
850 N=50
860 FORZ=1TON:NEXTZ:RETURN
869 :
870 DATA-.3,.3,0,.3,.3,.3,-.3,0,0,0,.3,0,-.3,-.3,0,-.3,.3,-.3
880 DATA160,210,198,192,195,196,197,227
889 :
890 PRINT"      PRESS ANY KEY TO CONTINUE"
900 GETQW$:IFQW$=""THEN900
910 GOSUB920
920 PRINT""TAB(11)"SEARCH & RESCUE                   ":RETURN
930 PRINT""TAB(13)"(C). 1982        BY G.J.LITTLE                & M.ORTON"
940 0RINT"        DO YOU WANT INSTRUCTIONS ? ";
950 GETQ$:IFQ$=""THEN950
960 QW$="NO":IFQ$="Y"THENQW$="YES"
970 PRINTQW$
980 RETURN
990 GOSUB920
1000 PRINT"   YOU ARE THE PILOT OF A  SEARCH AND "
1010 PRINT" RESCUE HELICOPTER. THE HELICOPTER IS "
1020 PRINT" CONTROLLED USING T(E NUMERIC KEY PAD "
1030 PRINT" AS FOLLOWS:-"
1040 PRINT"  7  8  9   THE '5' KEY HAS NO EFFECT"
1050 PRINT"   \ | /    AND THE OTHERS ACCELERATE"
1060 PRINT"     ┬      YOU  IN   THE   DIRECTI/N"
1070 PRINT"  4-    -6   RELATIVE  TO  THE '5' KEY"
1080 PRINT"            FOR  AS LONG AS THEY  ARE"
1090 PRINT"   / | \    DEPRESSED."
1100 PRINT"  1  2  3"
1110 PRINT"   OTHER CONTROLS  ARE THE SHIFT  KEY"
1120 PRINT" AND THE SPACE BAR."
1130 PRINT" THE SHIFT +EY  OPERATES  REFUELLING "
```

```
1140 PRINT" FROM THE TOP  OF THE LIGHTHOUSE ONLY,"
1150 PRINT" IT IS  0OSSIBLE  TO  RETURN  TO  THE "
1160 PRINT" LIGHTHOUSE TO  REFUEL DURING SORTIES."
1170 RETURN
1180 GOSUB890
1190 GOSUB920
1200 PRINT"▒   THE  ▒SPACE■ BAR  OPERATES  THE  ROPE,"
1210 PRINT" DROPPING  THE  PASSENGER  WHEN ONE IS"
1220 PRINT" CARRIED OR LOWERING THE ROPE WHEN ONE"
1230 PRINT" IS NOT."
1240 PRINT"   THE  IDEA  IS  TO   MANOEUVRE   THE "
1250 PRINT" HELICOPTER ABOVE TH% APPROACHING SHIP"
1260 PRINT" AND  LOWER THE  ROPE  ONTO ONE OF THE "
1270 PRINT" MEN ON DECK, W<O  WILL THEN CLIMB  UP"
1280 PRINT" INTO THE HELICOPTER. TO BRING THE MAN"
1290 PRINT" TO SAFETY 9OU MUST AGAIN MANOEUVRE SO"
1300 PRINT" THAT YOU ARE SITUATED  ABOVE THE ROCK"
1310 PRINT" PLATFO2M NEXT TO THE LIGHTHOUSE. THEN"
1320 PRINT" SIMPLY DEPRESS THE ▒SPACE■  BAR TO DROP"
1330 PRI.T" THE PASSENGER  WHO WILL THEN RUN INTO"
1340 PRINT" THE LIGHTHOUSE."
1350 PRINT"   IF  YOU  BEG>N  TO RUN  LOW ON FUEL,"
1360 PRINT" MOVE THE  HELICOPTER TO BE STATIONARY"
1370 PRINT" ABOVE THE  HELICOPTER PLATFORM (START"
1380 PRINT" POSITION) AND  DEPRESS  THE ▒SHIFT■ KEY"
1390 PRINT" UNTIL YOU THINK YOU HAVE ENOUGH FUEL."
1400 RETURN
1410 GOSUB890
1420 PRINT"▒ ▒POINTS TO NOTE■:-"
1430 PRINT"▒   THE  RATE  OF  FUEL  CONSUMPTION  IS"
1440 PRINT" RELATED TO THE AMOUNT O& FUEL  CARRIED,":
1450 PRINT" CARRYING  A  PASSENGER,  LOWERING  THE"
1460 PRINT" ROPE AND YOUR SPEED."
1470 PRINT"   THE  KEYS  ACCELERATE  YOU. THUS, TO"
1480 PRINT" CHANGE  DIRECTION YOU WILL  SLOW  DOWN,";
1490 PRINT" TURN AROUND AND THEN ACCELERATE."
1500 PRINT" PASSENGERS BEING FAIRLY F2AGILE CANNOT"
1510 PRINT" BE  DROPPED  ABOVE  THE  HEIGHT OF THE"
1520 PRINT" LOWEST LIGHTHOUSE WINDOW."
1530 PRINT"   WHEN YOU RUN OUT OF FUEL, IF YOU ARE"
1540 PRINT" POSITIONED  ABOVE  THE  HE,ICOPTER, OR"
1550 PRINT" ROCK PLATFORM YOU WILL LAND SAFELY."
1560 GOSUB890
1570 BP=25:GOSUB750
1580 FI$="┬─┬■":FD=8:FA=0:FQ$="HELICOPTER PAD":FL=24:GOSUB1660
1590 FI$=" ▒▒ ▒▒ ▒▒ ▒▒ ▒▒ ▒▒ ▒▒ ":FD=12:FA=1:FQ$="FUEL GUAGE":FL=25:GOSUB1660
1600 FI$="o":FD=18:FA=2:FQ$="MINIMUM HEI´HT FOR DROPPING MAN":FL=24:GOSUB1660
1610 FI$="▒▒▒▒▒▒▒▒▒▒":FD=21:FA=0:FQ$="ROCK PLATFORM":FL=24:GOS5B1660
1620 FI$=";":FD=20:FA=26:FQ$="MEN":FL=25:GOSUB1660
1630 PRINTD$(5)A$(9)"PRESS ANY KEY TO START"
1640 GETQW$:IFQW$=""THEN1640
1650 RETURN
1660 PRINTD$(5)A$(19-LEN(FQ$)/2)FQ$
1670 FORX=1TOF,:PRINTD$(FD)A$(FA)F$(FR)FI$:FR=1-FR:N=99:GOSUB860:NEXTX
1680 PRINTD$(5)A$(19-LEN(FQ$)/2)LEFT$(FB$,LEN(FQ$)):RETURN
READY.
```

VIC Connect-4

by Adrian Millet

This game, for a 3.5k VIC, is a game of the Othello type in which player and computer take it in turns to drop black or white pieces onto a 7x6 grid. The winner is the first player to obtain a line of four either horizontally, vertically or diagonally on the grid. To input the position on which you want to play a turn, simply type in the appropriate column numbers when the prompt is given.

The reverse video '/' in line 8020 is not directly available from the keyboard and can be left out if desired.

```
130 DIMB(8,7),E(2,9),Y(3),X(3)
200 GOSUB8000
220 IFNP=1ANDRND(0)>.5THENPRINT"
▒I'LL GO 1ST THIS TIME":GOTO300
250 C=2:GOSUB7000
300 C=1
310 IFNP=2THENGOSUB7000:GOTO250
350 GOSUB1000:GOTO250
499 REM * EVAL X,Y
500 E=EC(X)
510 FORD=0TO3
520 Q=X(D):R=Y(D)
530 FORC1=1TO2
540 N=0:I=X+Q:J=Y+R
550 IFB(I,J)<>C1THEN580
560 I=I+Q:J=J+R:N=N+1
570 IFB(I,J)=C1THEN560
580 O=(B(I,J)=0)
590 I=X-Q:J=Y-R
600 IFB(I,J)<>C1THEN630
610 I=I-Q:J=J-R:N=N+1
620 IFB(I,J)=C1THEN610
630 O=-(B(I,J)=0)-O
640 A=N*3+O:IFA>9THENA=9
645 C2=C1:IFC=2THENC2=3-C2
650 E=E+E(C2,A)
660 NEXT
670 NEXT
899 RETURN
1000 REM COMP MOVE B
```

PROGRAMS

```
1020 B=-1:BE=-1E9
1050 FORX=1TO7
1060 GOSUB1900:IFY>6THEN1200
1100 GOSUB500
1110 PRINT"███"TAB(X*3-2)MID$(ST
R$(E),2)
1120 IFE>BETHENBE=E:B=X
1200 NEXTX
1400 X=B:IFX<0THENRETURN
1410 GOSUB7500
1420 IFE<500THENRETURN
1430 PRINT"█I WIN. HIT SPACE
"
1440 GETA$:IFA$<>" "THEN1440
1450 RUN
1900 FORY=1TO6:IFB(X,Y)THENNEXT
1910 RETURN
7000 GOSUB7400
7020 PRINT"█"MID$("WHITEBLACK",C
*5-4,5)" MOVE? (OR █S█TOP)"
7030 GETA$:IFA$<>""THEN7030
7050 GETA$:IFA$="S"THENRUN
7100 X=VAL(A$)
7110 IFX=0ORX>7THEN7050
7120 GOSUB7500
7150 IFY>6THEN7050
7200 IFE<500THEN7400
7210 PRINT"█YOU WIN. HIT SPACE
 "
7250 GETA$:IFA$<>" "THEN7250
7270 RUN
7400 FORA=7680TO7745:POKEA,32
7410 NEXT
7490 RETURN
7500 FORY=1TO6
7510 IFB(X,Y)THENNEXT:RETURN
7550 FORA=X*3+7744TOX*3+8140-Y*6
6STEP22
7555 POKEA-22,32:POKEA-21,32
7560 IFC=1THENPOKEA,233:POKEA+1,
223:POKEA+22,95:POKEA+23,105
7570 IFC=2THENPOKEA,78:POKEA+1,7
7:POKEA+22,77:POKEA+23,78
7600 NEXTA
7610 GOSUB500
7650 B(X.Y)=C
7990 RETURN
8000 REM *NEW GAME
8020 PRINT"███1 OR 2 PLAYERS ?"
8025 POKE36879,8
8030 GETA$:NP=VAL(A$)
8040 IFNP<1ORNP>2THEN8030
8050 PRINT"███"
8100 FORX=1TO18:PRINT"|  |  |  |
  |  |  |  |";:NEXT
8120 PRINT"██  1  2  3  4  5  6
 7 █"
8200 FORX=1TO7:FORY=1TO6
8205 B(X,Y)=0:NEXT:NEXT
8210 FORX=0TO8:B(X,0)=-1
8215 B(X,7)=-1:NEXT
8220 FORY=0TO7:B(0,Y)=-1
8225 B(8,Y)=-1:NEXT
8400 RESTORE
8410 FORC=1TO2:FORX=0TO9
8415 READE(C.X):NEXT:NEXT
8420 FORX=0TO3:READX(X):NEXT
8430 FORX=0TO3:READY(X):NEXT
8450 FORX=1TO7:READEC(X):NEXT
8490 RETURN
9600 DATA0,2.3,0.4.6.1.12.16.100
0
9620 DATA0,0,0,0,2,3,0,8,11.120
9700 DATA0,1.1.1
9710 DATA1.1.0.-1
9750 DATA0,0,1,3,1,0,0
READY.
```

Program of the Month

Atari Character Set Mover

by A Ferguson

Here's an ingenious little routine for the Atari 400/800. As far as I'm aware nothing like it has been published before for this machine — certainly not in the popular micro press, anyway, but I'd stand corrected if this were not so. The whole program serves to demonstrate the Atari's internal register graphics modes which are not documented in the user manuals. In fact, most Atari owners are blissfully unaware of their existence and they cannot be accessed through the normal Basic GRAPHICS statement. If you're an expert you should be able to build on this program and make fuller use of your Atari's hidden potential, and if you're a beginner then looking hard at this program should teach you quite a bit about your micro's internal workings.

Basically, these internal modes centre around the Atari's 'Antic' LSI chip and are numbered 3, 4, 5, 12 and 14. Internal modes 4 and 5, which are dealt with here, are character modes. To use these, the 'display list', a small machine code routine for the Antic processor, has to be altered, which is very slow from Basic. This program does the job much more quickly and efficiently.

The first part of the program loads a small machine code routine into RAM at 'page 6' (hex 600, decimal 1536), which is reserved space. This routine is accessed using the USR function and it loads a redefined character set as five bit-maps into a postion just below memtop. The , $, %, & and ' keys are then found to be altered if you type them.

The second part of the program is a proper demonstration of operating system graphics modes 4 & 5. What actually happens is that the normal graphics square is changed so that you can only work with a 4x8 pixel block. Using the diagram below, this is how the colour controls work: colour location 708 (line 370) controls the colour if B is shaded; colour location 709 (line 350) controls the colour if A is shaded; colour location 710 (line 360) controls the colour if A and B are shaded and colour location 712 (line 380) controls the background colour.

When you run the program, first type , $, %, & and '. Then go into

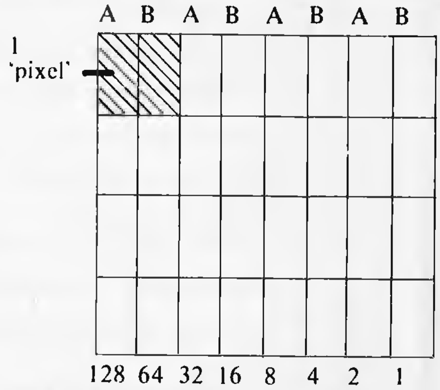

Fig 3 A representation of c character square and how it is changed by using the internal register graphics modes.

inverse video and type the % key again. An explanation of the alteration of the % key can be found by treating a row of pixels in the graphics square as a binary number, each shaded square being a 1. The %'s top row as it now appears in inverse video is 10101010 which, translated into decimal, is 170 (128+32+8+2). This comes from line 170 in which all the data items are 170. As all the squares which would be marked 'A' if the % character square were labelled as in the program are shaded the colour is controlled by location 709 — green.

To try out operating system mode 5 change the following lines:

310 POKE DL+3,69
320 FOR A= Ø TO 12
330 POKE DL+6+A,5

```
1 REM MACHINE CODE CHARACTER SET MOVER
2 REM A FERGUSON
3 REM
4 REM
10 TOP=PEEK(106)-5
20 POKE 106,TOP:GRAPHICS 0
30 TOP=TOP+1
40 Z=TOP*256:REM PAGES INTO BYTES
50 FOR A=0 TO 61:READ LOAD:POKE 1536+A,L
OAD:NEXT A
60 DATA 104,104,133,205,104,133,204,160,
0,185
70 DATA 0,224,145,204,200,192,255,208,24
6,160,0,230
80 DATA 205,185,0,225,145,204,200,192,25
5,208,246
90 DATA 160,0,230,205,185,0,226,145,204,
200,192,255,208,246
100 DATA 160,0,230,205,185,0,227,145,204
,200,192,255,208,246,96
110 X=USR(1536,Z)
120 REM  THIS SECTION ABOVE WILL LOAD YO
UR NEW CHARACTER SET IN  USING
          MACHINE LANGUAGE
130 REM START LOADING CUSTOM SET INTO
R.A.M SET THAT WE HAVE JUST CREATED
140 FOR LOOP=0 TO 39:READ NSET:POKE TOP*
256+(LOOP+24),NSET:NEXT LOOP
150 REM TO ALTER YOUR CHARACTERS
        CHANGE THE DATA NUMBERS BELOW
155 REM EACH CHARACTER IS FORMED FROM
156 REM AN 8X8 GRID. THE DECIMAL
157 REM VALUE OF EACH 8 BIT ROW IS
158 REM LISTED IN A DATA STATEMENT.
160 DATA 85,85,85,85,85,85,85,85
170 DATA 170,170,170,170,170,170,170,170
180 DATA 255,255,255,255,255,255,255,255
```

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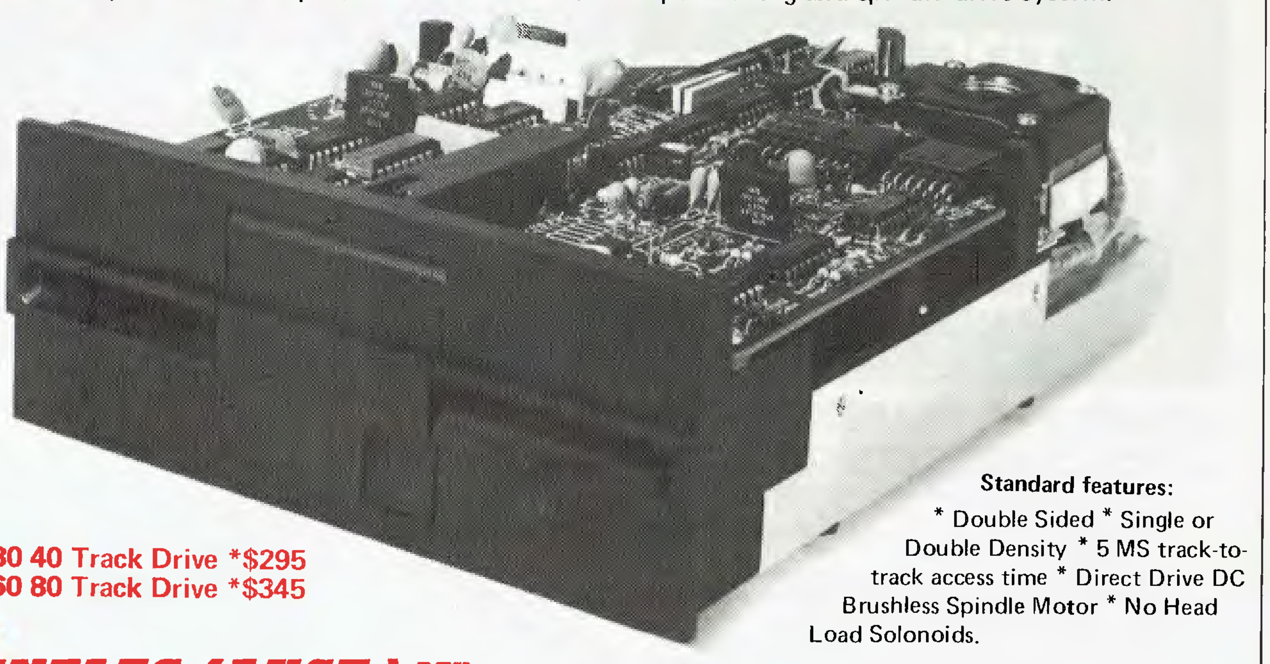

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PROGRAMS

```
190 DATA 250,186,190,255,190,186,250,0
200 DATA 170,170,170,255,255,170,170,170
205 REM  AFTER EVERY GRAPHICS STATEMENT
LOCATION 756 MUST BE POKED TO TOP OR TOP
+2 (lower case)
206 REM  OK AFTER YOU TYPE RUN TRY
           TYPING IN  # $ % &'
300 DL=PEEK(560)+256*PEEK(561):GRAPHICS
0
310 POKE DL+3,68
320 FOR A=0 TO 18:REM CHANGE 18 TO 22 FO
R FULL SCREEN MODE 4
325 REM NOTE THAT INTERNAL REGISTER
     MODE 4 IS not THE SAME AS
    BASIC GRAPHICS 4.
330 POKE DL+6+A,4
340 NEXT A
350 POKE 709,187:REM GREENY
360 POKE 710,54:REM RED
370 POKE 708,117:REM BLUE
380 POKE 712,11:REM BACKGROUND COLOUR
                         REGISTER

1000 POKE 756,TOP:REM POKE 756 WITH
     TOP AFTER EVERY GRAPHICS COMMAND
2000 REM ***************************
2001 REM MEANING OF MEMORY LOCATIONS
2002 REM ***************************
2003 REM
2004 REM 106= ACTUAL TOP OF RAM
       MEMORY IN PAGES (MULTIPLES
     OF 256 BYTES).
2005 REM 560,561= LO BYTE & HI BYTE
       VALUE WHICH POINTS TO THE
     ADDRESS OF DISPLAY LIST.
2006 REM 756= CHARACTER BASE REGISTER
2007 REM 708-712= COLOR SHADOW
       REGISTERS
```

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Some of the above functions are extended and greatly improved versions of those included in APC MON, written by myself, refer to APC October 1982, Vol 3, No 10.

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* This is an improved and final version of my 18 Function Utility. Customers who have purchased this utility before this issue of APC, and would like the improvements, please contact me.

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CHIP CHAT

This month we forego our usual ramblings to bring you Guy Kewney's on-the-spot report of the notable non-happenings at the Comdex extravaganza.

The way to keep up with the trends at Comdex in Las Vegas was to launch a new type of hardware and software. Everybody was doing it. The buzzword is "non-functional".

Easily the most impressive non-functional software at Comdex was a database program called Sequitur. This is apparently a word processing program, which stores letters and documents and bits of them, as directed, in database form.

Pacific Software showed it generating a standard form – a template, onto which data could be loaded. Then they demonstrated it deleting this form, which appeared to surprise the demonstrator more than a little. "Has somebody been patching this?" he enquired forcefully. Somebody had, it turned out.

Gary Kildall has teamed up with ex-Apple boss *Steve Wozniak*, to launch a new CP/M card for the *Apple*. "Hi, look at this," said Kildall, loading a disk and generating a faultless Dbos Error report. "As you can see, fully debugged," he remarked ironically. He then ground his teeth a little bit.

Victory, a new computer company which achieved fame at Comdex Europe for having the first machine with a photograph of a replaceable hard disk cartridge, achieved further fame in Las Vegas for having the first non-functioning hard disk cartridge.

Victory is also under a slight cloud, since many observers expect the new-look *Victor* to take exception to this close approximation of their new all-corporate name.

"Why don't you rename yourselves," one helpful visitor suggested, "say something like Victory Graphic, then you could get two lawsuits for the price of one?"

New company *Pixel*, demonstrating a most impressive multi-user Unix system (based on the Motorola 68000, like everybody else) were approached by a visitor who wanted a fresh terminal.

"I've crashed four of them so far," he explained, "and I want to see if it's a terminal problem or a system problem. Are there any more terminals on that system?" The salesman pushed a few keys in an exercising sort of way, flexed his fingers, and said he would go and find out.

He went. Whether he found out, is something we shall never know, because he failed to reappear.

Sage nearly got non-functionality points for the new Syquest replaceable (cheap) hard disk drive, which has a disk cartridge which is supposed to pop out of the drive when you push a button. It didn't.

Again, however, it turned out to be a simple matter of a loose screw, which was allowing the disk cartridge to hide behind the metal computer case. If you pulled the cartridge down, it popped out quite happily, which appeared to disappoint the salesman. Perhaps he was hoping to foil would-be thieves.

Osborne got a couple of points for the new "80-column upgrade option" which turned out to be slightly less illegible on the little screen than people expected – but which also turned out to have its own ideas on how much of the screen to fill with any extra characters on long lines.

Other non-functioning products were generally less imaginative, involving simple bugs in Basic programs, failure to format diskettes, and so on.

Top marks for creativity, however, must go to the demonstration double-density *Osborne*, which consistently refused to boot up double-density disks.

This one caused a full-scale investigation. Eventually, however, it had to be disqualified.

It turned out that the double-density controller board had been given a "phantom installation" by the engineer. It just wasn't there.

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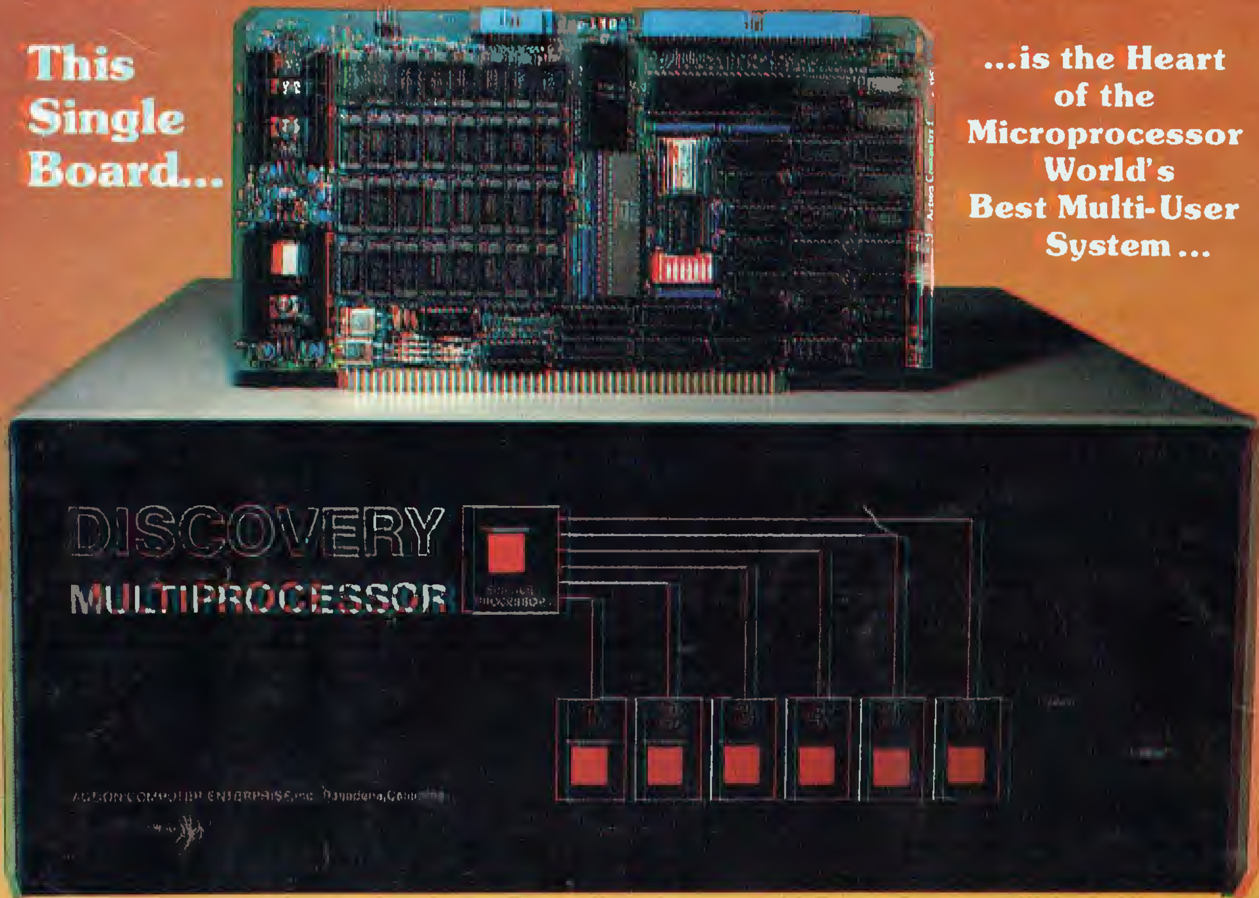

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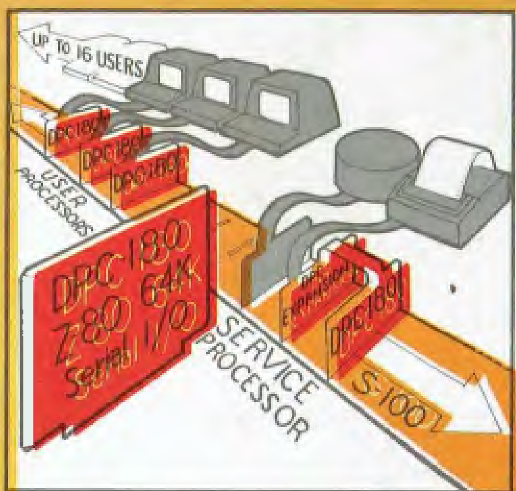

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