Australian Personal Computer

ALGEBRA CHECKING PROGRAM

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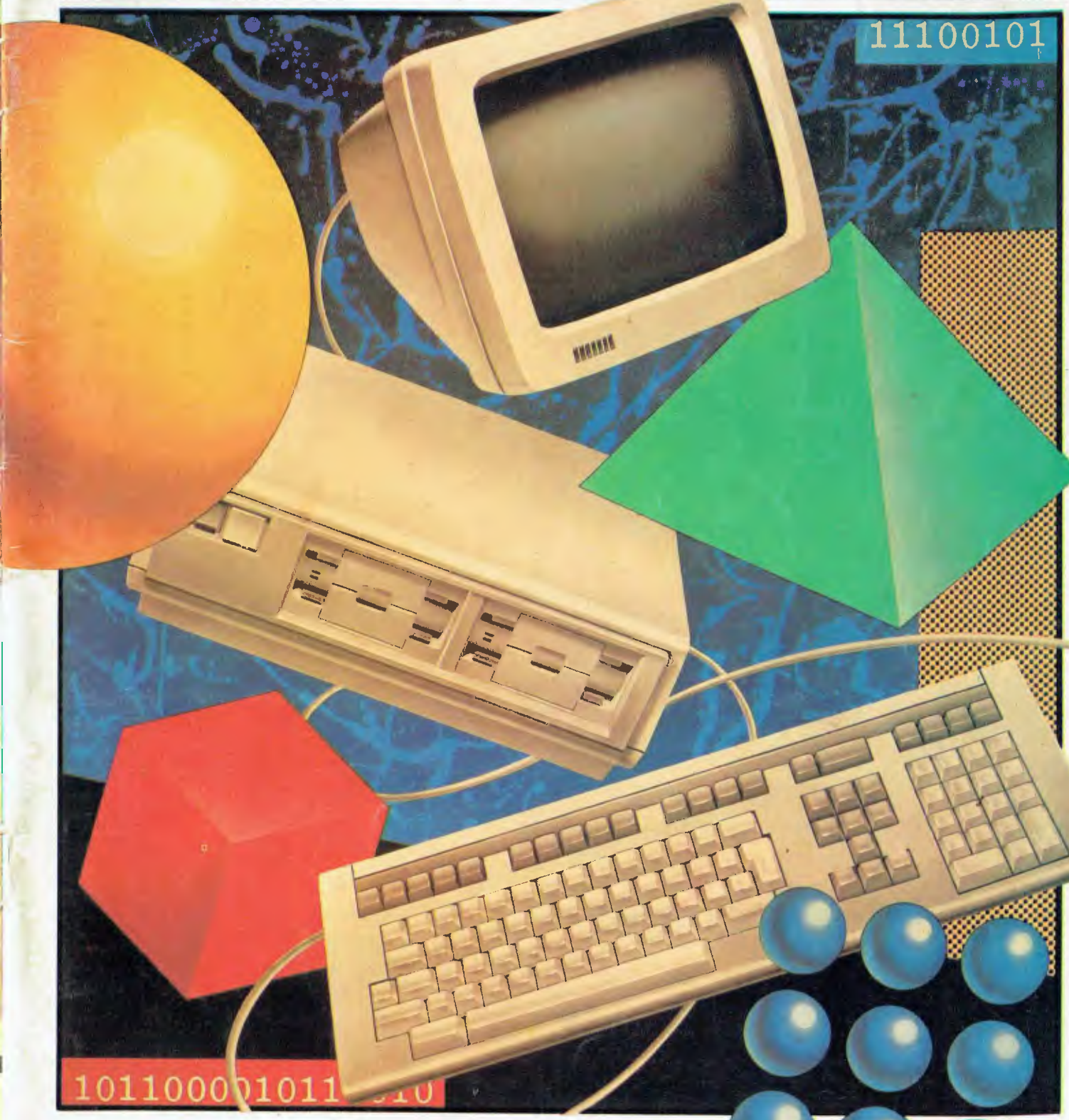

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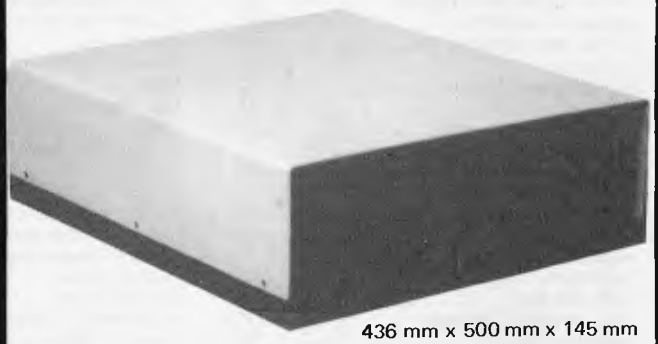
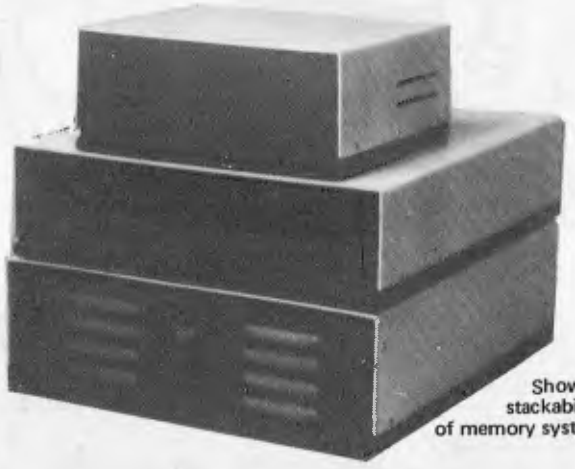


436 mm x 500 mm x 145 mm
designed to take 1 x 8" fixed drive.

436 mm x 500 mm x 118 mm designed to house two 8" slimlines and accompanying circuitry. Slimlines are attached to top panel and are raised above keyboard.



Showing stackability of memory system.

There are standard lines which can be ordered over the phone and sent to any part of Australia or New Zealand. And further chassis design can be provided to suit manufacturers needs. All panels are in sturdy 3mm aluminium, the top being epoxy paint (the colour of your choice), the bottom, front and back panels are anodised black and double as a heat sink.

TECHFRAME DEVELOPMENTS

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Editor
Sean Howard

Technical Editor
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Production Manager
Mike Northcorr

Advertising
Gerard Kohne
(03) 544 8855

Distribution Manager
Valerie Meagher

Typesetting
Marcia Brown

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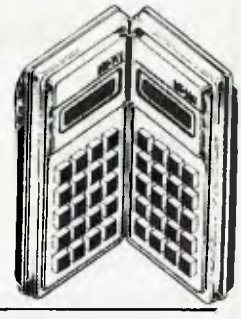

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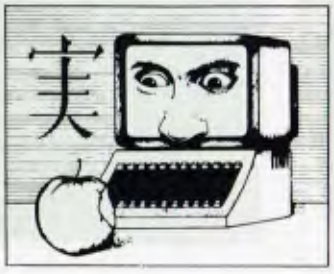

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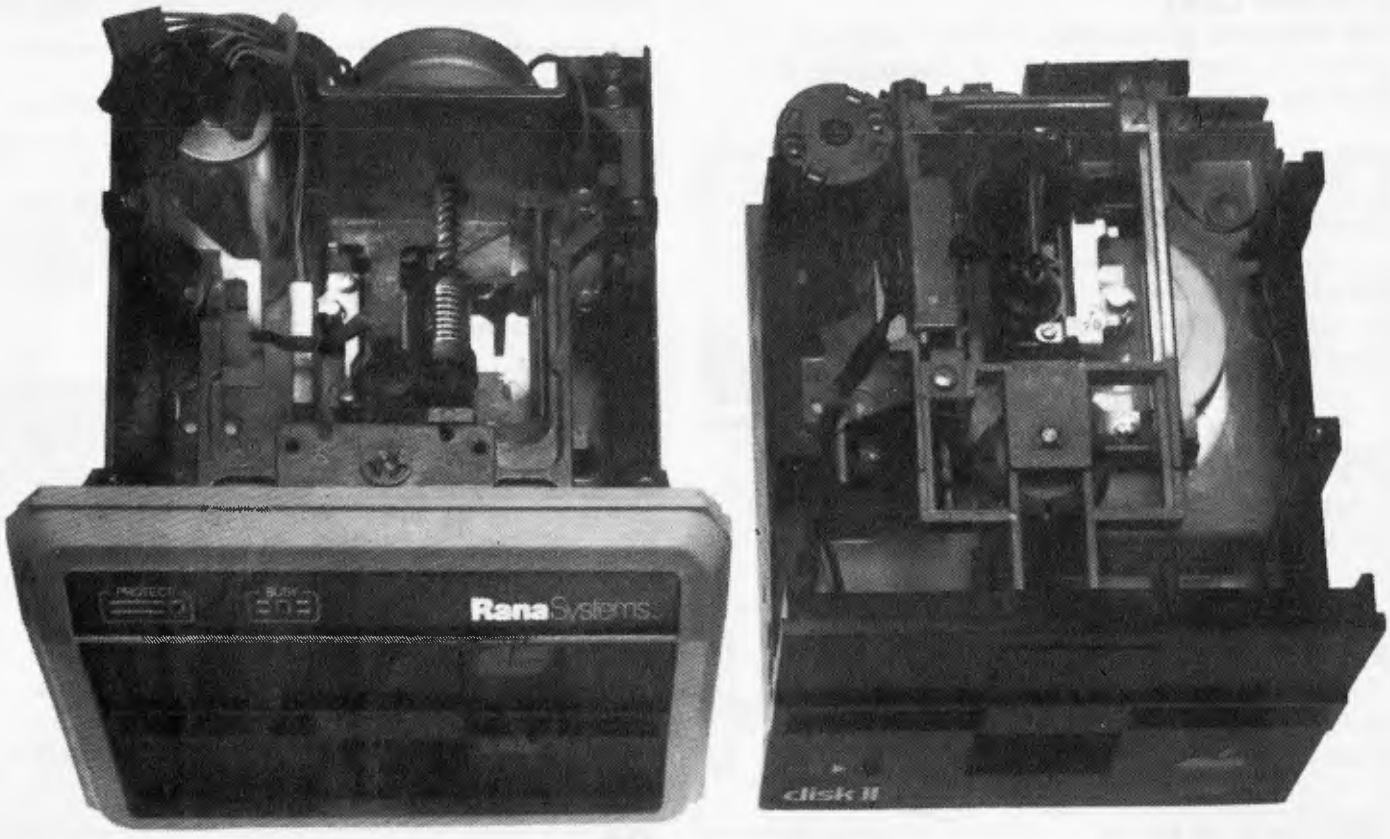
When you say your disk drive has more juice than Apple's, be prepared to cut one open.



Your Apple computer can grow from ordinary to awesome in a matter of minutes.

The Elite disk drive Series by Rana Systems *gives* you that kind of magic. Quickly, easily and cost-effectively.

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:

Elite One, the most economical Rana drive, delivers 15% more storage capacity than Apple's drive. The top-of-the-line Elite Three will provide an astonishing *four-times* more storage, approaching hard disk performance. It's done through exclusive high-density single and double-sided disks and heads.

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.

While Elite drives are all plug-compatible with Apple's controller, Rana's vastly superior controller card is a *must* for those with growing data processing demands. With it, you control up to *four* floppy drives using only one slot . . . while still utilizing your Apple computer to achieve dramatic new heights of system flexibility and processing power.

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.

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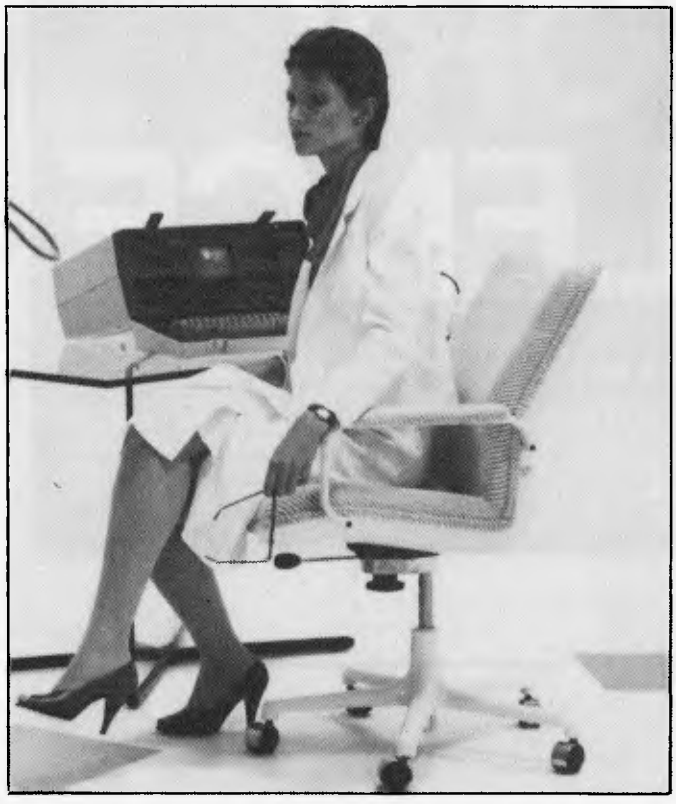
DINERS CLUB

AMERICAN EXPRESS

PRINTOUT

APC reports on the latest from the world micro scene.



The lady in this picture is the star of the Osborne commercial currently on national television.

The tall, dark-haired model, Belinda Davies, who demonstrates the ease of installing the Osborne 1 computer, certainly has looks and presence – but she was also chosen for the role because she is 'not just a pretty face'.

Belinda does have some of the usually accepted background, having modelled in Paris and Tokyo, and having held the title of Miss MS 1981 for the Multiple Sclerosis Foundation. Where Belinda differs from many other models is in the other side of her life. She joined the Army Reserve at 18 and went on to work in Aerial Photography Interpretation and Intelligence work. Belinda later transferred to the Sydney University Regiment for Officer Training – was commissioned a Lieutenant in May 1981 – and is currently serving as Intelligence Officer for this Regiment. And if that were not enough to keep this lovely 25 year old model busy, Belinda has just graduated as a Bachelor of Commerce in Marketing from the University of New South Wales.

Managing director of the Osborne Computer Corporation, Mr Richard Graham, is delighted to have Belinda Davies representing the Osborne 1: "Belinda represents the Osborne 1 computer user . . . the person who's reaching further with career and private interests, the person on the move . . . and is ready to grasp this new technology to further their working capacity and widen their horizons . . . And, I must admit, she looks terrific too."

The computer in the picture is an Osborne 1.

'81 keyboard

Gametronics of South Yarra has developed a full size keyboard for the Sinclair ZX81. It is designed to completely house the '81 along with RAM packs or other compatible add-ons such as 64k RAM, 4k graphics ROM or an 8 bit I/O port.

Further details from Gametronics on (03) 241 3031.

Turbo Tandy

Ilehead Pty Ltd has released a "Super Hi-Speed" mod. for the TRS-80 Model I. The unit costs $199 fitted and is claimed to speed up all functions by a factor of three including disk I/O. Details from P.O. Box 215, Forestville 2087. Telephone (02) 452 4435.

TRS-80 CP/M

Deforest Computers is importing three hardware/firmware upgrades from Hurricane Laboratories in the US for the TRS-80 Model III to allow use of CP/M software, increased RAM, full video processing and 4MHz clock options.

The three upgrades are Compactor I ($550), Compactor II ($945) and Compactor IV ($595).

Selecting a computer system

Six 'S' Business Advisory has released a 56 page booklet entitled "A Common Sense Guide to the Selection of a Computer System". It's aimed at the businessman, giving him a rundown (in a generally unbiased fashion) on the steps involved in buying a business micro.

Against the book are no contents page and references to a certain other micro magazine; for it is excellent presentation in both layout and editorial content.

The booklet can be obtained from selected computer stores or Six 'S' directly on (052) 22 4311.

Getting tough

People make far too much fuss about software copying and too little about software theft. Raiding is what you and I do when we 'borrow' a friend's program to try out, make a copy, and fail to delete it when we return his tape or disk.

Theft (which the industry still euphemistically refers to as 'piracy') however, is evil – and that is what Microsoft has moved against in its action against Advanced Logic Systems. a company which (Microsoft alleges) has copied the CP/M BIOS and BOOT code from the Z80 SoftCard which many people use to turn an Apple into a CP/M machine.

The difference between sampling one program and reproducing somebody else's code in bulk without the R&D effort they spent producing it is substantial.

Microsoft's evidence appears convincing to me: it reports that 'In a declaration filed at the US District Court, an independent source confirmed that, of 4352 bytes of the BOOT and BIOS programs, only 149 bytes were different in ALS' product.'

And, added the source, 126 of those 149 were the Microsoft copyright notice, leaving a grand total of 23 characters changed.

'ALS's code also contains the initials of the Microsoft programmer who developed the software, in similar location and format to the Softcard.'

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added the report. The hearing is in December.

Guy Kewney

Screen moves for new CP/M

With one blow, CP/M's inventor, Gary Kildall, has cut his company loose from the past, and has abandoned the Teletype.

The result could be a new generation of advanced applications software for CP/M machines.

Kildall revealed earlier last month that the new version of CP/M had taken the drastic step of abandoning the user "who can't scroll the cursor up."

Other technical advances he announced included a new venture to bring graphics to the business computer user, and the first concurrent operating system for the IBM Personal Computer.

Gary Kildall, founder of CP/M firm Digital Research: away from teletypes.

The most significant announcement for the average CP/M systems shop is CP/M Plus, previously known as Version 3.0 of the universal eight-bit operating system.

Up till CP/M Plus, anybody choosing to run CP/M on a Z80 system had a simple choice between a standard system with a maximum of 64 Kbytes, or an expanded system that was non-standard.

The first change that the user would notice, Kildall thought, was a "substantial speed improvement" in operation, "mostly through better disk handling, blocking, deblocking and 'least recently used' sector marking."

"We have also killed BDOS Error," Kildall claimed, "with an automatic disk log-on when the system does a disk operation."

"With CP/M up to version 2.2, we always had to assume that somewhere there might be a user sitting in front of a Teletype, with paper scrolling past him. It turns out that, quite often, that actually was the case," Kildall said.

Most users will be delighted with one little feature – the ability to move the cursor up the screen, and re-enter a command line.

Concurrent CP/M-86 looks likely to be slow to take off, largely because of blindness to its advantages.

The system would allow (for instance) a Supercalc user to compose a report with WordStar which referred to results he was concurrently computing on the spreadsheet, and which included graphics generated concurrently with a separate package, while using a database file for reference to names and addresses and phone numbers.

Today, such an operation would require four separate computers.

3Mb on 3½ inch disk

Toshiba has announced the development of a new 3½ inch disk drive mechanism incorporating vertical recording technology. The new method gives data density on the disk of approximately 27 times that

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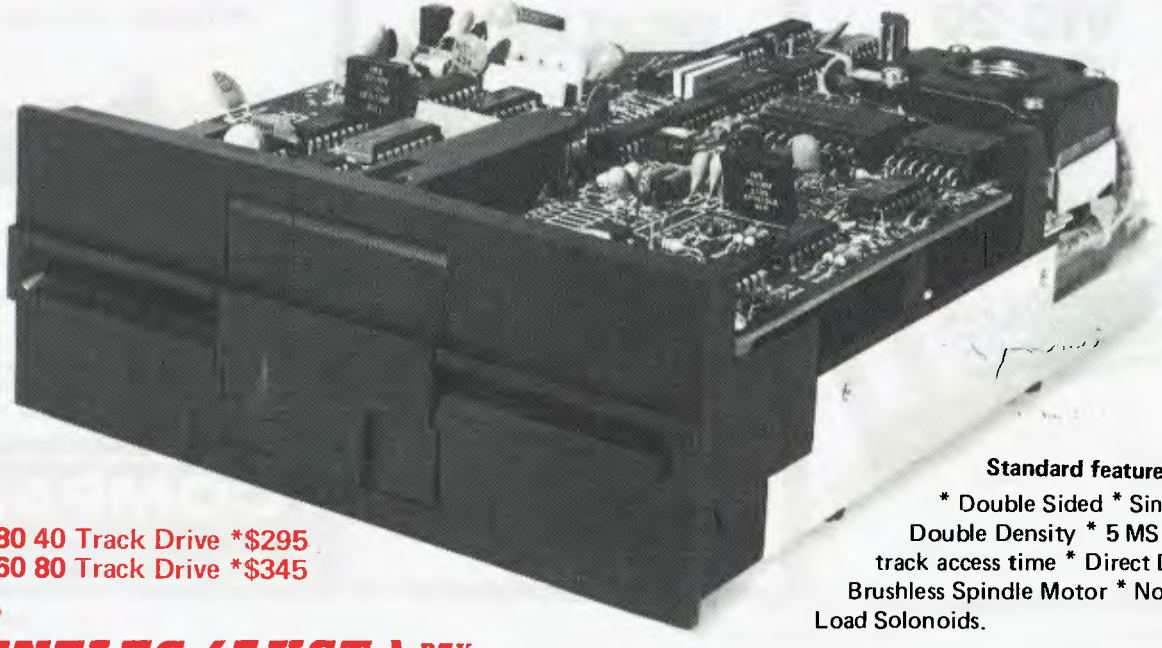

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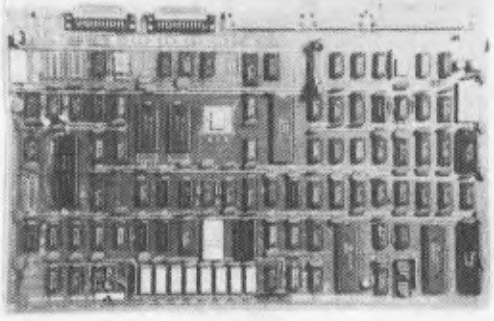

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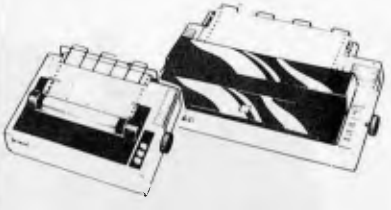

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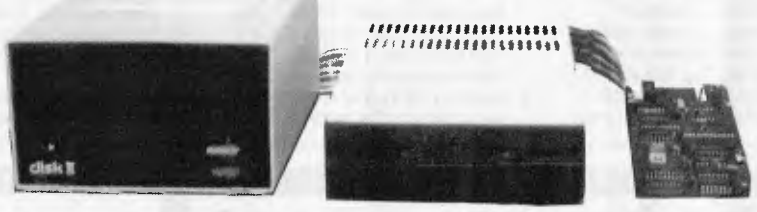

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of conventional recording methods – about 3 Mb on a single sided 3½ inch floppy disk.

The principal of vertical magnetisation of the magnetic medium has been know for some time – and has been applied to hard disk media by IBM among others – but the difficulty of applying the technique to floppy disks has kept the technique in the development labs until now. The chief technical difficulty to overcome according to Toshiba, has been designing a head able to make adequate contact with the disk. Since the magnetised zones go through the thickness of the magnetic coating, instead of across it as in conventional recording methods, the bit density can be much higher but this also demands a head of far greater resolving power.

The Toshiba system uses a 0.5 micron cobalt-chrome alloy film on both sides of the disk and a 0.4 micron gap high resolution ring type head specially developed by Toshiba. Also integral to the system is a high precision disk chucking device and ultra accurate head positioning mechanism.

These three innovations permit a recording density of 50 Kbits per inch and triple track density (144 tracks per inch) for a total of 3 Mb on a 3½ inch disk encased in a protective plastic sleeve.

Texas rides again

Probably the fact that Texas Instruments has started selling its cheap, home computer at a cheap, home price will mean that people will start buying it. Had Texas been a little less stubborn about being "right" and followed the market, who knows – there might, by this stage, be a substantial user base to sell programs to.

In the circumstances, however, the news that UCSD Pascal is available is not going to be quite the bombshell for the professional software world that Texas seems to think.

In particular, we were well entertained by one claim about how modern it all is. "Trends", said Texas last week, "indicate that Pascal is being adopted as the principal programming language by users all over the world. By providing UCSD Pascal on the TI 99/4A, Texas Instruments is ensuring that users of its Home Computer" (wait for it) "remain at the forefront of programming technology."

What are they going to do if somebody tells them about "C" language?

TI 99/4A at last with Pascal

It had to happen

We finally made it – an ACME computer co. Well, almost, it's ACME Software and its selling VIC 20 software. Three games and a M/L program which shows you how to get pseudo voice synthesis from a standard VIC. Details from P.O. Box 1053, Richmond North 3121.

Brother brings in personal small printers

We've had personal computers. Now it's personal printers. Brother – one of the big names in typewriters – has introduced a lightweight, battery-powered keyboard/printer combination which they describe as a personal printer. This is the EP-20 and the idea should have a bright future.

Basically, the EP-20 functions as a portable and compact printer which uses a thermal print head but prints on ordinary paper. The functions are similar to those found on electronic typewriters. A built-in memory allows simple editing and correcting to be carried out on the text, including changing position of words, insert and erase. The text is displayed on a 60-column LCD display. Calculator functions are also built in.

The price in Japan has been set at Y49,800 (about $195) and production will start in

Texas Instruments

Incl.
– modulator
– interface cable for 2 recorders
– power supply

TI-99/4A ONLY $499

Extended Basic	Mini Memory
Speech Editor	Terminal Emulator II
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ZX81 incl. power supply
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64K RAMPACK

The 63k Memory extends the memory of the ZX81 by a further 56k, and together with the ZX81 gives a full 64k, which is neither switched nor paged, and is directly addressable. The unit is user trensparent and accepts BASIC commands such as IO DIM A(9000). Plugs into the back of your ZX. $250.00.

4K GRAPHICS ROM

This module fits neatly inside the keyboard. The module comes ready built, fully tested and complete with a 4k graphic ROM. This gives you 448 extre pre-programmed graphics, your normal graphic set contains 64. This means that you now have 512 graphics and with inverse 1024. In the ROM are lower case letters, bombs, bullets, rockets, tanks, a complete set of invaders graphics and that only accounts for about 50 of them, there are still about 400 left. A spare holder on the board will accept e further 4k of ROM/RAM. IT NEEDS NO EXTRA POWER AND WORKS FROM YOUR NORMAL POWER SUPPLY. $124.95.

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ZX81 KEYBOARD AND JOYSTICK

A full keyboard with shiftlock and spacebar! A sturdy case which houses the ZX and memory pack. Also available: joystick controller, optional extre. $160.00. Joysticks $10 ea

ZX SOFTWARE

Money Chase	16k	Perilous Swamp	16k	OS Defender	16k
OS Scrambla	"	OS Asteroids	"	Invaders	"
ZX Galaxians	"	Space Trek	"	Pocket Book	"
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Double Breakout	1k	Super Invasion	1k	10 Exciting Programs	1k
ROM Disassembly	A-B	Understanding ROM		Machine Language made simple	
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earnest at the end of November. Brother plans to manufacture 30,000 units a month and will sell to OEM users.

Also announced by the same company is the M-2024. This is a 24-wire dot matrix printer aimed primarily at the Japanese word processor market. Chiyoda Data Machines will sell this product under their own brand label for use as a kanji (Chinese character) printer. The Chiyoda version has both Centronics type and RS232C interfaces and is said to be ideal as a graphics printer. Chiyoda plans to sell 12,000 of these a year starting from the end of November.

CP/M upgrade for Apple

FMS has released a Lifeboat supplied product for the Apple II to allow the upgrade to the many CP/M program utilities and languages they support. The Applicard is a single card with Z80, 64k of memory and softvideo support of all 96 ASCII characters, upper and lower case with keyboard shift, horizontal scrolling to 255 columns, a 70 x 24 screen mode supporting Wordstar. It runs simultaneously with the 6502 processor which is used for I/O and all of the standard Apple II peripherals are supported in addition to most popular add-on cards. A utility is provided to transfer files from Apple DOS to CP/M-80. It is priced at $495 excluding tax. Details from Fagan Microprocessor Systems on (03) 699 9899.

Chinese Basic

The hieroglyphics shown here are actually standard Basic code, displayed in Chinese, and the product which produces them has been launched by Multitech Industrial Corporation in the Chinese island of Taiwan.

Originally produced to help Taiwanese (who didn't speak English) to learn Basic programming, the product is now being sold to other non-English speaking peoples — or to English-speaking computer

Software for your VIC-20

LOCOMOTION
This game commands your undivided attention to control an ever increasing number of trains from colliding or running off the rails.

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A day at the race-track. Up to 9 players can place bets for win, place or each way on one of 8 horses — Your own T.A.B. A smash hit at parties, barbeques, etc.

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Dodge the robot sentinels who are out to get you — a fast moving game that tests your skill. This very addictive game has 6 levels of play.

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Record and play your own voice through the VIC's user port.

ACME SOFTWARE REQUIRES
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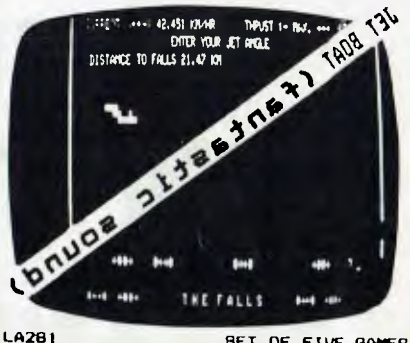

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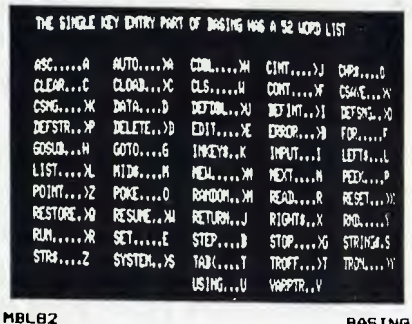

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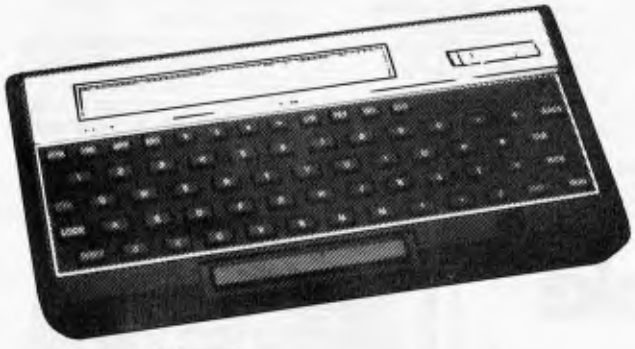

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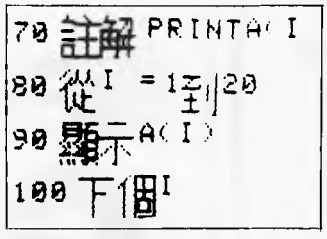
builders who wish to sell to them.

The secret of the machine is that one key produces the internal "token" which the computer interprets as the command. PRINT, another key produces the INPUT token, a third the LIST, and so on. The system doesn't even need a changed keyboard.

The extra sophistication is the display, which is set up to show the keywords in the operator's native language.

Multitech claims that the extra cost of a new Basic cartridge, providing a new



language in which to spell BASIC, is only $20 to $30.

Sorcerer controller

Digitrio, a Melbourne group, has developed a disk controller which they claim renders obsolete every other method of adding floppy disk drives to the Sorcerer microcomputer.

Robert Green, the designer explained, "The great advantage of our product is that it has unmatched versatility at a very reasonable price. Economy is achieved by having the controller connect directly to the Sorcerer rather than using the S100 buss. Our controller is unique in that it can handle both 5 inch and 8 inch drives in the same installation. The BIOS provides for very flexible operation. Virtually any soft sectored drive can be used. A full featured single drive capability is implemented which allows users with only one drive to run multidrive software. The selection of single and double density as well as single and double sided diskettes is transparent to the user. These features are achieved without any decrease of memory space. The Digitrio CP/M is less than 8k in length and by means of a RAM PAC it is possible to have CP/M sizes as large as 54k without changing the Sorcerer firmware."

The retail price for the board is $500 inclusive of CP/M 2.2, a cable to connect the board to the Sorcerer, The Osborne "CP/M Guide", documentation and in addition to the standard Digital Research utilities several Digitrio ones are supplied including utilities such as a compare and copy and facilities to read other 5¼ inch disk formats.

Further information is available from Digitrio, Dept A, Box 4553, Melbourne, Victoria 3001. Telephone (03) 578 4094 (24 hrs).

IBM Personal tops the charts

To find out who's buying what in the microcomputer marketplace, I contacted a sample of twenty personal computing dealers in the Western United States focusing on California's Silicon Valley.

Significant trends emerge as to who is purchasing the IBM PC and why. Small business owners and entrepreneurs seem to be the primary purchasers, buying a single computer and standard software such as accounts receivable, accounts payable and perhaps a spreadsheet program such as Visicalc or Supercalc. They have also shown an interest in data base programs such as DBIJ and a standard word processing program.

The next largest group of purchasers is programmers and software developers engaged in converting existing software programs and developing new programs. Home users make up the third largest category of purchasers. Surprisingly, it seems that home purchasers do not use their PC for entertainment or games but for educational or small business applications. Jeanette Maher, of IBM's Boca Raton headquarters in Florida says "statistics show that 50 per cent of our PC sales are to home-business users."

Bulk sales to industry and corporate managers, using asynchronous gear to tie in the PCs to mainframe computers, emerged as the fourth largest purchasing category. Other users include retired people, Boards of Education and secretarial services.

But why the PC rather than the myriad of other contenders? "People feel comfortable with IBM's follow-up support," says Jerry Holland of the Computerland Store in San Jose. "They want to know things like how to configure the equipment, what the software will do, and how to get hold of spare parts kits and how to use them. All this IBM provides." People feel comfortable with the IBM reputation for quality support and service for long-range expandability and follow up advice," says another store owner. Immediate delivery is another important factor and initial delivery problems have been overcome. The machine is fast and has more power than most mainframes had ten years ago. With further enhancements coming, the machine is seen as

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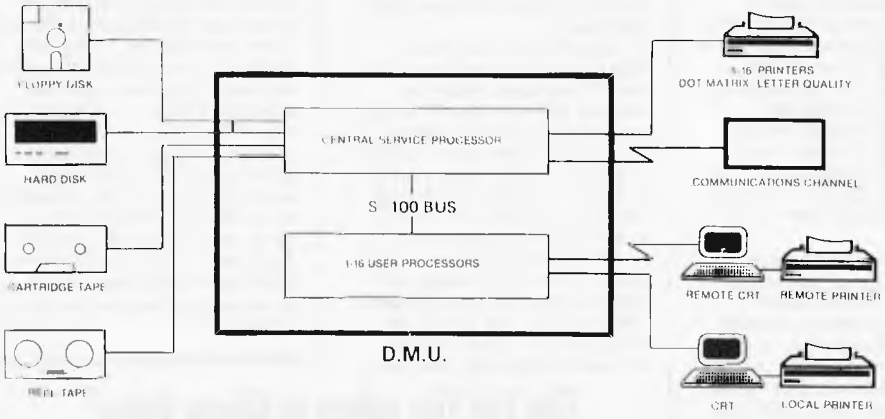

What is a D.M.U. . . . .

The growth in acceptance of CP/M based microcomputers and microcomputer software has created a demand for economical hardware solutions in environments where there are multiple users. Initially, attempts were made to time slice a single 8-bit CPU. These attempts have proven unsatisfactory in serious data processing applications because as the number of simultaneous users grew from one to several, the response time for each became unacceptably slow. With the advent of the single board computer, the concept of a **Distributed Multiprocessing Unit** or D.M.U. emerged. Unlike many multi-user systems that assign only bank-switched memory to each user, **the characteristic architecture of a D.M.U. requires that in addition to the memory, a dedicated processor and local console support be supplied for each user on the system.**

Sysnet2000. . . . .

The Sysnet2000 is designed around the concepts of a Distributed Multi-processing Unit with two additional objectives . . .

* meets IEEE S-100 standard
* completely CP/M Version 2.2 compatible

We give each user in the Sysnet 2000 a dedicated Z-80A microprocessor, 64K or 128K memory bank and local terminal I/O. In addition to each users individual processor and memory, a fully interrupt driven Z-80A based Central Service Processor and up to 512K main memory are added to support the entire network and manage all of the common system resources such as disks, printers, communications, and batch processors. The advantage of this design is clearly demonstrated in comparative benchmark tests against single processor multi-user systems. In its present form each Sysnet2000 D.M.U. will support up to 16 users. To produce an even larger configuration, multiple systems can be interconnected via a high speed communications channel to produce a major network of high performance microcomputers with outstanding response and throughput.

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* Dual Processor System using Z80A and 8088
* Smartkey Utility
* Memory drive option
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being linked to the future.

IBM's highly touted repair policies are another plus to users. The IBM Service Centre in San Francisco maintains a 48 hour turnaround time on most repairs and will fly in replacement components. These replacements are handled in one of three ways: users residing within a 30 mile radius of a repair centre will be visited by an IBM technician who will replace the malfunctioning part; users can remove parts and take them themselves to a service centre; or components can be sent for replacement by post.

IBM is at something of a disadvantage when attempting to compete with Apple's extensive and well established dealer network. Apple presently has 2,000 dealers which is quite a solid network when measured against IBM's figure of 425 dealers in 345 US and Canadian cities. To counterbalance this serious weakness, IBM's dealer support and training is being developed to include: a 'freephone' service for dealers with problems or queries; a monthly dealer newsletter called Feedback; and IBM's unsurpassed dealer training schemes. All potential IBM dealers must attend two separate training sessions – a 'solutions-oriented' 3 day technical course in such subjects as hardware, systems diagnostics and the intricacies of IBM's service and warranty policies, and a second course on selling techniques.

The trend noted by dealers of significant purchases by affluent senior citizens is not surprising. They have both the leisure and the capital to explore this new field. "They want to learn computers." says Jerry Holland. Linda Adams, manager of the IBM Product Centre, says that a significant number of IBM PCs are purchased by 70 year olds living off their 'investments', who purchase PCs to keep track of these investments.

Bulk purchases by Boards of Education emerged as the fourth largest category of PC purchasers. Most microcomputer manufacturers are aware that young users will most likely transfer their adult allegiances to the product and the manufacturer they have grown up with. Due to the inadequacy of the educational software that is available, Jerry Holland reports he has sold only ten PCs this year to strictly educational users. But other stores have reported a number of bulk sales in this area.

Both IBM and Apple realise the importance of capturing the lucrative and virtually untapped educational market share. IBM is following Apple's lead in donating micros to elementary schools. During the '82–'83 school year, IBM will donate 300 machines that will be used by over 10,000 first graders across the USA. These 300 PCs will form the basis of an interactive 'Writing to Read' program designed to teach elementary level language and reading skills.

IBM's wholl-owned subsidiary, Stanford Research Associates in Menlo Park is soon to release three new educational software packages that take full advantage of the PCs colour and graphics capabilities. "The line between education and entertainment is becoming blurred," says a spokesperson, "and this is reflected in these new programs. They will be aimed at high school level."

IBM has a firm lead in capturing the office data processing market. A spokesman for Microsoft says that the IBM PC is the 'Cadillac' of microcomputers to data processing managers. "Anything in a box with the IBM name on it would sell to this group," he says. IBM has built up a continuum of service and support that has successfully wooed and won the loyalty of large corporate DP purchasers.

Apple and Tandy have a reputation for going 'around' the DP managers, some say, whereas IBM are known to use the DP managers. A typical corporate DP manager is afraid of losing control of personnel and data, and the fact that the hardware is IBM is felt to be something of a reassurance.

"The IBM PC looks to the future," says the manager of San Francisco's Computerland. "DP managers see the PC as being part of a larger office automation scenario that will eventually include satellite communications and local area networks." Computerland sells in bulk to large corporations such as Wells Fargo and the Bank of America. Each local Computerland store that carries the IBM product has a locally based account manager whose specific assignment is to interface with major accounts.

The commonly expressed frustration by all the dealers interviewed about the IBM PC is the lack of adequate software. "You must realise," says Jerry Holland, "that the PC is the first one out of the chute and the situation will improve with time." Most dealers reported only insignificant breakdowns in the computer's first year, with no clear patterns emerging. Holland says "the failure rate so far is virtually nil – maybe 5 per cent." The most common breakdowns he's seen include keyboard and monitor adaptor failures.

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3	Osborne	Portable	$1795	64K
3	Atari	400 & 800	$400 to $3000	16K-48K
6	Texas Inst.	99/4	$525	16K
7	Radio Shack	TRS-80 Color	$400 to $8000	4K-64K
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10	Zenith	Z-89	$2900	48K

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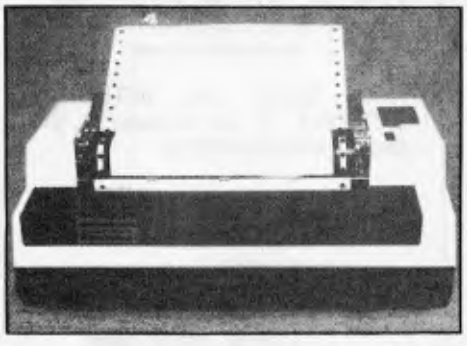

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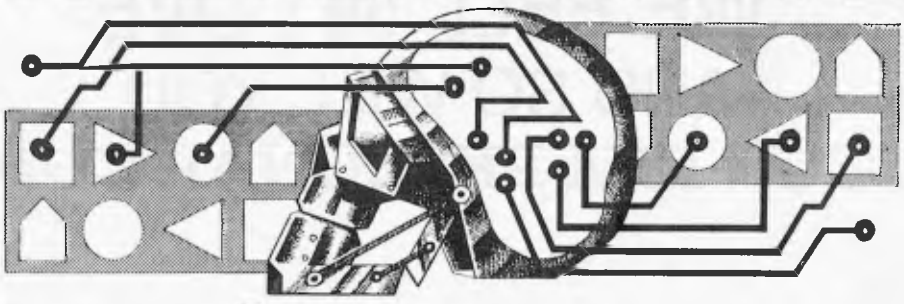
ALGY: THE ALGEBRA CHECKER



Or How To Use Artificial Intelligence To Cheat On Your Homework

Mike Liardet takes the class

This article will present a fairly simple Basic program that can verify the user's solution method for an elementary algebra problem. The program accepts algebraic statements as input, checks whether they make sense at all, and if they do it then checks to see if they logically follow from the previous statements. Without any apology, it can be unashamedly admitted that the program does not by any means have perfect performance. But just to make up for this we will show how it can be easily converted to a superior performance Boolean algebra checker. (Boolean algebra — the algebra of 'and's, 'or's, 'if-then's, etc — is simpler than the algebra of '+'s, '*'s, etc, but because the latter is more familiar to most readers we will start there.)

Like many programs in the realm of Artificial Intelligence, Algy can seem quite impressive for some examples, and quite unimpressive for others. Readers familiar with any of the Eliza programs (which simulate a psychoanalyst in a dialogue with the user) will know how easy it is for a moderately determined user to transform a previously sensible dialogue between two beings of apparently equal intellect into a conversation with one side appearing to be an imbecile. (And if they try very hard they can make the computer seem pretty stupid, too. . .)

Anyway, Algy provides a good simple start point for anyone interested in exploring the general area of automatic theorem proving. In particular, the article concludes with a list of suggestions for extensions and improvements so there is ample scope for keeping yourself up to all hours of the night!

Right! Let's assume you have your computer switched on and running Basic. Enter the following two lines of text:

```
X=1:A=2:B=3
PRINT X*(3*X+A+A)—B/B—2*A*X
```

Now, assuming your computer permits this sort of interaction, it should respond by printing the number 2. Now enter the line:

```
PRINT 3*X^2—1
```

Eureka! The computer should print the number 2 again, or at least it will do if '^' is your machine's symbol for exponentiation.

This little dialogue demonstrates the main principle behind the program. The fact is that the two algebraic expressions X*(3*X+A+A)—B/B—2*A*X and 3*X^2—1 are in fact equal for all values of X, A and B; and in particular when X, A and B have the values 1, 2 and 3. As it would take rather a long time to check equality for all possible values (there being an infinite number of them), the program Algy contents itself with checking just one set. If the user is not told what values Algy is using, and may even not know that this trick is being used at all, he is unlikely to try, say, X+B—A (which is also equal to 2, but not equal to the previous expressions) or 3*X^2—(X—1)/(X—1) (which is equal to the previous expressions but causes a zero divide error on evaluation).

Thus far we have only looked at a method to check algebraic simplification problems, and not the 'find the value of X' type of problem. Retaining the previous values of X, A and B, enter the following three lines:

```
PRINT (X—A)*(X—B)=0
PRINT X=A
PRINT X=B
```

So far, no apparent problem, as all three lines should present the same result (probably 0 — the usual way to represent 'false', but dependent on which version of Basic you use). Now enter:

```
PRINT X=123.456
```

Unfortunately this also produces the same result! In fact just about any expression at all is likely to do the same! The fact is that for completely arbitrary values of X, A and B it is highly unlikely that any expression involving equality will be anything but false (ie, 0). Having nearly all algebraic equalities evaluating to the same value is not going to lead to a particularly rigorous checker, so the basic methodology has to be changed. Algy actually sets all the values, bar X, to arbitrary values, as before, but then applies a numerical method to assign a value to X which makes the equality true. In fact it does this as each line is entered by the user (thus ensuring it evaluates to true) then re-evaluates the original start equation to see if that is also true for these values. Consider solving X^2—2*X+A*B*X=2*A*B. Retaining the old values for X, A and B, enter:

```
PRINT X^2—2*X+A*B*X=2*A*B
PRINT (X—3)*(X—B)=0
```

As expected, both expressions evaluate to the same value — false (and they are not equivalent). If, however, we reset X to 3 (which is one solution to the second expression) we find that re-entering the two lines results in false for the first and true for the second, thus showing that the second is not a valid step. On the other hand, a valid step such as (X—2)*(X+A*B)=0 would result in true for the original expression as well, providing X is first set to either of the solutions 2 or —6 (=—A*B for the preassigned values of A and B).

This just about completes Algy's domain of expertise — the ability to deal with the algebraic functions +, —, *, / and ^; all used in expressions involving numbers, constants A, B, C and D and the variable X. It can actually deal with square roots too (if entered in the form 'S(. . .)'). With its ability to solve equations it can handle equalities, and as a final refinement it can also be made to permit the use of 'or's. A frequent step in equation solving is as follows:

```
(X—3)*(X—B)=0      (1)
X=3 OR X=B         (2)
```

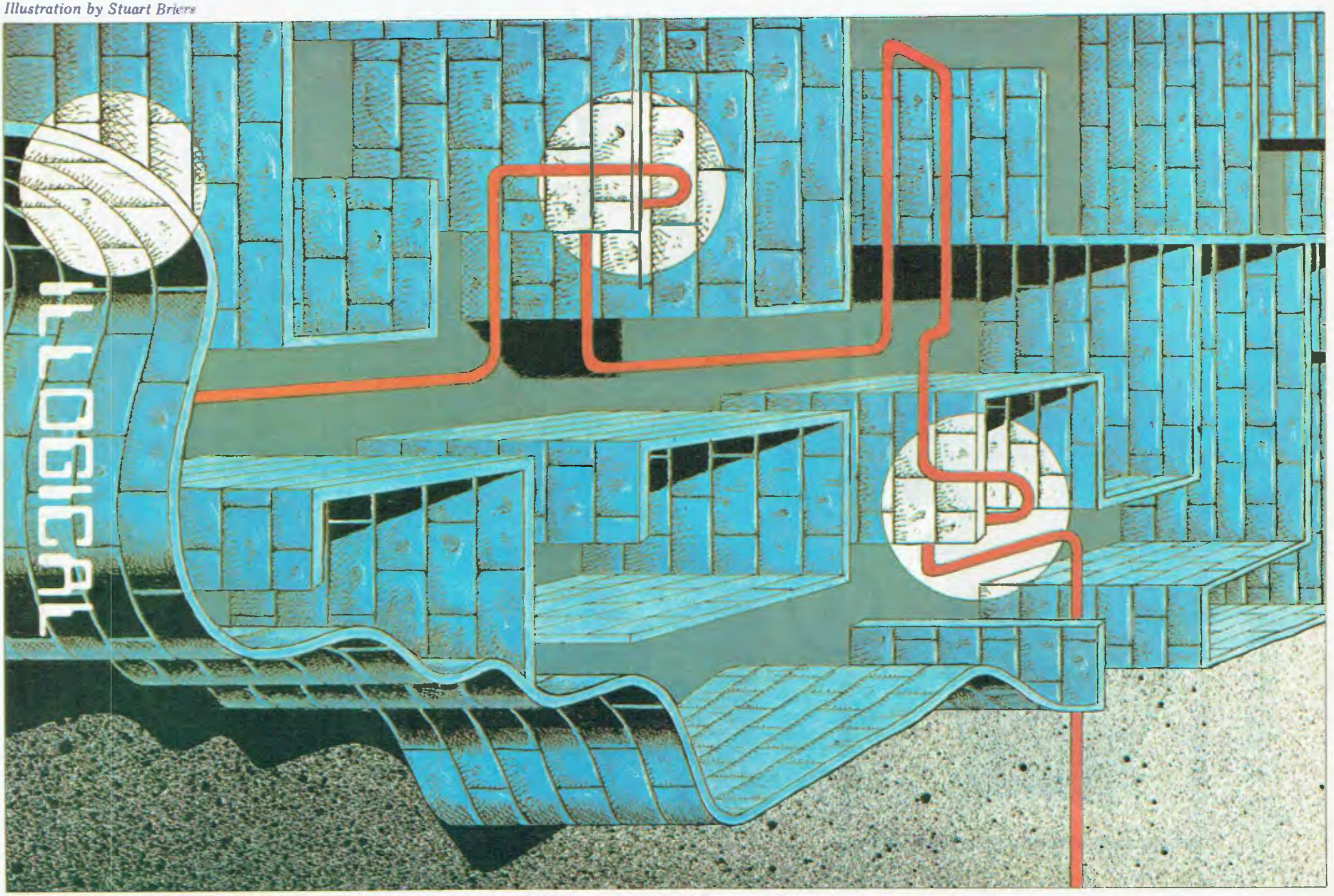
Before doing any analysis at all Algy does some preliminary rewriting of 'OR's and '='s, for example:

X=3 OR X=B is rewritten as ((X—3)*(X—B))

Except for the fact that extra brackets need to be introduced (because X—3*X—B would mean something quite different), this amounts to a straightforward substitution of '—' for '=' and '*' for 'OR'. As Algy always goes on to solve the resulting expression, the rewritten expression can be considered to have an implicit '=0' at the end and Algy is only applying the step (1) to (2) above in reverse. This means that even if the user is tackling a 'simplify' problem and not a 'solve' one it still treats it as a 'solve' problem and (unnecessarily) finds a value of X which evaluates the expression to zero.

Actually finding a solution to an arbitrary algebraic expression is not completely straightforward. Most methods either require the expression to be symbolically differentiated (worth an article in itself — see my efforts in June'82 *APC* on Lisp) or else require the expression to be first rewritten

Illustration by Stuart Briers



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ALGY: THE ALGEBRA CHECKER

in a special polynomial form. Here we present a less drastic method, which is doubtless a numerical analyst's nightmare, with horrendous convergance and rounding problems, etc:

1. To find one value of x satisfying the equation f(x)=0 first set up two initial guess solutions x1=—1 and x2=1.
2. If x1 and x2 are sufficiently close in value (eg, closer than .0001) then return x1 as the solution.
3. Draw a straight line through the points (x1,f(x1)) and (x2,f(x2)).
4. If this line is not parallel to the x-axis then it must cross it somewhere. Let x1 take this point as a new value and x2 be the old value of x1. Go back to 2.
5. If the line is parallel to the x-axis then let x1 be the average of x1 and x2 and let x2 be the old value of x1. Go back to 2.

So that just about covers all the theory behind Algy, but there remains one outstanding practical problem before we can actually implement it. Consider the following short program:

```
10X=1:A=2:B=3
20INPUT"TYPE AN ALGEBRAIC EXPRESSION";X$
30PRINT VAL(X$)
```

Suppose the user enters 'X+A+B'. In most dialects of Basic the VAL function will operate correctly only if its string argument is the text for some number. If it contains variable names or expressions it will usually fail to do what we actually want in this case, but will just return zero or cause an error message. In Algy this problem is overcome by pre-allocating a line of Basic which starts as an assignment, and then reserves enough space for whatever expression is typed by the user to be POKEd in and terminated by a ':REM'. Whenever that line is executed the assignment is made using the most recent expression POKEd in there. (We also have to use ON-ERROR trapping in case the user has entered something syntactically incorrect.) If you have ever heard of programs that work by self-modifying their code you will doubtless be delighted to realise that this is one of them. Unfortunately the details of where and how to poke in the expression are very much dependent on the particular version of Basic in use. The listing accompanying this article will work for Applesoft on the Apple II. If you are trying to implement Algy on another system then you may find the following points useful:

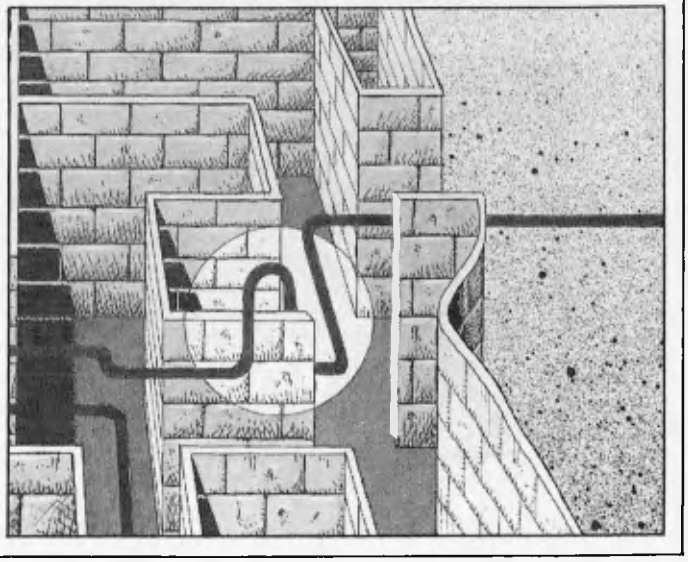
1. Most versions of Basic store the program in memory, not in the order in which lines are entered, but in order of line-number. Usually the first line of the program starts at some fixed position in memory, with the next line following immediately and so on.
2. Each character which is not a specific system function (ie, not a '+', '—', etc) is generally stored in the memory representation as just one byte, being the ASCII code for the character (most Basics have an ASC function to provide the ASCII code of a supplied character).
3. System functions may be encoded in just one byte, even if they appear in the listing as several characters. The code for a system function may bear no relation to its ASCII code and in many instances will exceed the maximum possible ASCII value of 127 decimal.
4. Each line of the program, as well as representing the text of the line as outlined above may be preceded by some extra bytes (eg, for the line number itself and the start address of the next line). There may also be some following bytes (eg, a zeroed byte to signal the end of the line). Frequently these extra bytes are not a literal text representation, but a binary encoding.
5. By setting up a line such as '10REM! ! ! ! !' it should be possible to find the memory address of the line by searching for five consecutive locations holding the same ASCII code (for '!'). Entering alternative line '10's and PEEKing at the same locations should provide some clues as to how your version of Basic stores a line of entered code.
6. If there is sufficient similarity between your version of Basic and Applesoft you may only need to alter the codes for the system functions (set up in DATA statements in Algy) and the values of LO and HI which define where in RAM to look for the lines that are subsequently POKEd into. LO and HI will have to be changed in the Applesoft version too if you change the program at all or do not type in the remarks, etc.

Once you have typed in the program, make sure you SAVE it before you attempt to RUN it, in case you have got the self-modifying bit wrong and it runs amok through your newly entered program. Test the program out by comparing it with the following dialogue:

```
RUN
ALGY - THE PROOF CHECKER FOR ALGEBRA
       EQUATION SOLVING..

INITIALIZING...

NOW TYPE EQUATION YOU ARE GOING TO
       WORK WITH...

>>2*B*X^2+A*D=A*B*X+2*D*X

NOW TYPE YOUR SOLUTION STEP BY STEP
       ('END' TO FINISH)..

1>>2*B*X^2-(2*D+A*B)*X+A*D=0

2>>(2*X-D)*(B*X-A)=0
WRONG! - TRY AGAIN...

2>>(B*X-D)(2*X-A)=0
I DO NOT UNDERSTAND!

2>>(B*X-D)*(2*X-A)=0

3>>X=D/B

4>>X=D/B OR X=A*.5

5>>END

NOW TYPE EQUAT..etc
```

Now you actually have the program working you can start thinking of ways to improve it. Try and find a selection of different examples that can 'fool' it. Consider the program fooled if it traps a correct step as incorrect or vice versa or if it 'I DO NOT UNDERSTAND's a syntactically correct expression. Just to set the ball rolling here are a few points to consider:

1. The program will not work with equations with imaginary or complex roots.
2. The program finds only one solution to an equation. If this is also a solution of the original equation then the equation is passed as correct. If the equation has more than one solution (typically the case) then the unchecked solutions could conceivably not be solutions to the original equation.
3. Using single pre-assigned values for A, B, C and D allows for 'coincidences' to happen — eg, 'If A=1 then X+1 and X+A would be (incorrectly) seen as equal by the program. For each step, considering several values each for A, B, C and D reduces the likelihood of this happening.
4. An unlucky choice of value of, say A=1, could cause the program to fail if SQR(—A) or 1/(1—A) is included in an equation.



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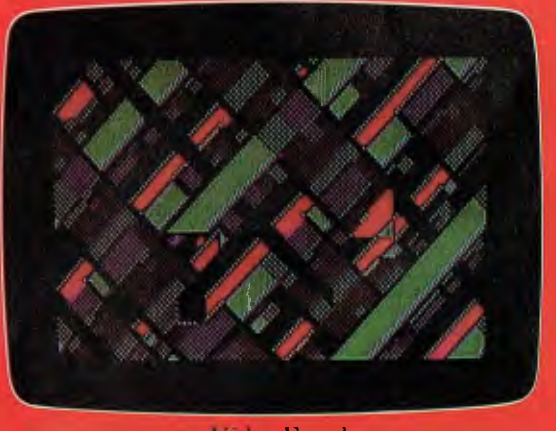

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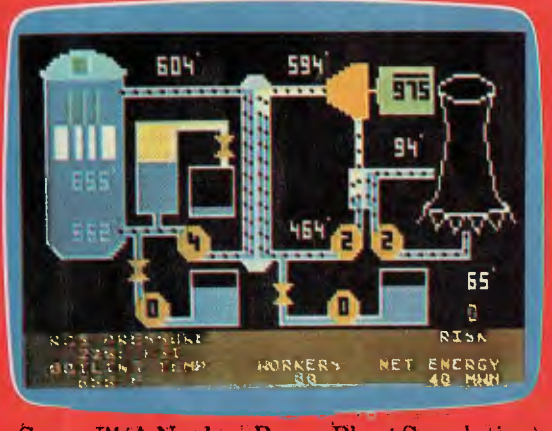

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ALGY: THE ALGEBRA CHECKER

5. The user is limited to using just X, A, B, C and D in the equations. By introducing a third self-modifying line (at 2080) the program could be made to set up whichever identifiers happened to be entered.
6. Most Basics have a range of powerful trigonometry functions. It should be possible to make use of them in an analogous way to the arithmetic functions.
7. Most Basics have a range of Boolean algebra functions as well. In fact, changing Algy to handle Boolean algebra instead is so easy that I cannot resist giving the solution — but first a crash-course in Boolean algebra for the uninitiated:

Boolean algebra was first formulated by George Boole in the last century in an attempt to provide a mathematical formulation for the intuitive human logic used by everyone. Instead of using symbols like '+', '*', etc, Boolean algebra has symbols like '&' ('and'), 'v' ('or'), '/' ('not'). These symbols operate, not on numbers which have an infinite range of possible values, but on propositions, which have just two: 0 ('false') and 1 ('true'). The pronunciations, given in brackets above, give some indication of how these functions work, and most readers will have some idea of what they mean from their usage in natural language and various programming languages. Because a variable in Boolean algebra can have only two values, it is not computationally prohibitive to consider all possible values for all variables in an expression. Thus it is possible to prove without any margin of error that two expressions are precisely equivalent — a considerable improvement on Algy's performance with the arithmetical algebra!

Without further ado, LOAD in Algy and make the following modifications:

```
2080 FOR A=0 TO 1:FOR B=0 TO 1:FOR C=0 TO 1:
   FOR D=0 TO 1
2090 GOSUB 9000
2105 NEXT D,C,B,A
2175 FOR A=0 TO 1:FOR B=0 TO 1:FOR C=0 TO 1:
   FOR D=0 TO 1
2180 GOSUB 9000
2200 MM=NN:GOSUB 8000:IF MM<>NN THEN PRINT
   "WRONG! — TRY AGAIN. . . ": GOTO 2140
2205 NEXT D, C, B, A
5000 RETURN
7070 DATA /,198,&,205,v,206,>,207,=,208,<,209
```

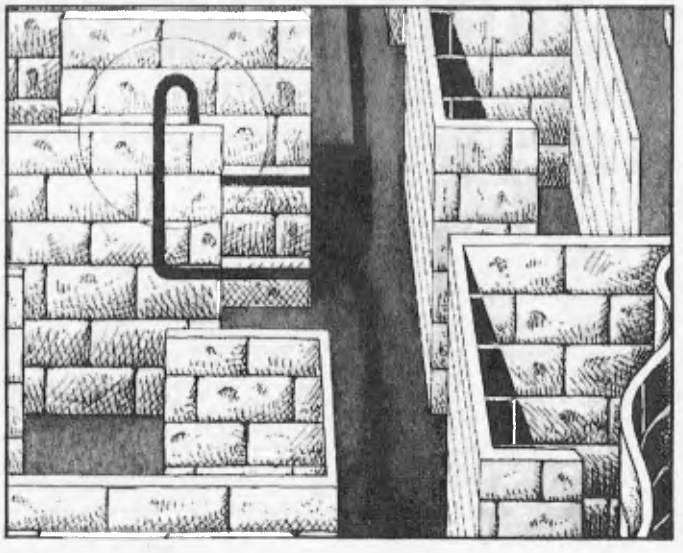
The last line is dependent on the version of Basic you use, as also is the range of the FOR-loops (0 for false, and 1 for true in Applesoft — some Basics use —1 so beware!). Now RUN the modified program (don't forget to SAVE it first — call it Booly if you like) and see if it agrees with the rest of the universe on DeMorgan's laws, namely that /(A & B) and (/A v /B) are the same, as are /(A v B) and (/A & /B). Notice that it will also accept Boolean algebra. There should not be any problems as long as you remember that 0 and 1 mean false and true and should not be used as numbers: eg, A<0 is meaningless — only A<B, etc, ought to be used. Now use the program to check that /(A<B v B<A v B = A) is always false (ie, 0).

Finally, readers already familiar with Boolean algebra will have noticed that two well-known Boolean functions have been omitted: '—>' ('if-then' or 'implication') and '<—>' ('equivalence'). The program can be made to handle these by redefining the subroutine at line 5000. This routine should be used to perform an immediate conversion of the user input to rewrite the symbols '—>' and '<—>' into expressions using just '/', 'V' and '&'. The basic principles to use are:
xxxx —> yyyy is converted to /xxxx v yyyy
xxxx <—> yyyy is converted to
(/xxxx v yyyy)&(xxxx v /yyyy)

Actually, although the conversion rules are easy enough to write down, they are not particularly easy to implement in Basic, requiring a recursive analysis of the expression (eg, consider converting (A—>B)—>(C—>D)). You have been warned!

Anyway, I hope the reader has found enough material in this article to stimulate some experimentation in the general area of automatic theorem proving. I personally believe that there are great possibilities in mathematics education for automatic theorem provers and personal computers and I certainly wish these sort of facilities had been around when I was learning algebra!

```
1999  REM ALGY - MICHAEL LIARDET (APPLE VERSION)
2000  PRINT "ALGY - THE PROOF CHECKER FOR ALGEBRA EQUATION SOLVING & SIMPLIFICATION"
2010  PRINT : PRINT "INITIALIZING...": GOSUB 7000
2020  PRINT : PRINT "NOW TYPE EQUATION YOU ARE GOING TO WORK WITH..."
2030  PRINT : INPUT ">>";X$
2040  GOSUB 5000: REM CONVERTS "=" & "OR" TO "-" & "$"
2050  IF  LEN (X$) > LN THEN  PRINT "LINE TOO LONG!": GOTO 2020
2060 S = S1: GOSUB 6000: REM MODIFIES LINE 8010
2070 S = S2: GOSUB 6000: REM MODIFIES LINE 9010
2080 A = 1.5:B = 2.5:C = 3.5:D = 4.5: REM ANY VALUES (NON-ZERO) USUALLY OK!
2090  GOSUB 3000: REM RETURNS X = A ROOT OF EXPRESSION @ 9010 (IF ER<>0)
2100  IF ER <  > 0 THEN  PRINT "I DO NOT UNDERSTAND!": GOTO 2020
2120  PRINT : PRINT "NOW TYPE YOUR SOLUTION STEP BY STEP ('END' TO FINISH)..."
2130 ST = 1
2140  PRINT : PRINT ST;">>";: INPUT "";X$: IF X$ = "END" THEN 2020
2150  GOSUB 5000: REM CONVERTS "=" & "OR" TO "-" & "$"
2160  IF  LEN (X$) > LN THEN  PRINT "LINE TOO LONG!": GOTO 2140
2170 S = S2: GOSUB 6000: REM MODIFIES LINE 9010
2180  GOSUB 3000: REM RETURNS X = A ROOT OF EXPRESSION @ 9010 (IF ER<>0)
2190  IF ER <  > 0 THEN  PRINT "I DO NOT UNDERSTAND!": GOTO 2140
2200  GOSUB 8000: IF  ABS (NN) > 2 * EPS THEN  PRINT : PRINT "WRONG! - TRY AGAIN..":
      GOTO 2140
2210 ST = ST + 1: GOTO 2140
2995  REM *
2996  REM *
2997  REM *
2998  REM FINDS SOLN X TO EQUATION AT LINE 9010 IF ER=0
2999  REM IF ER=1 THEN NO CONVERGENCE, IF ER=2 THEN SYNTAX OR OTHER ERROR
3000 N = NT:U1 =  - 1:U2 = 1
3010  IF  ABS (U1 - U2) < EPS THEN ER = 0:X = U1: RETURN
3020  IF N = 0 THEN ER = 1: RETURN
3030 X = U1: GOSUB 9000: IF ER <  > 0 THEN  RETURN
3040 N1 = NN:X = U2: GOSUB 9000: IF ER <  > 0 THEN  RETURN
3050 N2 = NN: IF N1 = N2 THEN TT = U1:U1 = (U1 + U2) / 2:U2 = TT:N = N - 1: GOTO 3010
3060 TT = U1:U1 = (U1 * N2 - U2 * N1) / (N2 - N1):U2 = TT:N = N - 1: GOTO 3010
3996  REM *
3997  REM *
3998  REM *
3999  REM FIND RAM ADDRESS (SET X) OF LN CONSECUTIVE X$ S
4000 CT = 0
4010  FOR X = LO TO HI
4020  IF  PEEK (X) <  >  ASC (X$) THEN CT = 0: GOTO 4040
4030 CT = CT + 1: IF CT = LN THEN X = X - LN + 1: RETURN
4040  NEXT X
4050  PRINT "CAN'T FIND ";LN;" ";X$;"S - SORRY!": STOP
4994  REM *
4995  REM *
4996  REM *
4997  REM REWRITES X$ WITH "=" & "OR" REPLACED BY "-" & "$"
4998  REM ADDS BRACKETS TO CORRECT FOR CHANGE IN PRECEDENCE
4999  REM EG X-B=C$D OR X$A=9 => ((X-B)-(C$D))$((X$A)-9)
5000 NX$ = "(":XX = 1
5010  IF  LEN (X$) < 2 THEN 5060
5020  FOR X = 1 TO  LEN (X$) - 1
5030  IF  MID$ (X$,X,2) <  > "OR" THEN 5050
5040 Y$ =  MID$ (X$,XX,X - XX): GOSUB 5100:NX$ = NX$ + Y$ + ")$(":XX = X + 2
5050  NEXT X
5060 Y$ =  MID$ (X$,XX, LEN (X$) + 1 - XX): GOSUB 5100:X$ = NX$ + Y$ + ")": RETURN
5099  REM SUBR FOR 5000 - DEALS WITH FIRST "=" FOUND IN Y$
5100  IF  LEN (Y$) = 0 THEN  RETURN
5110  FOR Y = 1 TO  LEN (Y$)
5120  IF  MID$ (Y$,Y,1) = "=" THEN Y$ = "(" +  MID$ (Y$,1,Y - 1) + ")-(" +  MID$
      (Y$,Y + 1, LEN (Y$) - Y) + ")": RETURN
5130  NEXT Y
5140  RETURN
5995  REM
5996  REM
```



```
5997  REM
5998  REM POKES IN EXPRESSION IN X$ AT ADDRESS S - TERMINATED BY ":REM"
5999  REM SOME SYNTAX CHECKING TOO..
6000  IF X$ = "" THEN 6080
6010  FOR I = 1 TO  LEN (X$)
6020 C$ =  MID$ (X$,I,1)
6030  FOR J = 1 TO NS
6040  IF C$ = SY$(J) THEN  POKE S + I - 1,VL(J): GOTO 6070
6050  NEXT J
6060  POKE S + I - 1, ASC (C$)
6070  NEXT I
6080  POKE S +  LEN (X$),COLN
6090  POKE S +  LEN (X$) + 1,RMARK
6100  RETURN
6996  REM ¢
6997  REM ¢
6998  REM ¢
6999  REM INITIALIZATION
7000 LO = 5300:HI = 48 ¢ 1024 - 1: REM  SEARCH AREA FOR "!"S AND "£"S (ON APPLE IE)
7010 LN = 70: REM NO EXPRESSION > 70 CHARS
7020 EPS = 0.0001:NT = 20: REM NUMERICAL TOLERANCE & NUM TRIES TO FIND ROOT
7030 X$ = "!": GOSUB 4000:S1 = X: REM START ADDRESS OF 70 "!"S
7040 X$ = "£": GOSUB 4000:S2 = X: REM START ADDRESS OF 70 "¢"S
7050  REM NOW FOR INTERNAL (POKE) VALUES OF SYMBOLS TO BE ENTERED BY USER
7060  REM NON-APPLESOFT WILL USE DIFFERENT VALUES...
7070  DATA +,200,-,201,¢,202,/,203,^,204,S,218: REM S USED FOR SQR!
7080 RMARK = 178
7090 COLN = 58: REM COLON & REMARK CODES TO TERMINATE POKED EXPRESSION
7100 NS = 6: REM NUMBER OF SYMBOLS
7110  DIM SY$(NS),VL(NS)
7120  FOR I = 1 TO NS: READ SY$(I),VL(I): NEXT I
7130  REM POKE IN ASSEMBLER ROUTINE THAT CORRECTS ERROR-TRAP BUG IN APPLESOFT...
7140  POKE 768,104: POKE 769,168: POKE 770,104: POKE 771,166: POKE 772,223
7150  POKE 773,154: POKE 774,72: POKE 775,152: POKE 776,72: POKE 777,96
7160  RETURN
7995  REM ¢
7996  REM ¢
7997  REM ¢
7998  REM SETS UP NN, BEING VALUE OF ORIGINAL EXPRESSION ENTERED BY USER
7999  REM VALUES A, B, C, D & X MUST BE SET BEFORE CALL. RETURNS ER<>0 FOR ERROR
8000  ONERR  GOTO 8030
8010 NN = !!!!
```

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MORE ON THE DOS BATTLE

Peter Rodwell looks at the latest developments in the MS-DOS v CP/M-86 fight

Since my epic comparison last month of the two currently most important 16-bit operating systems, MS-DOS and CP/M-86, two things have happened: Microsoft have begun talking about future developments with MS-DOS; and I found a bug in CP/M-86 three days after last month's issue went to the printers.

Out of pure conceit, and because I am only the 1500th person to discover it, I have named the bug the Rodwell Bug. I discovered it accidentally when, in trying to get a directory listing, I typed 'DIRT' instead of 'DIR' — a Freudian slip if ever there was one. Surprisingly, I got a directory listing — but 'DIRTY' or any other suffix to 'DIR' with more than one letter is rejected, unless it happens to be the name of a program on the disk. I tried renaming the Basic interpreter 'DIRT' and running it by typing 'DIRT'; all I got was — yes, a directory.

MS-DOS does not contain this bug — nor any others, if the Microsoft people are to be believed. The purpose of Microsoft's talk was to present details of MS-DOS version 2 and to tell us about Xenix, Microsoft's envisaged upgrade path from MS-DOS for when you want to start getting into complicated computing.

MS-DOS 2 looks interesting. MS-DOS seems to be a Unix-type core (hence the single-byte file granularity — the file structures are Unix-style) with a shell which, in version 1, makes it look rather like CP/M, as I described last month. Unless I've totally misunderstood what was said, it is chiefly the shell which has been changed for version 2, to give, for starters, a menu-oriented system. By this I mean that, instead of typing 'DIR' to get a directory, selecting a program and then typing its name to run it, under version 2 you will be presented with a menu of commands and select your program from this. Quite how this works I've yet to see, but it sounds like a step in the right direction. Additionally, MS-DOS 2 will have a tree-structured system, *a la* Unix and Apple SOS, but until I see how it works I have reservations as to its suitability for computer-naive end users.

What does sound good is the provision for 'context-sensitive help facilities'. This simply means that should any system error arise, a suitable error message will be generated — either by the application program trapping the error condition or, in the absence of this, by a default mechanism in the operating system itself — which varies according to what's happening at the time; none of this universal 'BDOS error on. . .' rubbish which has dogged end users for so long when using CP/M! Rather than copy Digital Research and produce a multi-tasking, single user version of MS-DOS, Microsoft has decided to limit its expansion in this direction to background printer spooling only. This may not in fact be as big a limitation to many users as it might at first appear, but it would have been nicer to see an MS-DOS version of Concurrent CP/M-86.

At a more technical level, MS-DOS 2 offers virtual disk facilities if you have the RAM to spare and a terminal interface to ANSI standard X3.64 1979, to simplify the standardisation of things like cursor addressing. A macro assembler with an 8080/Z80 to 8086 source code translation utility (rather like XLT-86) is promised.

Much was said at the seminar about Xenix, which Microsoft sees as the logical upgrade from MS-DOS. This is certainly Unix but with a different shell; and everything I have seen, heard and read about Unix convinces me that it's even less fit to put before the end user than CP/M. In common with Unix, Xenix has a shell around its core. Microsoft says that systems suppliers who don't like the standard Xenix shell will be able to write their own, to give it the appearance that suits them best. This is a rather naive approach: it's possible — and indeed reasonably easy — to customise the CP/M-80 BIOS to make the whole thing friendlier and easier to use but virtually nobody bothers to do it so I can't see the manufacturers bothering with the more complicated task of writing their own Xenix shells.

Xenix is a multi-user operating system — something which I have frequently maintained is but a folly to implement in the micro world, for these reasons: if several people want to compute, they must each be provided with a keyboard and a screen; both expensive items which, obviously, cannot be shared. They must all have a certain amount of memory in which to keep their programs and data and, as memory prices are dropping faster than DC10s, you can easily afford to give each user a useful amount of memory, too. In a microcomputer system, the cheapest component of all is the CPU so you might just as well spend about $15 or so to give each user his own CPU. Hard disks and daisywheel printers, on the other hand, are expensive and are worth sharing between users, so the obvious solution is to connect several microcomputers together with a local area network, into which are tied the shared disk and printing resources. Multi-user microcomputers simply make no sense whatsoever, either economically or technically, and I find it astonishing that Microsoft sees this as the way ahead — I guess there must be some minicomputer freaks in the background somewhere, as Xenix was unashamedly described at the seminar as a minicomputer operating system.

Thus we have a rather odd situation developing: Microsoft has by far the nicer single-user operating system in MS-DOS, yet Digital Research seems more in tune with the way the micro market is moving as it offers CP/NET, a networking version of CP/M as its upgrade.

Translating

On a slightly different tack, I've been carrying out some tests on XLT-86, the Digital Research package which translates 8080 source code into 8086 source code. Regrettably, lack of time has prevented my exploring this in detail and I'd be interested to hear from anyone who has been using it for a serious application.

Certainly translation offers a quick way to get your CP/M-80 software over to CP/M-86 but there are problems and penalties to pay for the convenience. Firstly, XLT-86 does not produce source code which can immediately be passed to an assembler — various tweaks have to be performed first and you really need to be familiar with the 8086 instruction set and with CP/M-86. Secondly, translated programs are less efficient than their 8-bit originals: Microsoft estimates a 30-50 percent size increase and a speed decrease of up to 300 percent. This is mainly because the translated program is not utilising the full power of the 16-bit processor but is forcing it to act like an 8-bit machine, and the code required to do this is inherently longer — and therefore slower — than true 16-bit code. It appears that many software houses are running their 8-bit software through translators and then hand-tweaking them, maybe even re-writing time-critical parts in assembler — to overcome the shortcomings of translation.

Further, many seem to regard this as a preliminary measure while the software is rewritten in C; suddenly everybody's talking about C so I have dutifully acquired a couple of books — and very interesting it is, too. Unfortunately, C compilers cost from $600 upwards, and I need three (CP/M-80, CP/M-86 and MS-DOS) to do a reasonable job of checking it out, so it doesn't look as though I'll get very far. I'm also told that C will only be popular for a couple of years and that the upcoming language is Ada — just as soon as somebody can fit it onto a micro, that is. Maybe by the time Ada appears I'll have saved up enough to buy it! END

HEWLETT PACKARD HP-75C

BENCHTEST PERSONAL COMPUTER

A new generation of portable computers is about to hit the market. Dick Pountain reviews the first to arrive in Australia, HP's 75C.

1982 has certainly been the year that the hand-held computer took off. The Sharp PC1500 extended the boundaries of what can be done with a hand-held package. Now, before the year is even over Hewlett Packard (soon to be followed by Epson) wades in with the next generation of machines.

Hewlett Packard, at the launch of the HP-75C, expressed the opinion that the demand for portable machines would grow by 130% (compared to 44% overall) within five years, and that they wanted to take a hefty slice of this business. Other major manufacturers such as Apple have declared their faith in this line of development too.

The fact is that the technology is now almost ripe to permit the manufacture of hand-held computers which have all the capabilities of the current generation of desk-top machines. It is possible now (though perhaps not commercially viable) to produce a 64k, twin-disk CP/M computer small enough to slip into a briefcase.

The current offerings are, however, not quite up to that sort of power or flexibility of application and so it is still of crucial importance to the manufacturer to identify a more limited area of application and design for his machine to be good at. The first hand-held machines were still calculator-based; their area of expertise was mathematical and statistical calculation. Other areas which can be identified are data collection (eg, for stock control), communications (portable access to a central database) and portable word-processing. The latter application is still hampered by the lack of large enough portable displays and fast mass storage devices; Teleram is starting to make waves in the US with a bubble memory based machine but it is too expensive for any but top professionals to afford.

Hewlett Packard has identified another area with the HP–75C, that of the portable 'executive assistant'; this fits in admirably with the upmarket HP image and allows it to be priced higher than a mass market device could be.

The HP-75C has powerful general-purpose computing functions combined with special firmware, allowing it to be used as a sophisticated appointments calendar, diary, telephone book and alarm clock without any programming.

Hardware

The 75C comes in a dark brown ABS case measuring some 10 in x 5 in x 1¼ in which is the size of a largeish paperback. You'd need a huge pocket to hold it but it slips easily into a small briefcase. It is supplied with a 'field case' which is a strong plush-lined leathercloth-covered carrying case of the type used for binoculars or electrical instruments.

The LCD display is set in a gold-coloured brushed alloy fascia; the key surround and the case back also have metal facings. The external appearance exudes quality and style and it won't look at all out of place in the back window of your Porsche.

Travelling around the case we find, at the front edge, three sockets to hold expansion ROMs and at the lower right corner an inconspicuous slot for the magnetic card reader. Underneath is a sliding lid compartment for the rechargeable Ni/Cad battery pack; this gives a minimum of 20 hours' full drain operation or several weeks of normal use. A battery low warning is issued when recharging is due and various modes of operation are disabled in turn, the highest priority being the preservation of memory contents. On the back edge of the case is a socket to attach the AC adaptor/charger which is supplied with the machine; this allows mains operation and simultaneously charges the batteries. Next to this socket are male and female sockets for the HP-IL interface loop; two HP-IL leads are also supplied.

As you would expect, the 75C runs on CMOS technology — and, as you would also expect, no details are avail-

able about the workings. The case halves are held together by those infernal barbed clips which cannot be opened without disfiguring the case, so I couldn't even look inside. Suffice it to say that one or more 8-bit processors, probably of HP's own design, are used and it comes with 16k of non-volatile RAM expandable to 24k via one of the module slots. A glance at the Benchmark timings will show that the processor is something new; they are as fast as most full size micro timings (almost the same as the Tandy Color) — which is to say ten times faster than the Sharp 1500 and other predecessors.

The keys are of the calculator type but rather larger than most; they are widely spaced so as to be very close to standard typewriter pitch. They have very short travel and a positive click when depressed. Although they feel quite unlike typewriter keys it is possible to do two-handed and even touch-typing on them after a little practice; the wide, conventionally sited space bar helps here. Upper and lower case are available along with a shift lock. The main obstacles to fast typing are the relatively small SHIFT and Return (RTN) keys; in particular the shift key must be held down as on a conventional keyboard, but somehow because it has 'clicked' one tends to release it too soon. All keys have auto-repeat.

Keys are provided for four-way cursor movement, clear display, tab and backspace as well as a toggling insert/replace so that full display editing can be done. If insert is on, the square cursor turns into a left arrow to signal the fact, elegant touch. The whole keyboard is redefinable (see below) and in particular the block of keys starting 7UJW can be used as a numeric keypad by pressing CTRL LOCK, as an alternative to the normal qwerty numbers. A keyboard overlay helps in using this mode; blank overlays are also supplied for user defined keyboards.

The three main modes of operation are selected by TIME,APPT and EDIT keys; I'll discuss these more under 'Firmware' below.

To switch the 75C on you press the ATTN (Attention) key. Auto power-off operates after five minutes unless a program is running or the STANDBY ON condition is set which allows use as a desk clock. A nice feature is that the command LOCK 'Dick' will protect the machine from unauthorised use; when switched on it requests the password and insolently switches off again if 'Dick' is not supplied. The ATTN key is made to work very hard as it is also the break key and is used as an action key instead of CR by many functions. To switch off you use SHIFT ATTN which is a rather cute bit of anthropomorphism.

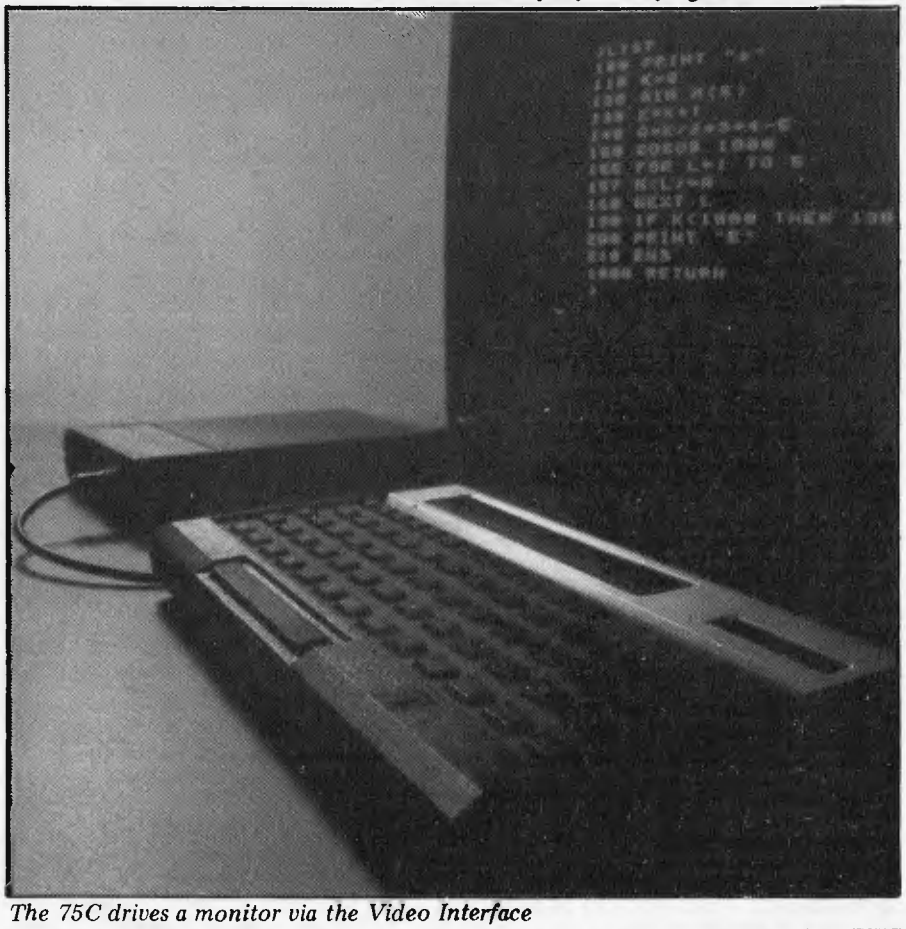
The 32 character LCD display is based on a 7x5 dot-matrix and contains annunciators for ERROR, BATT low, APPT and PRGM running conditions. It is a window onto a 96 character line and can be scrolled sideways with the ← and → keys. The line width can also be set, for display or printer, by the WIDTH and PWIDTH commands. A range of Greek and accented characters can be typed using the control key; even the various control keys have a printable character which can be displayed by SHIFT I/R, in which case their normal function is not performed. Display information can also be sent to a video monitor/domestic TV, printer or plotter on the HP-IL loop by declaring these devices as DISPLAY IS. This gives a 31 line display of 32 char/line; 16 can be on screen at a time and the rest are viewed by rolling the display up or down.

Mass storage is built in in the shape of a manually operated card reader; the 10 in long cards are pulled through by hand. A mark on the card shows where to align it and clever firmware prompts you through the whole operation even telling you whether you are pulling too fast or too slow; a rule of thumb is that it should take as long as it does to say 'Hewlett Packard'! The cards have two tracks and hold 650 bytes per track. I found saving and loading with cards to be totally reliable and in fact rather more confidence-inspiring than motor-driven card readers like those of the HP41C and T159 which are somewhat temperamental in my experience.

The Beeper is not tremendously loud but is programmable for pitch and duration; it is used by the system for alarm and appointment functions. The quartz system clock is adjustable by the user to maintain real-time accuracy; no less than 1001 independent timers are

10in cards are fed by hand

Military-style carrying case



The 75C drives a monitor via the Video Interface

PORTABLE POWER—AT A PRICE!

available to programs for real-time processing via the ON TIMER #n . . . statement.

Firmware

The 75C has three main modes of operation APPT, TIME, and EDIT. Each has a key to select it; normally on switching on it defaults to EDIT mode but after a memory reset or battery removal it comes up in TIME mode to prompt you to set the system clock.

EDIT mode (shown by a > prompt) is the command mode in which calculations are done, Basic programs entered, loaded or run and all system functions performed. There is no separate calculator mode; direct calculations are done by merely entering an expression and hitting return without an '=' or PRINT being required. There is a variant of EDIT mode which is entered by typing EDIT TEXT. In this mode (prompt changes to :) all input is regarded as ASCII text and stored in a text file so that the machine becomes a notebook or simple word processor. Lines of text still require line numbers, though these can be generated automatically by AUTO; they enable individual lines to be found and inspected by the FETch key. The whole file may be reviewed manually with the up and down keys or automatically (without line numbers) by typing PLIST; the rate of scrolling is controlled by DELAY. String searching is possible, of which more later. All input to the 75C is via a 95 character buffer whose contents can be recalled at any time by pressing CTRL FET (the Fetch key) to see your last entry.

TIME mode invokes the system clock and calendar and displays the time and date (you can choose US or Australian format for the date). To set the clock/calendar you type SET when the time display is on and a 'template' is shown which reads

Mo/Dy/Yr Hr:Mn:Sc AM

The cursor is then moved to each field in turn and the correct word or figure is typed in; you can use the cursor keys or back space or, better, TAB which automatically skips from field to field. Once the clock is set you can in future omit any template field which is not to change and the computer will fill in the details itself. The reason I've described this process in so much detail is that extensive use is made of these templates by the 75's designers; there are six in TIME and APPT alone as well as ones for defining keys and assigning devices. They are the one-dimensional equivalent of a menu and they work very well and save a lot of references to the manual.

The clock speed may be adjusted to allow for variations caused by different climates or age. It is typically accurate to 1.5 minutes per month but can be held to 15 seconds per month if you use the recalibration facility.

APPT mode is used to store future appointments. Up to 600 can be held at once and they can be stored on card or tape to free memory for other uses. Appointments are set by filling in a template like that for time. When one comes due the 75C switches itself on, gives one of nine different audible alarm sounds (which vary from mild to maddening) and displays the reminder message you've entered. If the 75C is already on and running a program the APPT annunciator comes on and the alarm sounds but the program will not be interrupted. You can inspect the message later when you've finished what you were doing. The file which contains appointments, called APPT, can be listed, edited and stored like any other file so that appointments can be altered or cancelled. A variety of options can be had when scheduling appointments; it's possible for one to be automatically rescheduled at any interval — eg, every day, every hour, every year from a single entry. Or you can demand that a particular appointment be acknowledged before it will stop pestering. All of this is obtainable without any knowledge of programming at all, though in fact the action scheduled could be to run a Basic program rather than to issue a reminder message.

Two calendars are included; the normal one being a one year one (with days of the week). An extended 10,000 year calendar can be selected (I should live so long) which can be used to answer questions such as what day of the week did Captain Cook land or what day is Christmas in 2082. There is something fairly surreal about a manual which has sentences like 'To schedule an appointment outside of the current century . . .'

The appointment facility is impressively powerful and well thought out and I suspect that many machines will be sold on this feature alone; if one has an adventurous sex-life it could even be life-saving.

The whole of the keyboard can be redefined — a total of 194 keys — and the messages assigned can be merely typed on the display or immediately executed (ie, they include a carriage return). The DEF KEY command is used to do this and the definitions are stored in a file called KEYS. Unfortunately there is no USER mode as on the HP41C which switches between the standard and redefined key set; instead you're stuck with any redefinition you make until you explicitly undo it. It is possible to temporarily access the original definition of a key by pressing SHIFT I/R before it but this is rather fiddly; a USER mode would have been easier to use. Sets of key definitions can be loaded from card or tape for special applications; if you want to restore the original keyboard all that's needed is to PURGE the KEYS file.

Typical uses for this facility are to provide typing aids — ie, assign frequently used words to a single key, or to set up special actions. For instance, if you define SHIFT ATTN to display the time and date then the 75 will revert to being a clock whenever it switches off. In this case you could only turn it off by typing the BYE command. You can also incorporate cursor positioning commands into a key definition and thus set up your own templates for formatted input.

While on the subject of typing aids, all the system commands and Basic keywords may be abbreviated; the shortest abbreviation accepted is often a single letter, eg, f. for FETCH and d. for DELETE.

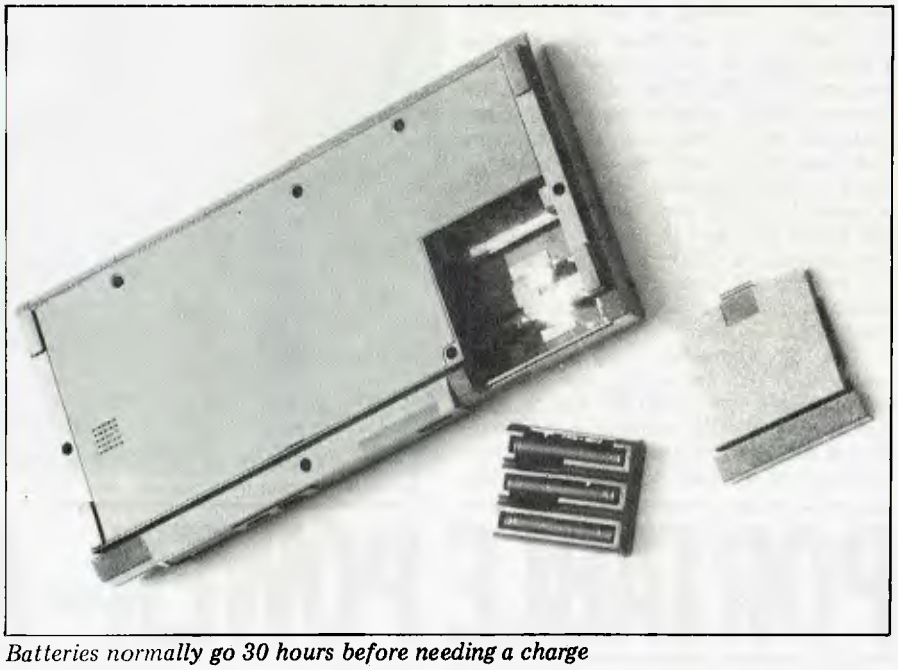
Software

Although the operating system and Basic are in ROM I have chosen to discuss them separately as 'software'.

The operating system is quite unique and in particular bears little resemblance to any previous HP software. It shows evidence of much development effort as well as an intelligent study of other operating systems, especially UCSD.

The basic problem for computers using CMOS memory, once they have sufficient memory for it to be a problem, is that the user will wish to keep data and/or programs in RAM rather than mass storage when possible. This means the memory must be organised in some way to allow simultaneous storage of more than one data object. Casio proposed one solution on its calculators and the fx9000 — namely to divide memory into 10 'program registers' separated by dynamically moved partitions (Epson appear to have gone this route too). HP's designers have come up with another solution altogether.

In the 75C, files are the principal data objects. As many files as will fit can reside in memory simultaneously. Basic programs are treated as files. in



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addition to text and data files and several sorts of special file. Some files are created and kept by the system itself (eg, appointment files and key definition files) while others must be created by the user. Files in RAM are no different from files on card or tape which, combined with the device independent character of the I/O routines makes life easy for the user. All files have a similar structure, which is that of a collection of numbered lines containing up to 96 characters each. There is no difference between a serial and a random access file; any file can be read either serially or randomly depending on whether or not you specify a line number. In a Basic file the lines contain program statements, in a Text file each line is treated as a contiguous string of characters; a data file is merely a Basic file full of DATA statements, the items on a line being separated by commas. Files can be opened, closed, written to or read from the keyboard as well as from a program.

When EDIT mode is entered a workfile is automatically opened to receive your input a la UCSD. At the end of input you can rename this file whereupon it becomes an independent entity. As only one workfile can exist and it is always the current — ie, open — file it is not possible to leave a non-empty workfile without naming it or purging it.

An existing file can be made the current file in place of the work file by typing EDIT 'filename' upon which its catalogue entry appears in the display — this gives the name, type, size in bytes and time and date of creation of the file. Pressing ATTN then puts you in the file to edit it. CAT ALL lists the catalog of all files in memory while CAT displays that of the current file.

Basic programs are thus treated as files which can be run either by RUN 'filename' or simply RUN if they are the current file. Text files cannot be run directly as Basic programs but a command TRANSFORM will turn a text file into a executable Basic file so that programs can be written using the text processor.

Files can be manipulated by the commands RENAME, PURGE, MERGE, COPY and NAME. MERGE writes the contents of one file into another between specified line numbers; line numbers which coincide will be overwritten. COPY duplicates a file under a new name or to a card or other specified device. NAME is used to name the workfile and open another of the same type. All these commands work in the same way within RAM, between RAM and mass storage or between mass storage and mass storage. To save a program for instance once could type COPY 'myprogram' TO 'myprogram:card' or simply COPY TO CARD if the file is the current one. Four levels of file protection are built in; a password may be assigned to limit access to a file, a 'private card' may be created by using PRCARD as the device name, which cannot be listed, altered or duplicated, and finally PROTECT creates a card which cannot be overwritten.

FETCH is a powerful command which can be used in several ways. On its own it fetches the current line from a file being worked on. Why would that be so useful? Because I might have broken off from editing to do a calculation or some system function; that can be done at any time in any mode merely by hitting ATTN. Then a simple press of the FET key puts you back where you were. FETCH 203 displays line 203 of the current file, while FETCH 'array-bound' would fetch the first line after the current one which contains the word 'array-bound'. FETCH 'string', 203 would search for the first occurrence of 'string' after line 203; this command works in both text and Basic files.

All errors in file handling are handled gracefully: ie, the system tells you of the error and then aborts the command and allows you to try again with no harm done, unlike some operating systems I could mention. The system is also consistent in that if you know the syntax of RENAME then you know COPY as well and so on.

This is an excellent operating system which deserves to be applied beyond the confines of the 75C. With a few additions for disk-based systems it would be a very neat way of coping with the new 'RAM disks' which are finding favour in the USA.

The HP75C Basic shows some similarities to the version used on the 80 series computers but also some major differences. It is an extension of ANSI Minimal Basic, the extensions being in areas like handling of spaces in input (the 75 strips extra spaces and inserts missing ones for readability) and the handling of FOR....NEXT loops (you can halt in the middle of one without error). The manual has an appendix which enumerates the extensions and deviations from the standard. One point that will not be lost on HP users is that the 75 supplies an invisible END in program files so its use is now optional.

Rather than devote a lot of space to describing features of the Basic I will outline the new features and refer you to last month's review of the HP86 for the rest. As on the 86, arithmetic is 12 digit with a dynamic range of 10E ± 499, with the option of SHORT and INTEGER types to save memory. The same large range of functions as on the 80 series is supported, as are calculator and program variables. Unlike the 80 series, however, the calculator variables are not accessible to programs. Variable names are limited to single letters or letter plus single digit; a calculator variable can have the same name as a program variable but in this case they cannot be accessed from the keyboard during a program interruption. Multistatement lines are allowed and AUTO line numbering, RENUMBER and DELETE are all supported.

No structured control statements are provided except for a single line, multistatement IF . . . THEN . . . ELSE, but a new and powerful CALL is provided which, combined with the file oriented operating system, has the same effect as a procedure.

CALL 'filename' will execute the named program and then return control to the calling program. Variables, DIM statements and all branching and subroutines are all of local scope, only system commands and file assignments being global, so that calling another program will preserve the values of variables in the caller. Values can be passed to a called program by setting up a temporary data file as a go-between. When the caller reads the results back from this file it can read them into the original variables or into new ones, giving the effect of call by value or reference as required. This is a neat way of providing modular programming; instead of writing subroutines you write a separate program which you can call by its name. Since ordinary subroutines are available as well, you have the choice of being a slob if you want to (unlike the 80 series labels are not allowed for GOTO or GOSUB destinations). Recursive calls, direct or indirect, are allowed.

The ONTIMER# GOTO statement can use any one of 1001 timers as mentioned above. These timer interrupts are local to program files so if a program calls another any timer in use will continue its count while the called program is in control but will not interrupt until control returns to the caller. Timer numbers are global however; There is only one timer # 9. Any called program can therefore declare timer # 9 and modify the timer set by the calling program.

As is expected with an HP product, there is no PEEK or POKE and no obvious way of interfacing to machine code programs. That doesn't mean it isn't possible, merely that they're not telling us (yet). It will probably emerge eventually via the users groups as usual. HP's paternalistic attitude to those who would probe into the innards of their products is too well established by now to be irritating.

File access is handled by ASSIGN# 'number' TO 'filename' and then READ# or PRINT#. If a line number is included in the READ# statement you have random access. Unusually, one or two dimensional arrays can be written to a file with a single PRINT# statement.

The HP-IL loop which is used to communicate with all peripherals is handled by the ASSIGN IO statement. After physically connecting the devices together on the loop and switching them on ASSIGN IO is executed in EDIT mode. The machine then announces '3 devices on the loop' or however many there are, and then produces a template

Device # 1 = ': '

for you to give a name to each device: eg, TV, PR or CASS.

From then on I/O to these devices is performed by including their name in the file name in a file manipulation command such as COPY TO 'myfile:cass'. In the case of display and printer I/O it is necessary to declare the device in use through DISPLAY IS TV or PRINTER IS PLOT. LIST IO shows a

Benchmark timings

BM1	2.6
BM2	4.5
BM3	21.4
BM4	21.1
BM5	23.7
BM6	39.3
BM7	56.6
BM8	13.3

All timings in seconds. For an explanation of the Benchmark tests see APC Vol 3, No.9, September 1982.

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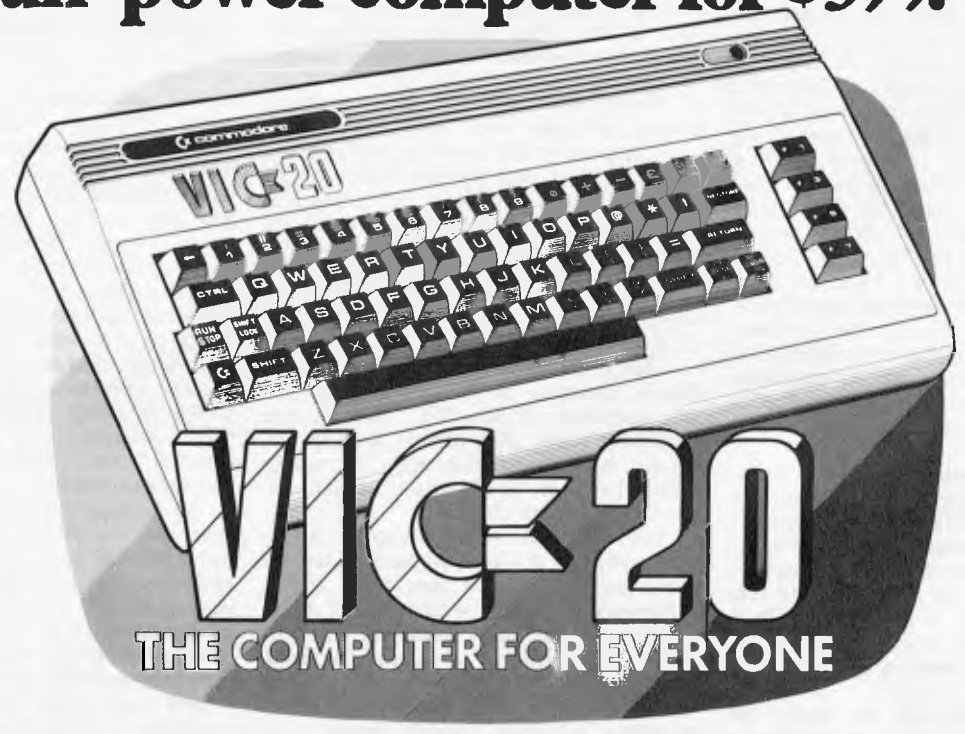

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catalogue of the device assignments in use.

There are no graphics commands built into the 75C Basic but a ROM module will be available to drive a plotter. Extensions to the Basic are added by LEX (language extension) files which can be on card, tape or in ROM and can be MERGEd, COPYd and PURGEd like any other type. Another special file type is the LIF1 (logical interchange format) file which is used to transfer files to other 75s or other HP computers via HP-IL in ASCII form. The TRANSFORM command can be used to turn a Basic or text file into LIF1 format for transmission and vice versa.

The only software which comes with the machine is a set of 8 cards called the Owners Pac which contains three programs, an address book program, a financial calculation program and a game called PAYATTN. Ten blank cards and a head cleaning card are included too.

Expansion and potential use

The 75C comes with 16k of RAM which can be extended to 24k by adding a module to one of the ROM slots. Applications programs for maths, statistics, engineering and business use will be provided on card or in ROM and on tape from the users library. Visicalc will be available as a ROM.

The key to all the peripheral expansions of the 75C is the HP-IL loop interface. When this new interface was introduced early this year for the HP41C calculator (see Calculator Corner Apr) there was a certain amount of puzzlement that HP, inventors of the HP-IB/IEEE, should go to so much trouble for a mere calculator. The answer is now clear; it wasn't just for a calculator but in preparation for a whole new series of battery powered computers of which the 75C is only the first. HP is committed to supporting HP-IL as well as HP-IB on many of its range of peripherals and obviously hopes to establish another world standard for a low power interface; it remains to be seen whether any of the other manufacturers in the field (mainly Japanese) will support it.

At the moment HP-IL devices available include the HP82162A Thermal Printer and HP 82161A Digital Cassette Drive, both of which are battery/mains operated portables. The digital cassettes hold 128k each. A Video Interface (HP 82163) can drive a standard black and white monitor or domestic TV. HP-IL versions of the 7470 two-pen plotter and an 80 column dot-matrix printer have just been announced along with a digital voltmeter, which is the first of a range of HP-IL instruments, and 9 in and 12 in monitors. Disk drives are not at present available for HP-IL.

Conversion from HP-IL to IEEE, RS232 and BCD is possible through adaptors and the RS232 link allows the use of a modem.

Who will use the HP75C? Given its high price, it is mainly going to appeal to the jet-setting executive for whom the appointments feature was clearly designed. He or she will also be able to use it for limited amounts of text processing, at the level of memos rather than great tomes and also for general calculating and computing chores. As long as there are people who can afford to buy Rolex watches then the 75C has a market.

The whole kit of computer, printer, cassette drive and modem can be put into a fitted briefcase and I suspect that some blue chip firms will equip their sales staff with such outfits.

The 75C is in no sense a toy computer as its speed and the power of its Basic exceeds that of many desk-top machines; only in RAM capacity does it give anything away to its larger brethren. This being so, many applications in science and engineering which involve working in the field will be open to it, and the price is unlikely to be a deterrent in such professional areas. The appointments mode provides a particularly powerful way of doing real time data-logging and processing with a minimum of programming.

One thing is certain; for the next few years the 75C will be the ultimate status symbol among the technologically inclined.

Documentation

The manual for the 75C surpasses even HP's own high standards. It is actually thicker, at 360 pages, than the manuals for the 80 series desk-top models — which is not surprising as the 75 is a very complex beast with lots of facilities. The manual starts with an easy summary called 'Getting Started' to allow the user to manage the basic operations quickly. It then goes on to individual chapters on all the various aspects, including card operations, HP-IL operations and seven chapters on the Basic. In addition to a ten page alphabetical index it has numerous appendices covering the character set, error messages, escape codes, key functions and listings of the Owners Pac programs which are supplied with the machine. The instruction set is listed on the inside back cover and the back cover has a contents index which is used in conjunction with coloured page edges to find a chapter quickly. A small quick reference manual is also supplied. Once again it is a model for other manufacturers to follow.

Prices

HP-75C 16k RAM (includes power supply, battery pack, field case, manuals, 16 cards, HP-IL leads)	$1639.50
8k Expansion RAM	$321.50

Technical data

RAM	16K expandable to 24k
System ROM	48k
Keyboard	64 keys, including four Cursor controls.
Display	32 characters, 5x7 dot matrix.
Storage	Magnetic cards 1.3k per card.
Ports	HP-IL in and out
Languages	Basic

HP 82163 Video Cassette	$486.00
HP 8216A Digital Cassette Drive	$906.50
HP 82162A Thermal Printer	$815.50
Magnetic Cards 40	$32.94
120	$82.36
ROM Software Modules	$49.42–$123.55

(All prices include sales tax)

Conclusion

The HP75C is a prodigiously powerful and complex computer for its size and is obviously the product of a long and careful design project. It has so many unusual capabilities that it makes the average CP/M based business machine look like child's play. Because of this, jests are already being made in the trade that it's so complex that no one can use it. Nothing could be further from the truth. The attention which has been payed to the operating system and user interface mean that someone with no computer experience will be able to use its major features such as the appointments and text processing modes within a few hours. So long as one doesn't feel obliged to learn everything about it at once it is a very 'friendly' machine indeed. Some of its more powerful facilities such as real-time programming may never concern the sort of executive user at which it is partially aimed. But for the sophisticated scientific user or the third party software writer these powerful features are well enough documented to be put to immediate use.

Its price at present puts it beyond the mass market; as it is the first of a new 70 series perhaps we will see a cheaper model before long. It would be nice to see in the future models incorporating full size typewriter keyboard, more memory and making use of the large scale LCD displays which will soon be on the market.

I have been a convert to the idea of portable computing for some time; the ultimate goal of microcomputer development is surely the pocket sized personal database cum calculator cum word processor cum communications station. This machine represents another large step towards that goal.

END

'Gentlemen of the jury, you have heard the evidence. . . '

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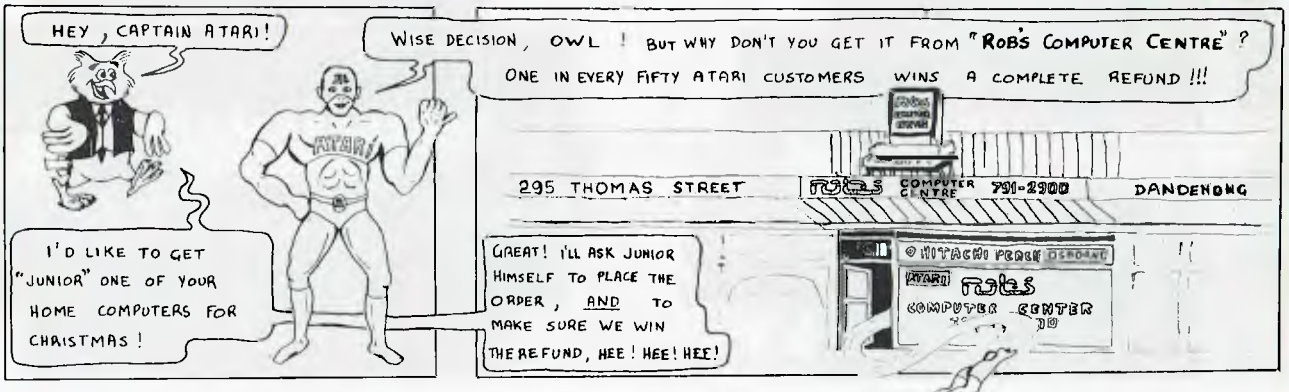

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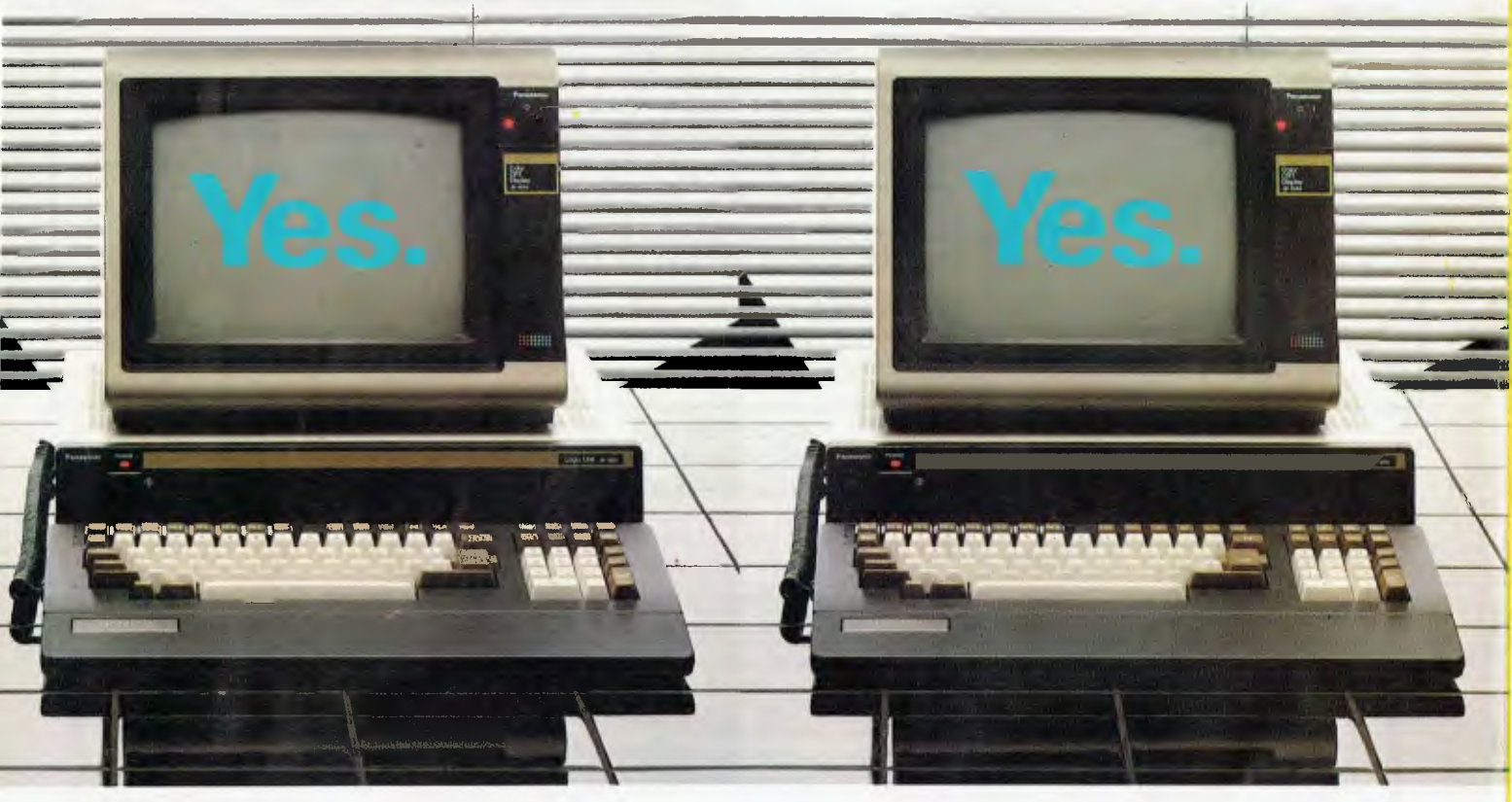

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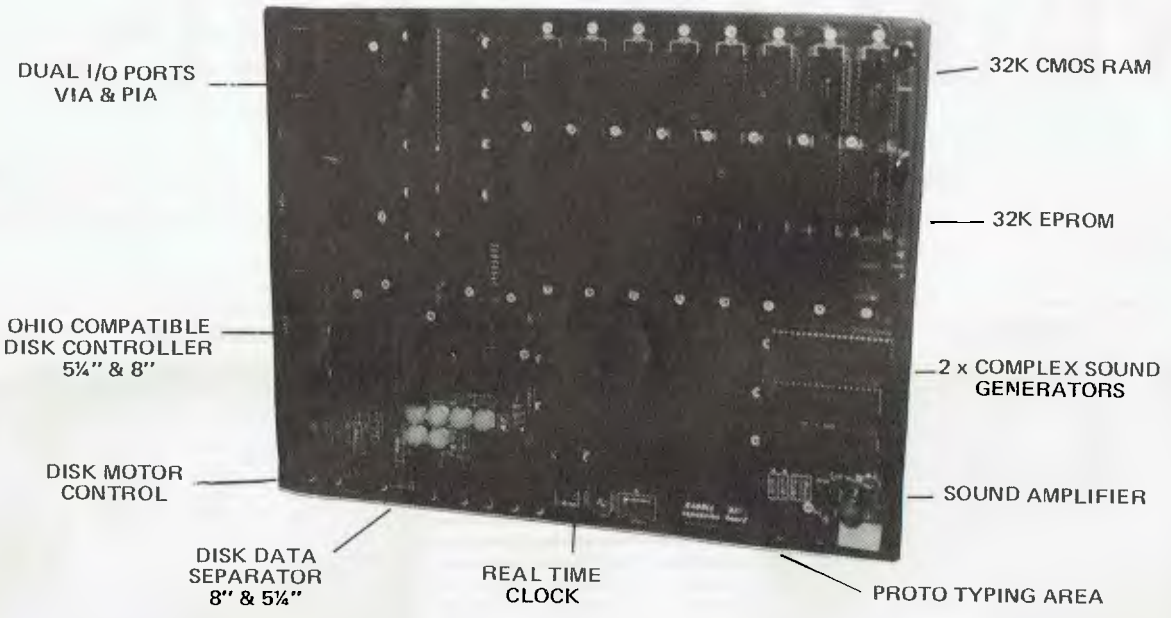

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APC welcomes correspondence from its readers but we must warn that it tends to be one way! Address letters to: 'Communications', APC, P.O. Box 280, Hawthorn, Vic 3122.

CP/M auto-start

I've just discovered an elegant method of 'auto-starting' programs under CP/M which can easily be put into operation by using SYSGEN and DDT. Probably the best way of explaining is to use an example: let's set up CP/M to execute the command line START START. DAT after both warm and cold-boots (refer figure 1). The first thing to do is load CP/M into memory using SYSGEN. This should present no problems, since SYSGEN's prompts are quite clear. Having returned to CP/M, the memory image must be SAVEd onto disk; any file-name will do, and SYSGEN should tell you how many pages to store. Next, load the memory image under DDT as in figure 1, and store the command line by using SA07. The first number is the length of the command line in characters, and the following numbers are ASCII representations of the characters themselves, in this case: OF – The command line is 15 characters long.

53 – ASCII 'S'
54 – ASCII 'T'
41 – ASCII 'A'
52 – ASCII 'R'
54 – ASCII 'T'
20 – ASCII ' '
53 – ASCII 'S'
54 – ASCII 'T'
41 – ASCII 'A'
52 – ASCII 'R'
54 – ASCII 'T'
2E – ASCII '.'
44 – ASCII 'D'
41 – ASCII 'A'
54 – ASCII 'T'
00 – Just to finish off.

The command line may then be checked using the D command.

The next thing to do is to set two flags at location 20FF:
Bit 0 : 0 = do not execute command line after cold-boot; 1 = do not execute command line after cold-boot.
Bit 1 : 0 = do not execute command line after warm-boot; 1 = do execute command line after warm-boot.

This again must be done using the S command (see figure 1).

After both these changes have been made, reboot b pressing control-C, and run SYSGEN again in order to save the memory copy onto disk (again, this should present no problems). Now cold-boot, and your auto-start CP/M should be fully functional.

```
DDT VERS 2.2
NEXT PC
3000 0100
-SA07
0A07  00  0F
0A08  00  53
0A09  00  54
0A0A  00  41
0A0B  00  52
0A0C  00  54
0A0D  00  20
0A0E  00  53
0A0F  00  54
0A10  00  41
0A11  00  52
0A12  00  54
0A13  00  2E
0A14  00  44
0A15  00  41
0A16  00  54
0A17  00  00
0A18  00  .
-DA07,A18
0A07  0F  53  54
41    52  54  20

0A07  0F  53  54  41
      52  54  20  53
      54  .START ST
0A10  41  52  54  2E
      44  41  54  00
      00  00  ART.DAT..
-S2 OFF
20FF  10  13
2100  C3

-
-
-  C
A  SYSGEN
```

Figure 1

Lastly, a word of warning – although this works on my version of CP/M (Lifeboat Associates CP/M Version 2.23 for 64k TRS-80 Model II), other versions may use different memory addresses, so make sure you have a spare copy of CP/M, just in case it doesn't work.

Robot controllers

Which of the following micro computers have Programmable Interface Adaptors (PIAs) or similar devices which would allow me to control devices such as robots, model railways etc – Apple II, Atari 800, TRS-80 Model III, System 80, PET 4032, NEC PC 8001? Could you also advise on their reliability?

M Metcalfe

In fact it is possible to use almost any kind of micro computer, or simple micro processor for such control applications, given appropriate software, and the correct interfaces. Having said that, then it is necessary to add that there can be an enormous variation in the ease with which the job can be done. For this reason the PET is undoubtedly the most popular microcomputer for such applications, as it comes ready equipped with what is fairly full implementation of one of the most widely used control interfaces – the Hewlett Packard HP-IB bus, more often referred to as the IEEE-488 bus. This was designed for the control of, and acquisition of, data from laboratory instruments.

Unless your application is of an on-off nature, you will probably need some type of analogue to digital (A to D) converter on the data input side, and a corresponding D to A converter to process the outgoing control signals. These are needed because the computer operates in discrete (i.e. digital) changes of output or input, while most equipment generates (or needs) data that changes in a continuous manner from one value to another.

So another important factor in making your choice would be the availability of suitable A to D and D to A converters. Here the determining factor as to availability tends to be the popularity of any particular computer, as well as its technical suitability, so your short list from the machines you mention is likely to include the PET 4032, the Apple II, the TRS-80 and the System 80.

I would not expect to find major differences in reliability between the machines you list. – Ed.

Auto-start

I have heard that CP/M provides a powerful and very useful facility to 'automate' the running of programs. If this is so, can you tell me more about it?
(Name and address withheld by request)

All versions of CP/M provide the SUBMIT.COM program which provides the feature you mention. Later versions (2.2 on) provide an enhancement, XSUB, while many implementations of CBIOS (the interface software between the 'standard' parts of CP/M and the particular hardware being used) provide an 'auto-start' feature in some form. In the Lifeboat Associates CBIOS, for example, this takes the form of a program AUTO.COM, which is run automatically on booting the system, once a micro (1-byte) patch has been made to the CBIOS.

With SUBMIT a whole series of commands can be entered into a file, and all are then executed one after the other, just by entering SUBMIT filename (the file with the commands can have any valid CP/M name, but must have the extension .SUB).

To give a real example, a secretary using a particular word processing system had to enter:

INSTALL DJ.PRL D000
DJRAM.PRL E400
L:
WS

every time before starting to use the facility.

These commands were all put in a file (created using WordStar under the 'n' option) called UP.SUB. The SUBMIT.COM program was then copied under the name START.COM (using PIP). All the operator had to do in future was type START UP!

As the next step the auto-boot facility was patched-in and SUBMIT.COM on the disk renamed to AUTO.COM. In addition 'UP' was patched into the auto-start routine in CBIOS. Whenever the system was then booted with that disk in drive A, the whole sequence was performed completely automatically.

SUBMIT is limited in that only direct commands can be executed from the .SUB file. Thus it would not be possible to run a program like DDT which requires information to be entered in response to prompts from the running program. This has been overcome with XSUB. It is entered as the first command in a .SUB file, the appropriate responses can be built into the file, and will be read from it.

Another feature of SUBMIT is that it is possible to put some of the commands in as

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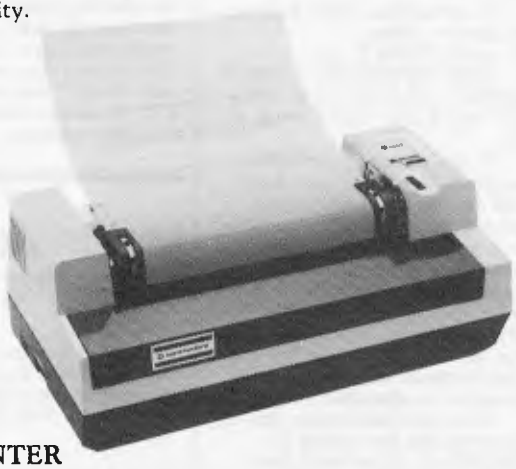

VIC PRINTER

The VIC Printer, like all VIC peripherals, offers a very high specification at a very competitive price.

It will print programs, letters, business data, graphic displays and so on.

Its main features include: 80 characters per line • Tractor feed dot matrix • 30 characters per second print speed • Full alphanumerics and graphic printing • Double-size character capability.

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The VIC single-drive Disk Unit provides a fast, accurate and efficient means of storing and retrieving data and programs.

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Special plug-in cartridges are available to expand VIC's memory. 3K, 8K and 16K RAM packs plug directly into the computer.

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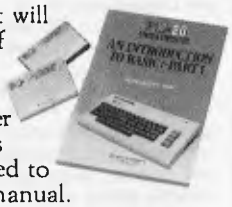
1. Introduction to Basic



This package contains materials that will enable you to learn the fundamentals of programming in the BASIC computer language on your VIC 20 computer. It assumes no prior knowledge of computer programming and includes two cassettes containing 17 programs specially designed to accompany a comprehensive 152 page manual.

2. Progamming Aids

To aid programmers to write their own programs, Super Expander, Machine Code Monitor and Programmers Aid cartridges are available.

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The VIC 20 has the largest selection of cartridge and cassette-based games available on any personal computer. VIC 20 games offer a real challenge and take a great deal of skill, time and mental agility to win.

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VIC 20

So much brain for so little.

when SUBMIT is run. Thus it is possible to choose which files should be listed, for example, at the time SUBMIT filename is entered.

This is certainly a very powerful facility, particularly if you are writing a series of programs to be run one after the other, by inexperienced, or non-computer, operators. – Ed.

Taking it apart

How do I write a program that will decompile a Basic program? The program I have is called the .COM type and accesses a file BRUN.COM.
Mark Ryan.

Disassembling is a comparatively simple task – but even this task cannot reproduce the original exactly. A decompiler is a different order of difficulty again. I doubt very much if a program, once decompiled, will be very easy to understand for the following reasons: all REM statements will be gone; meaningful variable names will be missing; line numbers will be in 10s and function names will have changed.

If the machine code happened to be compiled by an 'optimising' compiler, then the problem will have been worsened because a lot of the resulting code will have been compressed for efficiency. More likely still is the fact that you may not even have a machine code program to decompile – it may be in an intermediate code. You cannot decompile this if you don't know the code.

I should approach the author and get the original listing. You do not say why you want to decompile the program – but remember that professional programs are subject to copyright. – Ed.

Beeb colour

I found your article 'Beeb Colour Hi-res', in the September edition, most informative but misleading. If I may quote a short section from the first paragraph: ' . . . but unfortunately the character so defined is a text character and as such may be displayed in two colours only – background and foreground. To create more exotic shapes requires some knowledge of the screen format.'

It is on this point that I must differ. Not only is it possible to display multicoloured text graphics but knowledge of the screen formatting is most certainly not a prerequisite to doing so.

The designers of the BBC Micro were most kind in granting all users the ability to access (from Basic) the VDU drivers by means of the VDU command and its equivalent PRINT CHR$ (VDU number).

The following short program is a demonstration of this point. Having the basic Model A machine, it's written in MODE 5. What can be done in one MODE, however, can also be done in any other multicoloured MODE.

The essential section in the program is at line 40. Here A$ is defined, using a combination of VDU commands in the alternative form of CHR$(VDU no) and in A$ we have effectively set up a small section of program, its equivalent in Basic being: GCOL 3,2 : PRINT CHR$ (240) : VDU8 : GCOL 3,1 : PRINT CHR$(241)

The result of this is to obtain a three-coloured character which is easily moved about the screen. Larger characters merely require the extra definitions and cursor control VDU characters inserted.

T A Richards.

```
 10 ON ERROR GOTO 160
 20 MODE 5:VDU 5:VDU 19,2,2,0,0,0,19,3,5,0,0,0:REM Select
    graphics mode, colours
 30 VDU 23,240,60,126,219,90,0,0,0,0:REM 1st half of char
 40 VDU 23,241,0,24,60,60,36,66,129,0:REM 2nd half of char
 50 A$=CHR$18+CHR$3+CHR$2+CHR$240+CHR$8+CHR$18+CHR$3+CHR$1+
    CHR$241
 60 REPEAT:PROClissajous :UNTIL FALSE:REM Main loop until
    ESCape pressed
 70 DEF PROClissajous
 80 TX=-1:TY=-1:X=RND(25):Y=RND(30):REM TX,TY temp loop
    variables
 90 FOR A=0 TO 2*PI STEP PI/300
100 IF X>-1 MOVE TX,TY:PRINT A$:REM Not first time round
110 TX=25*(20*COS(A*X)+25):TY=20*(20*SIN(A*Y)+30):REM keep
    on screen limits
120 MOVE TX,TY:PRINT A$
130 NEXT
140 CLS:REM ready for next sequence
150 ENDPROC
160 MODE 7:IF ERR<>17 REPORT:PRINT " at line no ";ERL:END:
    REM reset screen on error, only report if not ESCape
```

Handy one-liners

Although Basic can be used for both scientific and commercial applications, I am sure many programmers like myself bemoan the lack of a comprehensive set of mathematical functions as found on cheap calculators and in languages such as Fortran.

To partially remedy this situation, I present the following one-liners for inverse trigonometric functions:

1 ARC SIN(X):
DEF FNASN(X) = 180 * ATN (X/SQR(1-X*X+ (ABS (X) = 1))) + 45 *X*(ABS(X) =1)

X in radins, angle between -90o and + 90o.

2 ARC COS(X):
DEF FNACS(X) =-FNASN (X) + 90

X in radins, angle between 0o and + 180o.

3 ARC TAN(Y, X):
DEF FNTXY(U) = 180 * (ATN(Y/(X+(X=0)))/ + 1 + (X =0) + 1)) - 135*Y*(X = 0).

U is a dummy variable, angle between 0° and 360°. NB the boolean operators take care of division by zero and square-roots of negative numbers. Also the above expressions apply to machines with a positive truth value ie, Apple II, while for the PET the signs before the boolean expression will have to be changed.

You can determine this on your micro by typing in PRINT (2 1) or such like. If you get a value of -1, change the signs. The PET supports the variable , else use PI = 3.141592654 as usual.

The last expression can be used to give the angle in a rectangular-polar conversion.

P M Doherty,

What's happening

In my VIC-20 I noticed something strange! When I hit a letter (not graphic) and then, holding the left shiftkey down, hit the RUN/STOP key, the VIC-20 displays:

XLOAD
?SYNTAX ERROR
READY
RUN

and then the program stored in memory runs. Can you explain that to me?
P P Michaelidis

Simple. When you press a key, say 'X', it puts X in the keyboard buffer. Pressing shift run puts LOAD <return>RUN <return> into the keyboard buffer. This also applies to PETs with Basics 1 and 2 (Basic4 puts dl," <return >RUN <return >to load from disk). So what happens? XLOAD is examined by Basic which, not surprisingly, says ?SYNTAX ERROR and then prompts with READY only to find the RUN command waiting, so it runs your program. – Ed.*

Inconsistent recording

I have two ordinary cassette players. Would it be possible to connect one of them for use with my VIC-20?
A J Heaps

It would be worth your while using a proper VIC cassette recorder, since a normal audio cassette recorder will neither give consistent results nor interact correctly with the cassette operating system. – Ed.

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BANKS' STATEMENT

Martin Banks muses on the wisdom of making predictions in the microcomputer biz, and chickens out from making his own.

Placing bets

A few years ago I was, in the course of my labours, asked to attend a conference in the fair city of New Orleans, USA. Not unnaturally, I would have much preferred to have stayed here watching what was happening to the microcomputer industry — the cut and thrust of the business, who was telling the best fibs about sales figures, which companies had just gone bankrupt. But no, the editor for whom I worked banned me from such fun and sent me to the salt mines of Louisiana.

The reason for all that unwarranted cruelty (ask any journalist just how cruel such working trips abroad can be) was that New Orleans was to be the site of a conference on personal computers. Yeah, well, a conference is a conference is a conference I hear you say — and most of the time I would agree with you. This one, however, was different. For a start it was not just a vehicle for flight-testing hot-air balloons like many of the events normally are; and for a finish it was being run by one of that fair nation's most widely respected analysts of the electronics and computer industries, one Benjamin Rosen.

That fact alone made it interesting. It was a conference run by finance men, for finance men, and about the personal computer industry. Not surprisingly, the personal computer industry took note, and attended in small, but *very* select numbers (some say that's why I was there, but I would deny it).

During the course of this conference a new game came into being. To be fair, I suppose it wasn't a new game as such. The rules were as follows: someone asks the speaker (senior people from the industry) who's going to be top dog in five year's time. What was new about the game was that the speakers felt obliged to answer. They did not try to duck the issue as they normally would have done. This time, perhaps because of the heavyweight audience, they were giving straight answers — or as straight as possible, anyway.

What was interesting was the nature of the answers, and what they indicated about the perceived future of the industry. This year was, in fact, 1980. All the speakers at the conference, which included the likes of Steve Jobs (Apple), Chuck Peddle (then Commodore), John Roach (Tandy), Alan Alcorn (Atari) Dan Fylstra (Personal Software) and Portia Isaacson, were putting money on Apple and Tandy to be in the first three. That third place, the consensus said, would go to a Japanese company.

There are still three years to run on that prognosis, but even now the odds seem to be lengthening, especially on Apple.

The pace at which this particular industry develops makes playing the predictions game a fool's errand at the best of times. It is surprising however, that the likes of IBM were ignored by all but one speaker — Portia Isaacson. She said that the number one comany would be Tandy and IBM, which would be a joint venture. Apple ranked only third in her prediction, and that only after it had been acquired by a Japanese company.

Most of the assembled delegates thought these predictions to be a wizard wheeze, and therefore no doubt promptly forgot them. With the benefit of two years' hindsight, they are predictions that do not look quite so silly. They certainly bear some examination.

The first point to consider is the pace of development that has continued in the business. At the time of that conference, Sinclair had yet to launch the ZX80 in the US. Clive was a man with a reputation, to the US financial men, for flair in design and danger in manufacturing. Since then he has created a whole new personal computer marketplace around the world, and has almost certainly stopped being poor.

Nobody could really have predicted that particular event, or the scale of it, two years ago, yet the speakers at the conference knew that some events were likely. In particular they knew about IBM and the chance of it coming into the market. Despite the pace at which the market was developing, IBM was a predictable entrant. Yet only one person, Portia Isaacson, ventured to suggest that it might be amongst the leaders in five years time. Could it have been that the leaders of the industry had such a poor view of IBM, or perhaps a grand view of themselves?

With that benefit of two years' hindsight, it is perhaps possible to reappraise those predictions, especially those of Portia Isaacson, and see where the strengths and weaknesses lie.

What the last two years have taught us is that: 1) there will always be room for something new, and that something new can happen very quickly in this business, eg, Clive Sinclair; and 2) not all the old analogies always work — only some of them.

That second, probably obscure statement refers to the Japanese, who were punted by just about everyone at that conference as the source of one of the top three companies for the future. A Japanese company was punted for the then-obvious reason that, as a nation, it had done well in just about every other industry it had looked at. Analogies abounded. Shipbuilding, motorbikes, cars, televisions, hi-fi, semiconductors. Everywhere there was an analogy of how the Japanese can take an industrial sector by the throat and make it theirs.

Yet, for some reason, no Japanese company has managed the trick in the personal computer business — well, not yet, anyway. There could be two reasons for this. One, that they are just biding their time until an appropriate moment, and two, that another analogy is in play. That analogy is of the popular music business — that while the Japanese have the world hardware market in hi-fi, they are nowhere in the software — the music that gets played on hi-fi systems. In personal computers, it is usually the case that without the right software the hardware means little.

It could be that a combination of

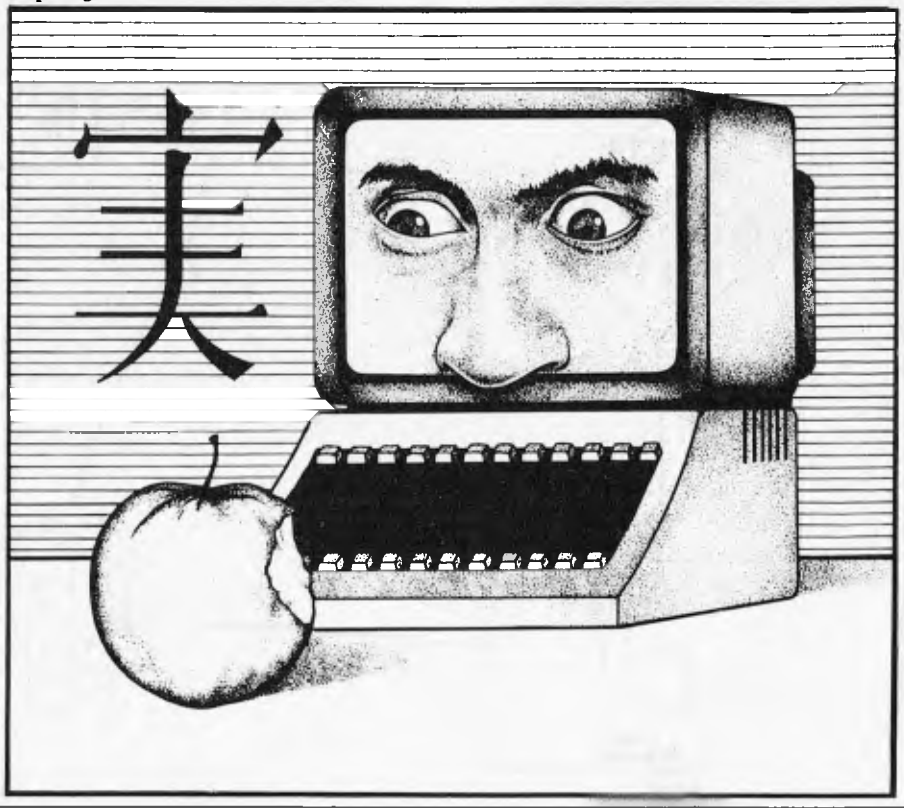

Illustration by John Ellis

MORE THAN GAMES FOR VIC*20

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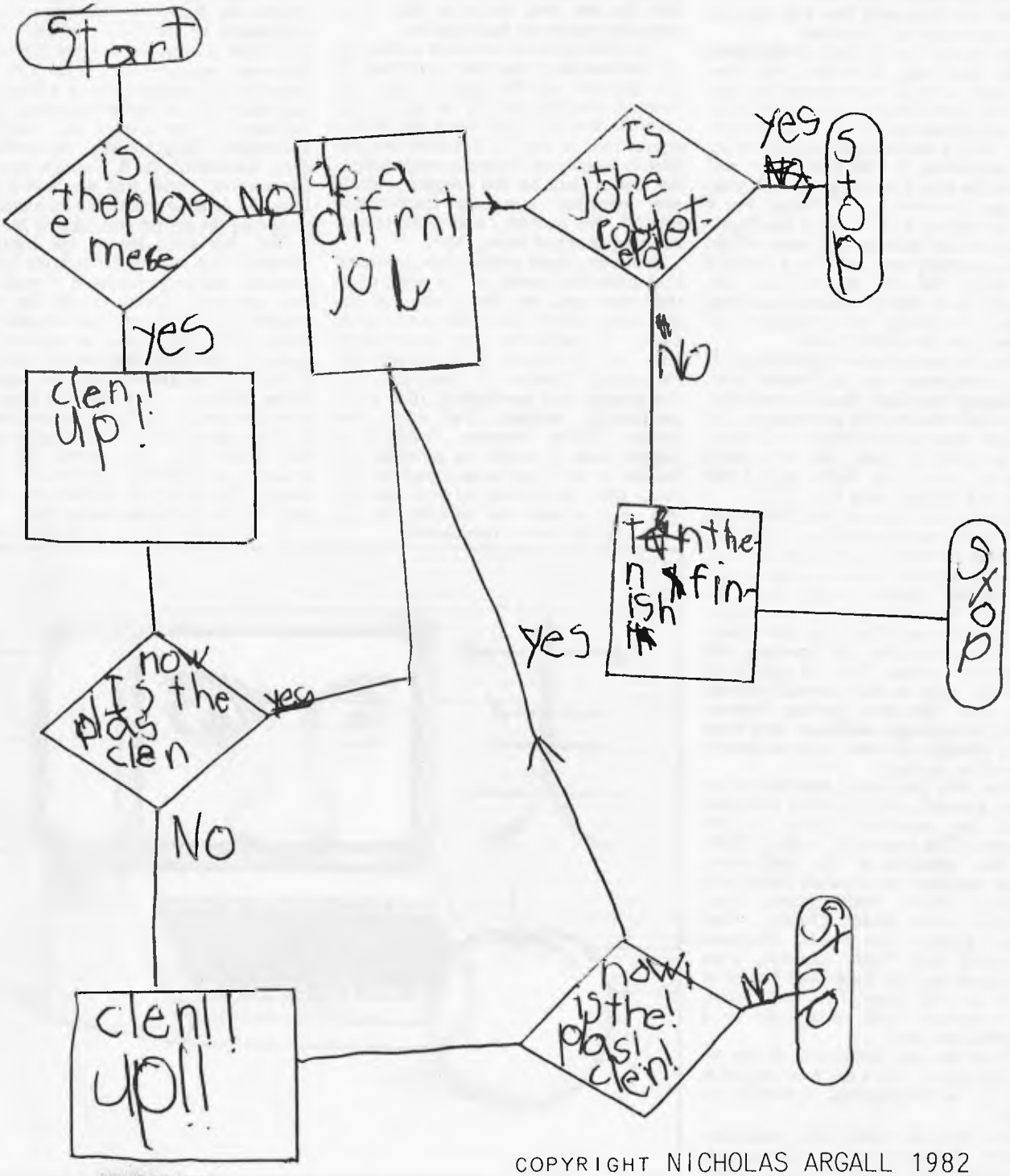

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these reasons prevails, and that leads back to Portia Isaacson's prediction — that third place in the world market would be taken by Apple, which would be owned by a Japanese company.

The chances are that an acquisition of this type is the best way the Japanese can make the big transition from the unfamiliar position of also-ran to market leadership. (There is also, of course, the chance that they are about to do a Sinclair and come up with something entirely new.) If acquisition it be, then whom should be purchased? Ms Isaacson's suggestion is maybe not that outlandish. Apple and its contemporary Commodore are both showing the hints of vulnerability, while having a presence in the market of considerable value.

A star of the US stock market, Apple's financial performance has recently started to plateau. Its early growth rates have diminished to levels that, while still good for industry in general, are no longer at the dramatic and significant levels of two years ago. One New York stock analyst has said that the company might be slowing down.

On top of this, the company's product range has hit a hiatus. The Apple II has been one of the outstanding successes of the industry; in many ways it helped to create the viability of the whole business.

It still sells well, but it now long in the tooth. The follow-up, the Apple III, limped into existence with a million problems, not least of which was the fact that the company was going public at the same time. The machine has since been revamped, which took around a year, but it has been in many ways superceded by events (or more specifically systems like the IBM and the Sirius) without making any major impact.

Yet the company has an excellent international distribution set-up, generally sound marketing with only occasional public squabbling, and a software base that is worth a fortune. A Japanese company could be tempted if Apple fails to come up with something good in the next year.

In that respect, Commodore is slightly better placed. It looked almost dead on its feet a year ago, but now it has a whole range of products available (or coming, at least). Commodore's biggest weakness has, however, always been the fact that its penetration of the US market has been weak, with European sales supporting the operation. As the company has a broad base, with manufacturing in a variety of product areas, the right offer from a Japanese company for the microcomputer bits could be tempting.

But what of Ms Isaacson's other prophesy, that IBM would be number one in a joint venture with Tandy?

Well, apart from the fact that, at first glance, IBM stands a good chance of being number one all on its own, the suggestion of a joint venture with Tandy does make some sense. This is especially so outside the US, where IBM has yet to get its marketing act together formally.

In practice, such a venture is unlikely. IBM will no doubt announce soon enough that it is appointing dealers in Australia. Everyone knows it is talking and planning, and knowing my luck, it will have already announced details by the time you read this.

Nevertheless, such a joint venture would have a great deal going for it. Both companies have design and manufacturing skills par excellence, both have strong marketing. Tandy has the distribution game sown up tight, while IBM has *the* name to put on any box that is liable to be called a computer. Last, but by no means least, the combined financial clout of the two companies would mean that no investment — either in developing new products or in bombing prices to kill the opposition — would be too excessive.

It is an interesting exercise to guess market leaders for the future, though rarely one to do in public. Already, in two years, the whole scenario on which expert judgements were based has changed significantly. I will, this time, opt out of such endeavour, but I will leave you with the latest US suggestions on the subject.

Given that there are now several personal computer markets, and that the following is not concerned with the one created by Clive Sinclair, but more about the professional and business/commercial market, then two names now emerge. For anyone who has had anything to do with the mainstream computer business it will be just like old times, for the projected leaders in the future personal computer market are — yes, you guessed it — IBM and Digital Equipment Corp.

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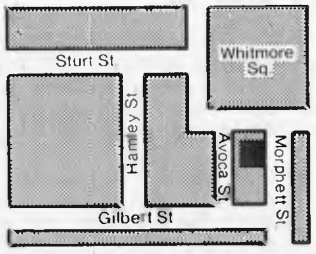

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CLOCK IT TO ME

In the first instalment of a two-part article, Bruce Marriott describes a real-time clock/calendar card for the Apple II

Many programs require time and date information: either directly, as in tagging output for later identification, or for generating or measuring accurate intervals of time — as, for instance, in scientific data logging.

In the former case, the user can be asked to input the time and date but this is irksome and error-prone since it has to be done at least once for every program run. For generating or measuring time intervals, recourse is often made to assembler or Basic timing loops, the programming of which is complex and hard to modify. Since computers are used to increase efficiency, an automatic (and cheap!) solution to such routine requirements would be particularly useful: this is what led to this design for a clock/calendar card.

This month I shall cover the hardware design of the real-time card; next month I shall go on to describe suitable driving software. Depending on which system is being used, and the chosen construction method, the cost of the card varies between $30 and $85. As usual with such articles, complete details are only given for one machine, in this case the Apple II. Don't let this dissuade you from reading on if you own another micro — the hardware itself is not complex and some information on implementing the design for other machines is given.

The Apple II uses the 6502 processor, so the design will be easiest to adapt to other 6502-based machines; owners of 8080/Z80 machines will have to work a little harder — but again, the comparative simplicity of the hardware cannot be overemphasised.

Background

There are several methods for implementing a real-time clock on a micro. The easiest is to generate regular interrupts (at least once a second) and have an operating system which counts the interrupts into time (and possibly date) registers in a reserved area of memory. This system — used in several micros — is fine until the power is turned off; the clock has to be reset every time you turn the machine on.

Until two or three years ago the only other practical method was to implement a design totally in discrete hardware using a crystal timebase and a host of TTL chips, with power supplied by rechargeable batteries. This method suffers from two drawbacks: cost ($300) and excessive power consumption, requiring an AC charger which has to be left permanently on, more or less.

The most satisfactory solution came with low-power CMOS clock/calendar chips specifically designed to interface to micro buses. These chips typically use a 32768 Hz crystal as a timebase and will continue to operate on about 20 microAmps at 2.2 volts, supplied by battery backup which should last for months. Access to the time and date registers is usually through 4-bit address and data lines.

One of the first of these chips was the National Semiconductor MM58174A, which has been described for use in a number of articles. Unfortunately it suffers from a serious flaw: it has no year register, which seems ludicrous. You either have to design a circuit with CMOS RAM to hold the year, or modify the disk operating system to store the year on all disks. Otherwise the user of an applications program is, rather perplexingly, asked to enter just the year instead of the full date. NatSemi has recently produced a rather more sophisticated chip, the MM58167A, but this too lacks a year register!

Casting around for a better device to use for this design produced the Oki MSM5832RS. This chip has no serious drawbacks and, surprisingly, has been available for two years, though it would seem to be used only in professional circles. After opting for the Oki chip, I have heard of a Motorola device, the MC146818, and this might be worth checking out as it has a very advanced specification. It is, however, rather expensive — about $30 one-off.

MSM5832 anatomy

Figure 1 shows the functional block diagram and pin-out of the 5832. The chip interface breaks down into three broad areas: supply requirements, control systems, and data and address lines.

The supply requirements are a 3276 Hz crystal across XT and XT and +5 volts at Vcc when being accessed, or a minimum of 2.2 volts when on standby (ie, when supplied from a battery).

The major control signals are HOLD, READ, WRITE and CS (chip select). The CS input is rather unusual in that it is not normally connected to the micro bus or tied to a power rail through a resistor but is connected directly to the +5 V supply. With +5 V applied, CS enables all inputs and outputs but when the power is removed (but battery back-up is working) CS goes low, disables all the control lines and effectively isolates the chip. The HOLD line is effectively the chip enable (or select) signal and while high suspends updating of registers so that stable conditions exist for reading from or writing to the chip. The READ line goes high to enable reading data from the chip and WRITE goes high to enable writing data.

Two other control signals exist, neither of which is normally used. The ± 30 ADJ input, when briefly taken high, resets the seconds register to zero and if there were more than 30 seconds, the number of minutes is increased by one, otherwise the minutes are left unchanged. The TEST input, as its name implies, is used for testing; with CS high, pulsing high signals on this pin will directly clock certain registers depending on the addressing used.

The last group of signals comprises the address and data lines, which follow normal practice with the address lines selecting a specific register within the 5832 and the data lines actually passing the contents. Figure 2 shows the register

ADDRESS INPUTS					INTERNAL COUNTER	DATA I/O				DATA LIMITS	NOTES
HEX	A3	A2	A1	A0		D0	D1	D2	D3		
0	0	0	0	0	S	*	*	*	*	0∿9	S1 or S10 are reset to zero irrespective of input data D0∿D3 when write instruction is executed with address selection.
1	0	0	0	1	S 10	*	*	*		0∿5	
2	0	0	1	0	MI 1	*	*	*	*	0∿9	
3	0	0	1	1	MI 10	*	*	*		0∿5	
4	0	1	0	0	H 1	*	*	*	*	0∿9	
5	0	1	0	1	H 10	*	*	†	†	0∿1 / 0∿2	D2 = "1" for PM, D2 = "0" for AM; D3 = "1" for 24 hour format, D3 = "0" for 12 hour format
6	0	1	1	0	W	*	*	*		0∿6	(Day of the week)
7	0	1	1	1	D 1	*	*	*	*	0∿9	
8	1	0	0	0	D 10	*	*	†		0∿3	
9	1	0	0	1	M0 1	*	*	*	*	0∿9	
A	1	0	1	0	M0 10	*				0 1	
B	1	0	1	1	Y 1	*	*	*	*	0∿9	
C	1	1	0	0	Y 10	*	*	*	*	0∿9	

(1) *data valid as "0" or "1".

Blank does not exist (unrecognized during a write and held at "0" during a read)

† databits used for AM/PM, 12/24 HOUR and leap year.

(2) If D2 previously set to "1" upon completion of month 2 day 29, D2 will be internally reset to "0"

Fig 2 MSM5832 register addressing

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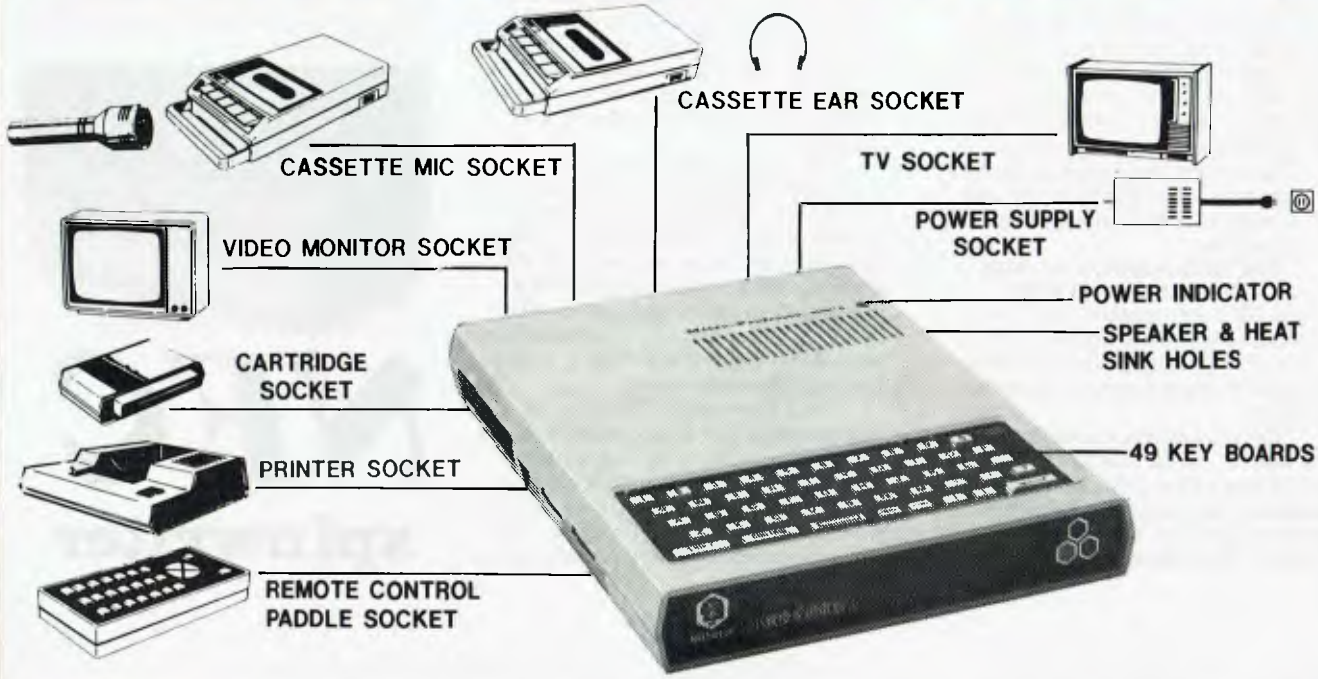

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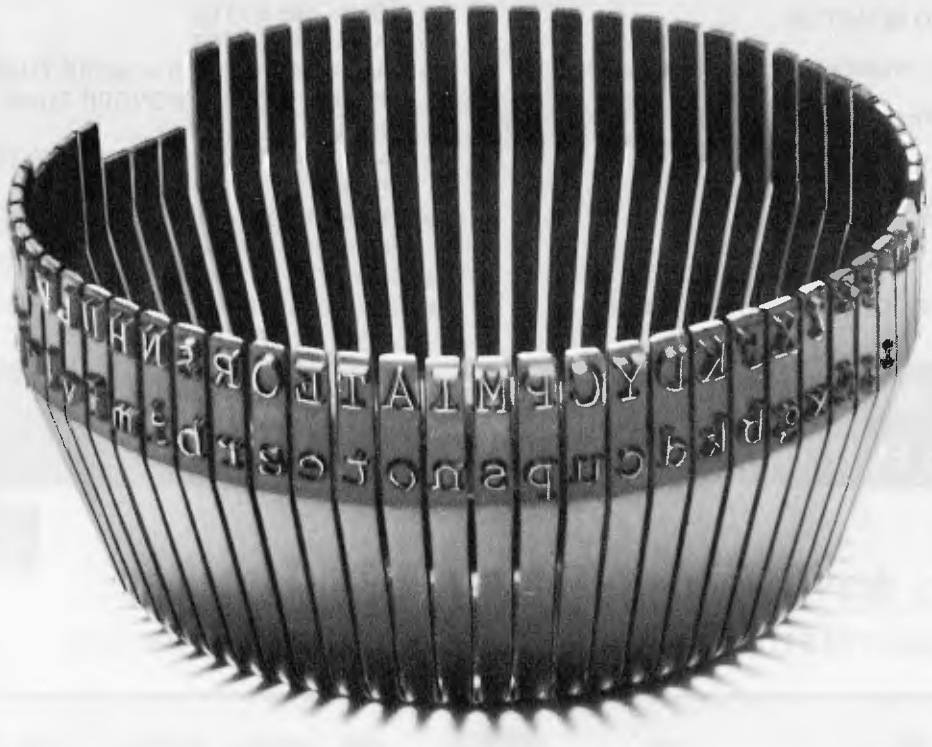

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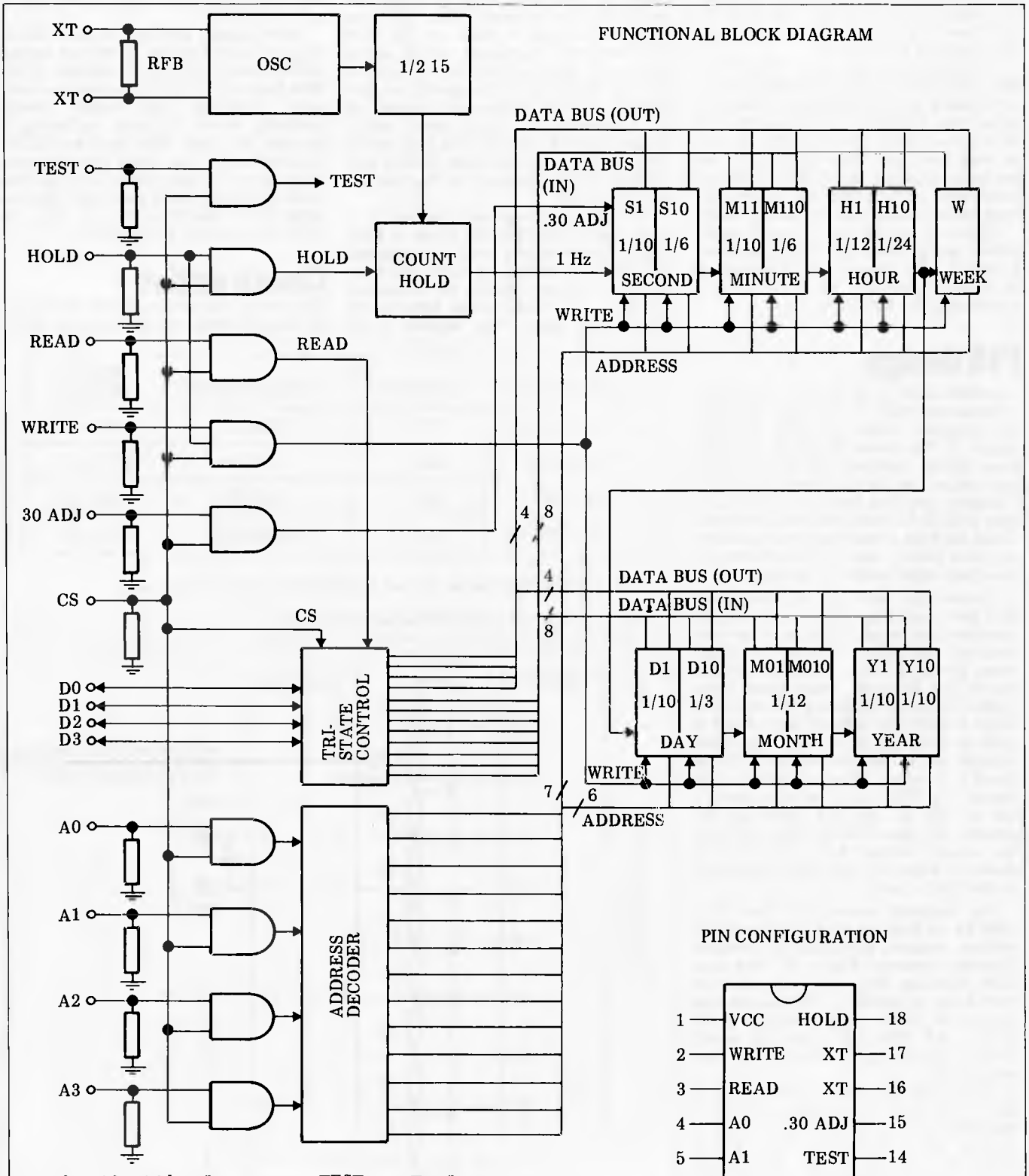
addresses; note that two registers (tens of hours and tens of days) not only hold time and date digits but also use some bits for control of time format and leap years.

One facility of the 5832 which is not apparent from the pinout is the chip's ability to generate interrupts. These appear on the data lines under specific control and address line conditions, as shown in Figure 3.

Interfacing

The easiest way to interface the 5832 to most popular systems is to use a 6821 PIA (Peripheral Interface Adaptor) for 6800/6502 systems or the equivalent 8255 PPI (Programmable Peripheral Interface) for 8080/Z80 based systems. The Oki data sheet shows the way with a 'typical application' based on the 8255.

An advantage with using a PIA/PPI is that the normally critical timing constraints involved with discrete logic interfacing are no longer a problem as timing moves from the microsecond



A0 to A3:	Address Inputs	TEST:	Test Input
WRITE:	Write Enable	±30 ADJ:	±30 Second Correction Input
READ:	Read Enable	XT & XT:	xtal oscillator connections
HOLD:	Count Hold Enable		
CS:	Chip Select	GND:	Ground
D0 to D3	Data Input Output	VCC:	+5V supply

Fig 1.

domain to the processor's clock and instruction times, which are much longer. For instance, to write to the 5832 using a direct design would need HOLD to go high for 150 microseconds before the address and data with the actual WRITE pulse following within a minimum of 0.5 microseconds and lasting at least 1 microsecond. With a PIA/PPI, everything is slowed down to the speed that instructions can be given and these in all cases will be longer than the minimum times given.

Another advantage of a PIA/PPI is that this is the most popular addition to a system (with the exception of memory chips) and hence for most readers will be a known entity. With a 6821 device, as used here, the interrupt inputs are available, allowing the 5832's interrupt capabilities to be exploited under software control rather than by jumper leads.

Figure 4 shows the 'typical application' design from the 5832 data sheet. I haven't tried this so I can't guarantee its correct operation, but it should give a good start for 8080/Z80 users.

PIA design

For 6800/6502 systems, the 6821 PIA is the easiest chip to use. Figure 5 shows the complete circuit diagram for the Apple II. The heart of the system has been heavily outlined and is usable on any system, so I'll talk about this first. I assume that you know how to interface a 6821 to your particular system; if not, then get a book on your processor or, even better, one on interfacing to your particular computer system.

Connection between the two 8-bit PIA ports and the 5832 requires some consideration because the ports are not identical and this can affect the 5832 when the 6831 PIA is reset. The critical line is HOLD which, when taken high, stops the 5832 updating its registers. When a 6821 PIA is reset, both A and B ports become inputs but the A port has internal pullup resistors while the B side doesn't. The net effect of this is that should the HOLD line be connected to the A side of the PIA resetting the system will take HOLD high and stop the clock. Hence the control lines shown in Figure 5 have been connected to the PIA's B side.

As discussed earlier, the four data lines have a dual function: moving actual register contents and acting as constant interrupt sources (Figure 3). For data flow handling they are connected to port B but, in addition, the lines are also connected to the four interrupt ports (CA1, CA2, CB1, CB2) through which their interrupt signals can be software controlled.

Power-off operation comes from a 3.5 V 100 mAh Nicad battery which is automatically trickle-charged during normal use. Precise setting of the required clock frequency is achieved with a variable capacitor. Two stitches are used in this design: one allows the use of the ± 30 second adjust mentioned earlier while the other write-protects the 5832.

Apple extension

The ports outside the heavily lined area in Figure 5 are specific to the Apple II.

The Apple has a unique I/O structure which, considering the age of the design, is quite exemplary. At the back of the Apple are eight slots for peripheral cards. Slots 0 and 7 are unique and have specialist uses but the other six can generally be used by any Apple-compatible card. Each slot has 16 locations for general I/O and a 256-byte page of memory which is normally used to hold the card's driving program. The 256-byte page is corrected to Basic via the IN# (slot number) command which, when processed, means that the peripheral card in that slot will respond to subsequent INPUT statements instead of the keyboard. It's clearly much neater to use INPUT TIME$, DATE$ rather than resorting to the usual PEEKs and POKEs, so the circuitry to do this has been included.

The driving program is housed in a single rail 2716 EPROM which is both cheap and relatively easy to program. This is a 2k device, so eight 256-byte driving programs could be contained within it. As I don't think anyone will need that many, the highest 2716 address line (A10) has been permanently connected to ground, so only four spaces are available, and are conveniently decoded by switches 1 and 2.

Output enable for the EPROM comes from the Apple-supplied I/O SEL line which is fully decoded for each of the slots. The 6821 PIA is mapped into four of the 16 general I/O locations which have an equivalent chip select signal called DEVSEL.

Most signals available at each slot in the Apple are capable of driving several LSTTL loads with the exception of the data lines which can drive only one such load. Although the design would probably work without buffering, I decided to play safe and an LS245 tri-state buffer has been incorporated. Chip select for this device (G) is derived from an LS08 (AND gate) and the two Apple lines DEVSEL and I/O SEL. All other connections are standard.

Construction

The circuit can either be constructed on an Apple-compatible prototyping board

CONDITIONS	OUTPUT	FREQUENCY	PULSE WIDTH
HOLD = L	D0 (1)	1024 Hz	duty 50%
READ = H	D1	1 Hz	122.1 µS
C.S. = H	D2	1/60 Hz	122.1 µS
A0 ∿ A3 = H	D3	1/3600 Hz	122.1 µS

(1) 1024 Hz signal at D0 not dependent on HOLD input level

Fig 3 Control of MSM5832 interrupt facility.

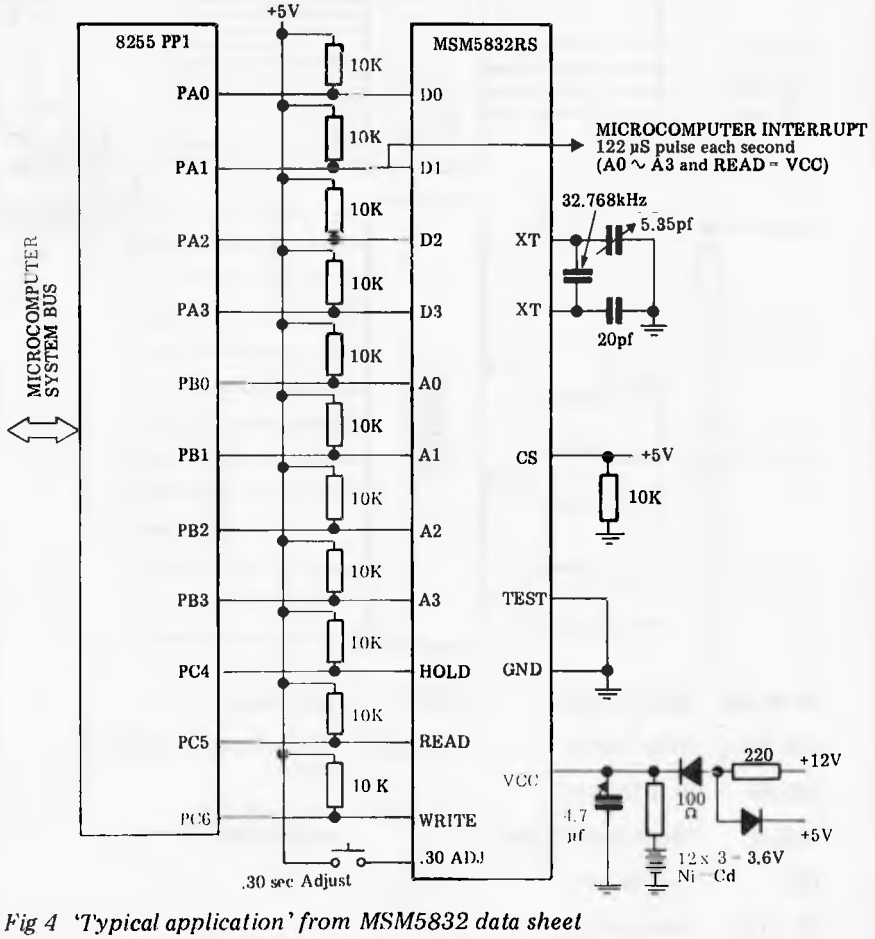


Fig 4 'Typical application' from MSM5832 data sheet

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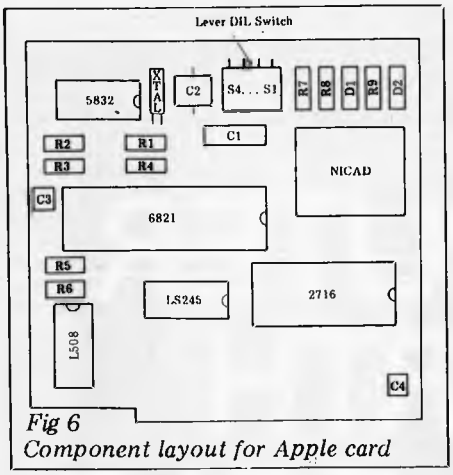
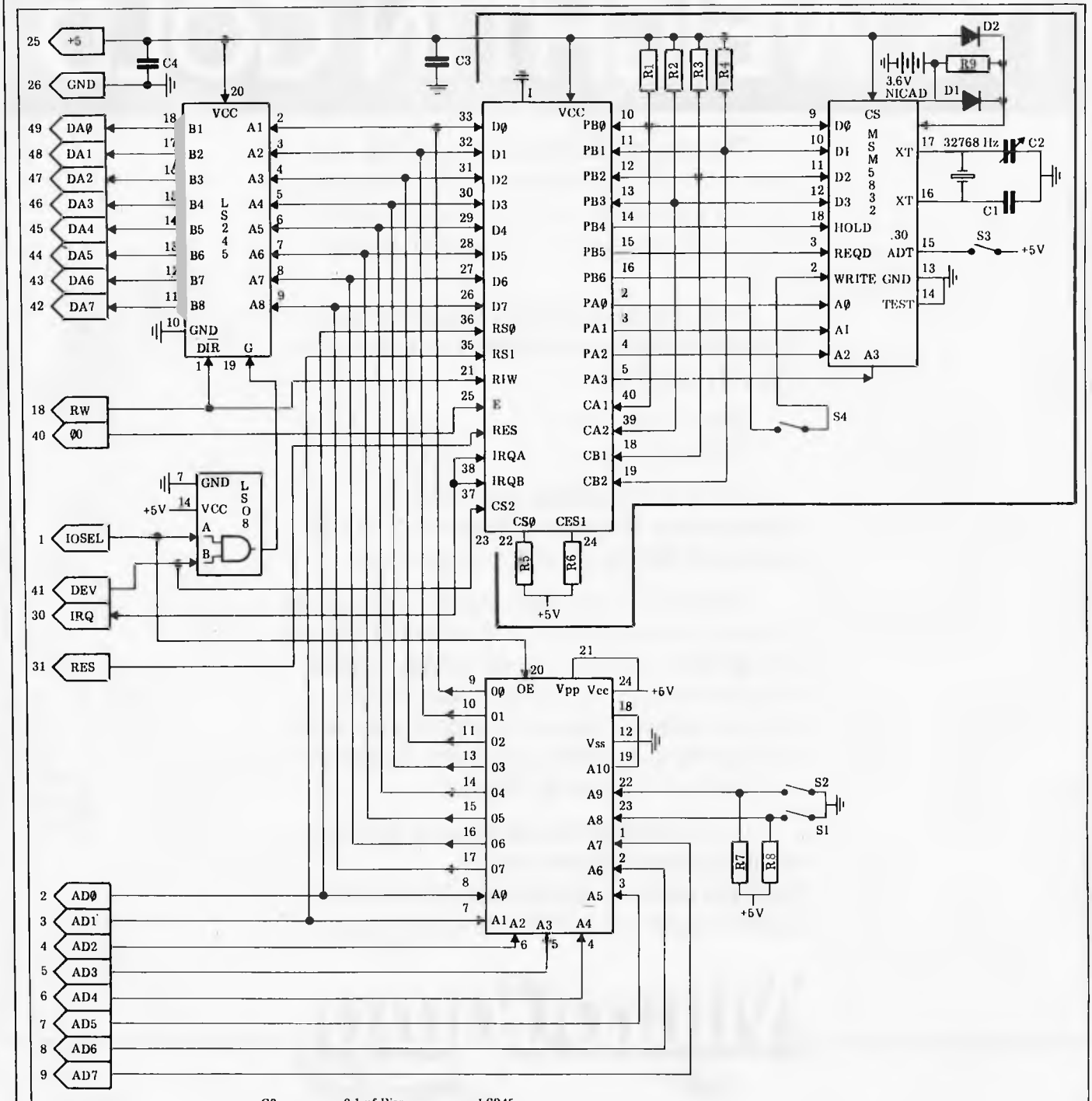


Fig 6
Component layout for Apple card

or, rather more easily and with less chance of errors, on the double-sided, through-plated PCB which is available for this project — see the 'Suppliers' section at the end of this article for details. Figure 6 shows the component layout for this card and this can probably be used as a guide if you're using a prototype board.

Start constructing the board by mounting the resistors, diodes and the crystal. Then add the DIL socket followed by the capacitors, DIL switch and battery. Finally, add the ICs, remembering that the 5832 is a CMOS device and needs careful handling, and make sure that they are all correctly oriented. As a final safeguard, before powering up, check that all components have been mounted properly and carefully inspect the tracks for any bridging.



PARTS LIST

R1,2,3,4	- 10K ¼W	C3	- 0.1 µf Disc	LS245
R5,6,7,8	- 3.9K ¼W	C4	- 4.7 µf Tantalum	2716
R9	- 100 ¼W			6821
D1,D2	- ORΩ7	*S1,2,3,4	- Single pole lever type 4-way DIL switch	Oki MSM5832 RS
C1	- 20 pf MICA			32768 Hz XTAL
*C2	- 5.5 — 65 pf trimmer	3.6 Volt 100mAh PCB Battery		40 pin DIL Swt
		LC508		24 "
				20 "
				18 "

Fig 5 MSM5832 interface to Apple II.

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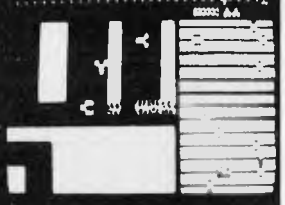

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Australian Personal Computer

SHOW NEWS

The 1st Australian Personal Computer Show

Centrepoint Sydney
10-12 March 1983

ACS backs Personal Computer Show

Recognition of the significance of The 1st Australian Personal Computer Show, 10–12 March 1983, and the industry support it has attracted, has been given by the NSW branch of the Australian Computer Society. It has announced plans to stage a top-level personal computer conference programme timed to coincide with the exhibition. The two events will be linked in a joint promotional effort highlighting the benefits of attending both functions.

International guest speakers, acclaimed leaders in their fields, are being specially brought to Australia. They will be speaking on a variety of subjects designed to appeal to a broad profile of existing and prospective microcomputer users.

The conference will focus on key issues relating to the enormous impact of the personal computer on society today. Subjects covered will range from the business and professional applications of the microcomputer through to the social implications of the personal computer boom now sweeping the industrialised world. Specialised technical sessions and a look at the state of the microcomputing art will ensure that the conference programme satisfies the insatiable appetite of the most enthusiastic computer buff as well as providing 'down-to-earth' practical information for the first time user.

The move by the Society to support a specialised personal computer exhibition is a reflection of the changes which are taking place in the computer field. The personal computer market is growing at an astounding rate against the background of an economic environment which is widely accepted as a world depression. Personal computer sales are representing a rapidly increasing share of the overall computer market. By 1984 it is probable that personal computer sales in Australia will exceed $200 million per annum as compared to an estimated $50 million today. The entry of the corporate giants, IBM, Digital Equipment, NEC and others into the battle for a share of the personal computer market is a clear indication that the stakes are very high.

The combined impact of Australia's largest ever microcomputer exhibition now complimented by a prestigious ACS-organised conference programme, will ensure that Sydney is host city to one of the most exciting events ever staged for the computer industry.

Further details of the conference programme may be obtained from Australian Computer Society Inc, New South Wales Branch, Science Centre, 35–43 Clarence Street, Sydney, NSW 2000. Telephone: (02) 290 3887.

London's Personal Computer World Show

This year's Personal Computer World Show at the Barbican Centre in London from September 9–12 broke all previous attendance records. In one year the exhibition has grown by 300 per cent. The net visitor figure this year was 47,460 – as compared with 16,200 in 1981. Exhibitors reported plentiful orders being taken direct from the stand for microcomputers, software peripherals and books. The Personal Computer World Show and The 1st Australian Personal Computer Show are both organised by members of the UK's Andry Montgomery group.

Big names back Personal Computer Show

Recent confirmed bookings for The 1st Australian Personal Computer Show include industry leaders Tandy, Commodore and NEC. The list of exhibitors has taken on the appearance of a 'Who's Who' of computer companies boasting such names as IBM, Digital Equipment, Texas Instruments, Sharp, Sanyo, Sigma Data, Osborne, Computerland, The Computer Company and many others.

With new products being announced almost daily, The 1st Australian Personal Computer Show provides buyers with an ideal opportunity to see and compare the latest Microcomputer developments at one convenient location. Manufacturers and suppliers now have a specialised event aimed at the rapidly expanding multi-million dollar Australian personal computer market, predicted to expand at least 4-fold in the next 4 years.

Mr Graeme Selby, Director of Australian Exhibition Services Pty Ltd, said, "The strong sales response to The 1st Australian Personal Computer Show clearly reflects the growing preference for specialised exhibitions in Australia. This trend had long been apparent overseas and is recognised as the most effective method of attracting a precise audience." He added, "An exhibition is the ideal marketing medium for microcomputer companies: it provides face to face contact with the buyer and facilitates sales by helping to overcome fear of the unknown. The 'user-friendly' aspect of the microcomputer can be projected with great effect."

How personal?

The exhibition title The 1st Australian Personal Computer Show has aroused a variety of responses from different sectors of the microcomputer industry. They range from "Pity you've chosen the wrong name for the show" to "With a name like that we simply have to be there."

It seems that the term "personal computer" can be variously defined as synonymous with microcomputer; restricted to microcomputers for hobby use; descriptive of desktop microcomputers; microcomputers under $10,000 and single user microcomputers.

The only point on which there does seem to be a consensus is that a personal computer is based on a microprocessor unit. Right or wrong, we are using the term "personal computer" to describe a single user microcomputer suitable for applications in commerce and industry, science, education, other specialised professions and the home.

Great names at a great show

Acorn
Adaptive Electronics
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Anderson Digital Equipment
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Apple
Atari
Attache
Australian Business Computer
Australian Personal Computer
Barson
BBC Computers
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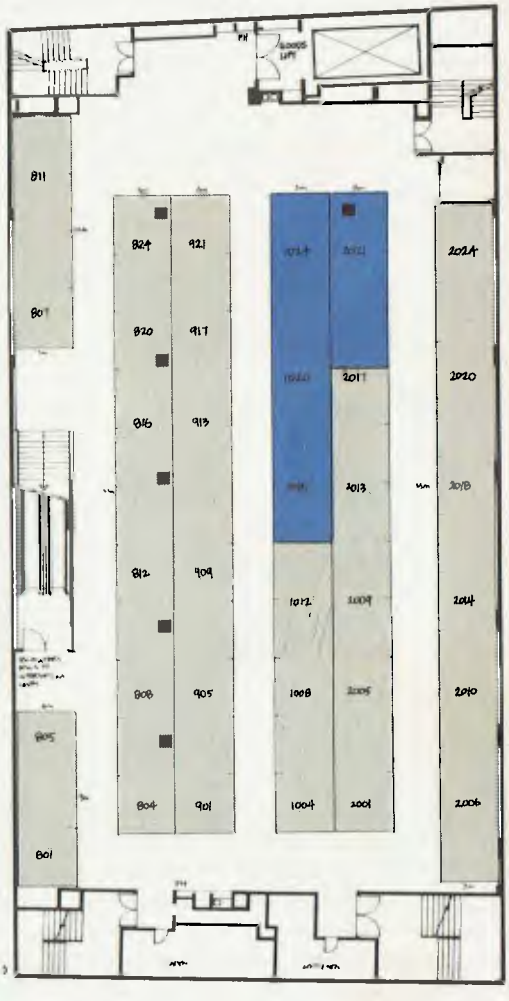

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Hall Column Base Measurement 950 x 350mm

Buyer promotion campaign underway

With 3½ months to go before the show opens, the buyer promotion campaign is well under way. Promotional material including brochures, invitation tickets, letter stickers, car stickers and posters are being forwarded to exhibitors over the coming weeks. Carefully co-ordinated advertising with major daily newspapers, the trade press, Australian Personal Computer and Australian Business Computer has been scheduled for the months leading up to the exhibition. Business and professional associations are being provided with access to brochures and half price invitation tickets to encourage the attendance of their members.

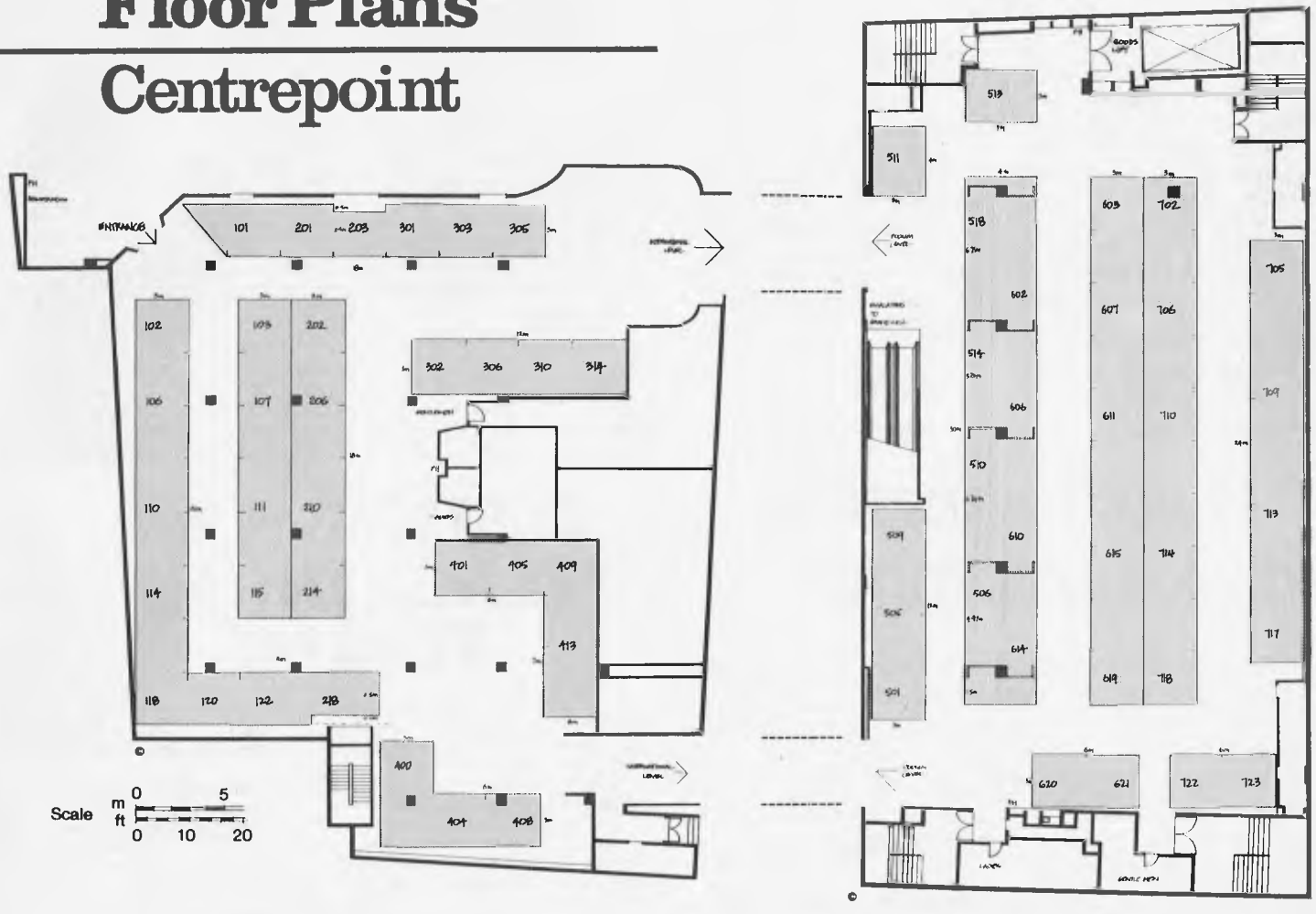
Promotion for the show is geared to the precise requirements of the exhibitors. It has been specifically designed to attract the prospective buyer whether he falls into the category of businessman or home user. In particular, the promotion takes into account the fact that many first time buyers may not yet be readers of the computer trade press or computer magazines. Consequently a significant proportion of the promotional budget will be spent with the daily newspapers which reach vast numbers of prospective personal computer buyers.

In accordance with our desire to attract an audience of buyers rather than simply "lookers" a quality control mechanism has been introduced to limit the number of non-buyers. An entrance charge of $3.00 has been instituted. Invitation tickets distributed by exhibitors and the organisers will admit visitors at half price and $1.00-off discount vouchers will be included in all advertisements. The nominal entry charge will help maintain the quality of the audience at the required level.

'Don't panic — I left the printer running on my pocket calculator'

Floor Plans

Centrepoint



PODIUM LEVEL

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These plans subject to alteration.

INTERNATIONAL LEVEL

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PerCompAsia 82

Following a recent visit to Singapore for PerCompAsia (20–23 October 1982) Graeme Selby reports the event was an outstanding success. The exhibition was staged on a remarkably short lead time of about 6 months and took place at the Hyatt Convention Centre. It attracted buyers from throughout the ASEAN region at the rate of approximately 3,000 per day. All the big names were represented at the show including IBM, ICL, NEC, Apple, Tandy and Commodore.

From the outset of the exhibition, large orders were reported by the exhibitors. After only two days of the exhibition a local Singapore company Action Computers Pty Ltd claimed sales totalling A$250,000. Not surprisingly the elated Managing Director, Mr G Pasuopathy, confirmed his interest in a larger site in 1983!

The exhibition was accompanied by a successful conference programme which was held alongside the show at the Hyatt Hotel. Guest speakers included Mr Adam Osborne who attracted considerable press attention. He was reported to have commented, '. . . that to be No 1 you do not have to have the best product. You do not even have to have a good product. You have to have an adequate product that is properly supported and readily available'.

PerCompAsia is organised by Singapore Exhibition Services, a member of the UK's Andry Montgomery group. Details of PerCompAsia 83 are available through Australian Exhibition Services.

Who's behind the show?

The emergence of Australian Exhibition Services is a result of the close ties between Director, Graeme Selby and the prestigious London based Andry Montgomery group. Mr Selby spent 7 years in London working for Andry Montgomery Ltd and during that time gained valuable experience running exhibitions in a variety of locations including Bahrain, Singapore, New York, Riyadh and London.

The Andry Montgomery group is one of the most successful companies in the field of exhibitor organisation management and consultancy. It is responsible for a show program which spans 14 countries and 5 continents and includes the Personal Computer World Show in London, PerCompAsia in Singapore and now The 1st Australian Personal Computer Show.

What the exhibitors say

MEMOREX. Robert Ek, National Media Manager.
The Exhibition will help Memorex to become a household name in flexible discs and ensure that other equipment manufacturers are aware of the presence of Memorex.

The 1st APC Show provides an opportunity for the user to see the many different software programmes currently available. Never before has there been a show aimed directly at the personal computer on a level for the consumer, as personal computers are now well within the price range of the average income earner.

COMPUTERLAND. Peter Allen, Development Manager.
We are entering the exhibition to increase the public awareness of Computerland and to promote our number one position. The exhibition is an opportunity to meet with the public and to inform them of what Computerland is all about.

COMMODORE. Roger Davis, National Sales Manager.
It is the 'first', the 'only' and therefore the most important personal computer show in Australia. There are many general exhibitions including computers ranging from mainframes to microcomputers. We would not dare be left out of this one because the personal computer is really what we are all about. We think the 1st APC Show will be a success because we are dealing with a massive market.

NEC. Jolyon Bone, Marketing Manager.
Following the announcement of The 1st APC Show it was very noticeable that other general computer shows became more personal computer oriented. At NEC we think that The 1st APC Show is the one to be at if you regard your company as being strong in personal computers.

In Japan we have 45% of the personal computer market, our share in the USA is increasing and I see us as taking a larger share of the Australian market. We are a force to be reckoned with and we shall be at The 1st APC Show to demonstrate our ability.

THE COMPUTER COMPANY. Garry Blom, Managng Director.
The personal computer is rapidly becoming an identity on its own. When exhibited alongside minicomputers and mainframes it can be very confusing for the first time buyer. It is important that personal computers should stand out on their own in a specialised show.

I foresee that the personal computer will develop quite separately from the computer industry.

AUSTRALIAN PERSONAL COMPUTER. Sean Howard, Publisher.
As sponsor of the exhibition we are delighted with the interest generated by The 1st Australian Personal Computer Show. It closely follows our own experience. With the backing and enthusiasm of the microcomputing industry Australian Personal Computer has the highest circulation of any computer publication in Australia. We have more pages and more advertising than any other computer monthly and there are no signs of decrease in the role of development. There is little doubt in our minds that The 1st Australian Personal Computer Show will be the outstanding event of its type in Australia.

Huge increase in desktop computers

A recent report in Melbourne's "Age" claimed that "There will be one desktop computer for every six people in Australia by 1985 if sales continue at today's rate."

Predicting this at a recent IDC Research Australia industry briefing in Sydney, Mr Millard Lowe, an IDC consultant, gave projected figures for desktops as 185,000 by 1985.

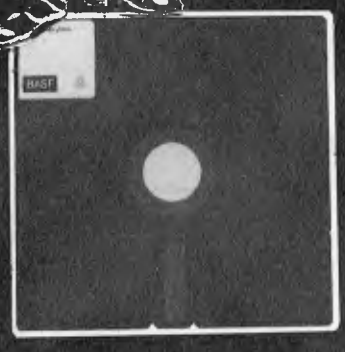
"The business professional market is where it's at," Mr Lowe said. "By 1985 there will be one desktop computer for every two businesses, or every six people."

RESERVE YOUR PLACE IN THE FUTURE

With informed sources predicting a major shake-up in the personal computer industry over the coming years, now is the time to reserve your place in the future by securing space at Australia's largest microcomputer exhibition.

The 1st Australian Personal Computer Show is set to occupy all the available exhibition space at Sydney's Centrepoint from March 10–12, 1983. Interest in this specialised personal computer event reflects the importance of microcomputers within the computer market. By 1985 it is anticipated that mainframe computers will comprise only 30% of the total market as compared with 70% in 1975.

ACT NOW to book one of the few remaining sites by contacting Australian Exhibition Services Pty Ltd, 1250 Malvern Road, Malvern, Victoria 3144. Telephone: (03) 20 1208. Telex: AA 39329.



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APC SUBSET

by Ian Davies

More machine language subroutines to add to your rapidly expanding library of useful utilities. As always, contributions are very welcome and should be sent to APC SUBSET, care of APC.

6502 relative call

The ability to call subroutines based on a relative displacement is essential to implementing completely relocatable programs. Our first data sheet for this month is from Gavin Every and provides a relative call mechanism for the 6502 processor.

The displacement of the subroutine is specified in the byte following the JSR RLTVL instruction. Gavin's routine is completely self-contained in that it does not call any other *APC* SUBSET routines. RLTVL does use bytes M0 and M1 of the SUBSET work area, which may be situated anywhere in your 6502 address space.

Datasheet

```
;= RLTVL - Relative call
;/CLASS: 1 (if interrupt routines save M0, M1)
;/TIME CRITICAL?: No
;/DESCRIPTION: Causes a call to the address formed by
;/             adding the displacement, given in the byte
;/             following JSR RLTVL instruction to the
;/             address of the next byte following the
;/             displacement byte
;/ACTION: S=S-2
;/        Save all registers and M0, M1 (lo, hi)
;/        Return addr = return addr + 1 (on stack)
;/        New jump addr = return addr+disp+1
;/        Restore M0, M1 and registers
;/        Jump to calculated addr
;/SUBr DEPENDENCE: None
;/INTERFACES: None
;/INPUT: The byte following the JSR RLTVL instruction
;/       holds the signed displacement
;/OUTPUT: The program counter is set to the addr of the
;/        displaced routine to be executed
;/REGs USED: None
;/STACK USE: 8
;/LENGTH: 67
;/TIME STATES: 131 to 139
;/PROCESSOR: 6502
;
RLTVL: PHP              ; Room for calculated      08
       PHP              ;  jump addr               08
       PHP              ; Save                     08
       PHA              ;  all                     48
       TXA              ;  the                     8A
       PHA              ;  registers               48
       TYA              ;  on                      98
       PHA              ;  the stack               48
       LDA  M1          ; Save                     A5 ZZ
       PHA              ;  working                 48
       LDA  M0          ;  space                   A5 ZZ
       PHA              ;  on stack                48
       CLD              ; Need binary mode         D8
       TSX              ; X=stack pointer          BA
       INC  $0109,X     ; Incr return              FE 09 01
       BNE  RL1         ;  address - ie, skip      D0 03
       INC  $010A,X     ;  displacement byte       FE 0A 01
RL1:   LDA  $0109,X     ; Move address             BD 09 01
       STA  M0          ;  of displacement         85 ZZ
       LDY  $010A,X     ;  byte to zero page       BC 0A 01
       STY  M1          ;  and Y= hi byte          84 ZZ
       LDX  #0          ;                          A2 00
       LDA  (M0,X)      ; Load displacement byte   A1 ZZ
       BPL  RL2         ; If negative              10 01
       DEY              ;  then decr hi jump byte  88
RL2:   SEC              ; Add 1 plus               38
       ADC  M0          ;  displacement            65 ZZ
       BCC  RL3         ;  to jump addr            90 01
       INY              ;                          C8
RL3:   TSX              ; X=stack pointer          BA
       STA  $0107,X     ; Store jump addr lo       9D 07 01
       TYA              ;                          98
       STA  $0108,X     ; Store jump addr hi       9D 08 01
       PLA              ; Recover                  68
       STA  M0          ;  zero                    85 ZZ
       PLA              ;  page                    68
       STA  M1          ;  bytes                   85 ZZ
       PLA              ;  and                     68
       TAY              ;  registers               A8
       PLA              ;  from                    68
       TAX              ;  stack                   AA
       PLA              ;  and                     68
       RTI              ;  jump to subroutine      40
```

Z80 text handling

The use of microprocessors for text handling is becoming deservedly popular, and nobody who has used a word processor is going to want to go back to typewriter and Tipp-Ex. The trouble is that text takes a lot of space, and who dares buy disks now, when we are constantly being told how much better and cheaper they will be within the year?

So text compression can be very useful. In a previous SUBSET we had PAC/UNPAC to compress characters in the range 20H to 5FH into 6-bit portions of contiguous memory and restore them to full 8-bit characters. This Datasheet, TOKN, from Bruce Tanner of Malvern, gives another way of saving space with a routine to output text that has been 'tokenised'.

The most commonly used phrases, words or groups of letters are given a single-byte token in the range 80H to FFH, allowing for up to 128 tokens. The tokens are defined in an area of memory, each definition being separated by a zero byte. These definitions are not themselves numbered, as the first is taken to be token 80H, the second 81H and so on. As the routine is recursive, a token may be used in the definition of another token. Thus, in the example given by Bruce, the first token is for the letters TH, defined in hexadecimal as

54 48 00; the second is for THE, defined as 80 45 00; the third for THEATRE, defined as 81 41 54 52 45 00. The token 80H in the definition of THE represents the letters TH and the token 81H in the definition of THEATRE represents the word THE.

The 'tokenised' text consists of ASCII characters and tokens and must end in a zero byte. Using the three tokens already defined, the text 'THIS THEATRE IS THE THIRD OF THREE THEATRES' would be 'tokenised' into these hexadecimal bytes: 80 49 53 20 82 20 49 53 20 81 20 80 49 52 44 20 4F 46 20 80 52 45 45 20 82 53 00.

A short example like this doesn't illustrate the saving in space that can be achieved but, in a sample *APC* review, Bruce counted nearly 100 'the's. If the 'the', including a space on either side, had been held as a single-byte token, space of nearly 400 bytes would have been saved on account of that one word alone.

Try the TOKN routine and then determine the 128 most space-saving tokens for normal English usage. We will be glad to publish any useful ideas on this. Once we have decided on the best tokens, we will need a routine to convert normal text to 'tokenised' text.

Datasheet

```
;= TOKN - outputs 'tokenised' text in full ASCII
;/CLASS: 2 (not position independent)
;/TIME CRITICAL?: No
;/DESCRIPTION: Outputs ASCII text, expanding tokens into full text
;/ACTION: Outputs all ASCII characters. Recursively expands tokens
;/        into ASCII
;/SUBR DEPENDENCE: subroutine OUTPUT to put the ASCII character
;/                 in the A register to the screen/printer, etc
;/INTERFACES: Two areas of memory. The first holds text consisting
;/            of ASCII characters and tokens, in the range 80H to
;/            FFH, representing groups of letters, words or phrases.
;/            This 'tokenised' text is terminated by a zero byte.
;/            The second holds un-numbered token definitions,
;/            separated by a zero byte. These definitions may use
;/            other defined tokens.
;/INPUT:  HL points to the first character of the 'tokenised' text
;/        DE points to the first character of the token definitions
;/OUTPUT: Normal text starting from current video/printer position
;/        HL points to the end of 'tokenised' text + 1
;/        DE is unchanged
;/REGs USED:   AF, B, DE, HL
;/STACK USE:   depends on the extent to which recursion caused
;/             by token definitions
;/LENGTH: 37
;/PROCESSOR: Z80
TOKN:  LD   A,(HL)    ; Pick up character          7E
       INC  HL        ; Point to next              23
       OR   A         ; End of text?               B7
       RET  Z         ; Z=1 if done                C8
       PUSH HL        ; Save text position         E5
       BIT  7,A       ; Token?                     CB 7F
       CALL NZ,TKN2   ; Go if yes                  C4 YY YY
       CALL Z,OUTPUT  ;  else output character     CC XX XX
       POP  HL        ; Restore pointer            E1
       JR   TOKN      ; Do it again                18 F0
TKN2:  PUSH AF        ; Save flags                 F5
       PUSH DE        ; Save token defn pointer    D5
       AND  7FH       ; Reset bit 7 and test if zero  E6 7F
       JR   Z,TKN6    ; DE points to token defns   28 08
       LD   B,A       ; B = token number           47
TKN4:  LD   A,(DE)    ; Search                     1A
       INC  DE        ;  for                       13
       OR   A         ;  correct                   B7
       JR   NZ,TKN4   ;  token                     20 F8
       DJNZ TKN4      ;  text                      10 F9
TKN6:  EX   DE,HL     ; HL = pointer               EB
       POP  DE        ; Restore pointer            D1
       CALL TOKN      ; Recurse back again         CD YY YY
       POP  AF        ; Restore flags              F1
       RET            ; Return                     C9
```

Z80 bubble sort

Here is an interesting sort from John Hardman. What makes it interesting is that it can sort strings of specified length from within larger blocks of memory. It can therefore be used to sort multi-dimensional arrays. John uses the routine himself for sorting athletics teams into the order of their scores – the lowest score wins.

Datasheet

```
;=BSORT - Bubble sort
;/CLASS: 2 (registers not saved & references to absolute
;/        addresses)
;/TIME CRITICAL?: No
;/DESCRIPTION: Sorts strings of any length into ascending
;/             order from within larger blocks of memory
;/             if required, on either one or two-byte keys.
;/ACTION: Set number of comparisons to go = number of
;/         strings less one
;/         Zeroise string switch indicator
;/         Compare each set of adjacent strings
;/         Switch strings whenever 1st string pair>2nd string
```


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```
;/        pair and set switch indicator
;/        Decrease the number of comparisons to go by 1
;/        Repeat until a complete pass made without switching
;/        any strings
;/SUBr DEPENDENCE: None
;/INTERFACES: 18 bytes of directly addressed RAM, used for
;/            input parameters or working storage and a
;/            further block of RAM, the length of one string
;/            to be sorted, used for temporary storage
;/INPUT: The area of RAM to be sorted.
;/       The following parameters set in RAM before the
;/       routine is entered:
;/       NUMBR: 2 bytes - the number of strings to be sorted
;/       START: 2 bytes - the addr of the 1st char of the 1st
;/                        string to be sorted
;/       DISPL: 2 bytes - the difference between the addresses
;/                        of the 1st char of two consecutive
;/                        strings
;/       TEMP:  2 bytes - the addr of STRST to hold 1 string
;/       LENTH: 2 bytes - the no of chars in the string to
;/                        be sorted
;/       POSTN: 2 bytos - the pos'n in the string, numbering
;/                        from the 1st string byte as 1, of the
;/                        1st sort key byte.  With a 2-byte key,
;/                        the 1st byte is the high order byte.
;/       BIT:   1 byte  - Set to 8 for a 1-byte sort key, else
;/                        a 2-byte sort ket is assumed
;/OUTPUT: The area of RAM sorted
;/        Other input unchanged
;/REGs USED: AF, HL, DE, BC
;/STACK USE: 2
;/LENGTH: 161
;/PROCESSOR: Z80
;
STRST:  DEFS   nn          ; When nn=no of chars in a string
NUMBR:  DEFS   2
START:  DEFS   2
DISPL:  DEFS   2
TEMP:   DEFS   2
LENTH:  DEFS   2
POSTN:  DEFS   2
BIT:    DEFS   1
TOGO:   DEFS   2                ; Holds no of strings still
                                ;  to be compared
FLAG:   DEFS   1                ; Set when an exchange of strings
                                ;  made
ADDR:   DEFS   2                ; Addr of 1st sort key currently
                                ;  being processed
BSORT:  LD     HL,(NUMBR)       ; Set no of comparisons    2A YY YY
        DEC    HL               ;  to go=no of strings     2B
        LD     (TOGO),HL        ;  less 1                  22 YY YY
        SUB    A                ; Zeroise string           97
        LD     (FLAG),A         ;  switch indicator        32 YY YY
        LD     HL,(START)       ; Get addr                 2A YY YY
        LD     DE,(POSTN)       ;  of 1st string sort      ED 5B YY YY
        ADD    HL,DE            ;  key into                19
        DEC    HL               ;  HL and                  2B
        LD     (ADDR),HL        ;  store it                22 YY YY
BS4:    LD     D,(HL)           ; Get first byte           56
        INC    HL               ;  of 1st sort key         23
        LD     E,(HL)           ;  and next byte           5E
        PUSH   HL               ;  into DE                 2B
        LD     A,(BIT)          ; If one-byte              3A YY YY
        CP     8                ;  sort key                FE 08
        JR     NZ,BS1           ;  indicated,              20 02
        LD     E,+0             ;  zero E reg              1E 00
BS1:    LD     BC,(DISPL)       ; Get addr of next string  ED 4B YY YY
        ADD    HL,BC            ;  sort key into HL        09
        LD     B,(HL)           ; Get first byte           46
        INC    HL               ;  of second sort key      23
        LD     C,(HL)           ;  and next byte           4E
        DEC    HL               ;  into BC                 2B
        CP     8                ; If one-byte sort         FE 08
        JR     NZ,BS2           ;  indicated,              20 02
        LD     C,+0             ;  zero C reg              0E 00
BS2:    LD     HL,(ADDR)        ; Get 1st string sort koy  2A YY YY
        LD     A,B              ; Compare adjacent         78
        CP     D                ;  strings and if          BA
        JP     M,BS5            ;  1st string key          FA YY YY
        JR     NZ,BS6           ;  less than or            20 42
        LD     A,C              ;  equal to                79
        CP     E                ;  2nd string key,         BB
        JP     P,BS6            ;  jump                    F2 YY YY
BS5:    LD     DE,(POSTN)       ; Else adjust addr         ED 5B YY YY
        AND    A                ;  in HL to                A7
        SBC    HL,DE            ;  start of                ED 52
        INC    HL               ;  1st string              23
        LD     DE,(TEMP)        ; Get addr of STRST in DE  ED 5B YY YY
        LD     BC,(LENTH)       ; Get string length in BC  ED 4B YY YY
        LDIR                    ; Move 1st string to temp  ED B0
        LD     DE,(LENTH)       ;  store, point HL back    ED 5B YY YY
        AND    A                ;  to start of 1st         A7
        SBC    HL,DE            ;  string and              ED 52
        PUSH   HL               ;  save it on stack        E5
        LD     DE,(DISPL)       ; Get start of 2nd         ED 5B YY YY
        ADD    HL,DE            ;  string into HL          19
        POP    DE               ; Get start of 1st string  D1
        LD     BC,(LENTH)       ; Get string length in BC  ED 4B YY YY
        LDIR                    ; Move 2nd string to 1st   ED B0
        LD     DE,(LENTH)       ;  string place, point HL  ED 5B YY YY
        AND    A                ;  back to                 A7
        SBC    HL,DE            ;  start of                ED 52
        PUSH   HL               ;  2nd string and          E5
        POP    DE               ;  put it in DE            D1
        LD     HL,(TEMP)        ; Get addr of STRST in HL  2A YY YY
        LD     BC,(LENTH)       ; Get string length in BC  ED 4B YY YY
        LDIR                    ; Move 1st string to 2nd   ED B0
        LD     A,+1             ;  string place, set indic 3E 01
        LD     A,(FLAG)         ;  to show strings switched 32 YY YY
BS6:    LD     DE,(DISPL)       ; Store addr               ED 5B YY YY
        LD     HL,(ADDR)        ;  of next                 2A YY YY
        ADD    HL,DE            ;  sort key                19
        LD     (ADDR),HL        ;  in ADDR                 22 YY YY
        LD     DE,(TOGO)        ; Reduce the number of     ED 5B YY YY
        DEC    DE               ;  comparisons to go by 1  1B
        LD     (TOGO),DE        ; If the number of         ED 53 YY YY
        LD     A,D              ;  comps to go <>0         7A
        OR     E                ;  jump to compare next    B3
        JP     NZ,BS4           ;  pair of strings         C2 YY YY
        LD     A,(FLAG)         ; Else if strings exchanged 3A YY YY
        CP     1                ;  jump back to start      FE 01
        JP     Z,BSORT          ;  of next pass            CA YY YY
        RET                     ; If no strings exchanged  C9
```


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Graphics package

The remainder of this months SUBSET has been contributed by Dave Barrow, who has developed a powerful set of routines for graphics manipulation on memory mapped Z80 machines. The routines are as hardware independent as possible, and I think make an excellent basis for writing fast moving graphics programs. Over to Dave . . .

The general-purpose RAM file handling routine, DIFA, has wide application in all aspects of computing. As used here, in creative recreational computing, a file is either one shape table (with number of records, record length of 3 and records being the 3-byte vectors defining the shape) or one of the matrices for transformation (with number of records = 16, record length = 1 and records being the 1-byte entries to TFORM or the quicker but limited version QTFORM). In the index, DIFILE, holding 2-byte displacements from the DIFILE base address to the base addresses of the other files, the first two bytes are not used, as the displacement to file 1 is at the third and fourth bytes, the least significant byte to the displacement is given first at the lower addressed byte of DIFILE, followed by the most significant byte.

To the accompaniment of many groans, I invite you all to take another look at the following.

Tables

The 6502 has a couple of very powerful addressing modes – pre-indexed indirect. The Z80 really can't match them, and so I wrote a routine, CMTA, which repositions HL at byte B of Table C when input HL points at the base addresses. A routine such as CMTA may be useful for anyone who has lots of single-byte-entry tables to deal with.

My first Datasheet DIFA, although larger and slower than CMTA, is of more general use. Allowing up to 356-byte entries classifies it as a file in-RAM handing routine rather than a table-handling routine, but it is for its reasonably efficient handling of matrix and shape tables that I have included it in this set.

Datasheet

```
;= DIFA - Displacement Indexed File Addressing

;/ CLASS: 1
;/ TIME CRITICAL ?: No
;/ DESCRIPTION: Main routine of a File/Table handling system.
                 All files formatted: byte 1 = No. of Records
;
;/                                    byte 2 = Length of Records
;/                                    up to 256 Records.
;/              The Index File (DIFILE) Records are the 2-byte displacements
;/              calculated by FILE BASE ADDRESS minus DIFILE BASE ADDRESS.
;/ ACTION:      POINT <-- DIFILEBASE + (FILENUMBER * 2)
;/              READ FILEDISP
;/              POINT <-- DIFILEBASE + FILEDISP
;/              READ NUMOFRECS, RECLENGTH: INCREMENT POINT TO RECORD1
;/              DECREMENT RECREQUEST
;/              IF = 0 THEN END
;/                    ELSE POINT <-- RECORD1 + (RECREQUEST * RECLENGTH)
;/              END
;/ SUBr DEPENDENCE: None
;/ INTERFACES:  None
;/ INPUT:       HL = DIFILE BASE ADDRESS
;/              C = Requested File number
;/              B = Requested Record number      00H = 256
;/ OUTPUT:      (HL) = First byte of Requested Record
;/              B = Number of Records in File
;/              C = Length of Record             00H = 256
;/ REGs USED:   HL B C
;/ STACK USE:   6 max.
;/ LENGTH:      43
;/ TIME STATES: Record 1: 168  Records 2 - 256: 555 to 603
;/ PROCESSOR:   Z80

DIFA:   PUSH AF         ;                                F5
        PUSH HL         ;save DIFILE BASE                E5
        LD   A,B        ;save Record number              78
        LD   B,0        ;BC <-- File number              06 00
```


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Media & Formats
The list of available formats is subject to chenge without notice. If you do not see your computer listed or are uncertain, call to confirm the format code for any particular equipment.

AES SUPER PLUS IV . . . M4
ADDS Multivision . . . RT
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Altair 8800 . . . B1
Altos . . . A1
Apple CP/M 13 Sector . . . RG
Apple CP/M 16 Sector . . . RR
Archives 1 . . . SG
AVL Eagle I . . . RB
AVL Eagle II . . . ST
BASF System 7100 . . . RD
Blackhawk Micropolis Mod II . Q2
BMC IF-800 . . . SR
California Computer Sys 8in. . A1
CDS Versatile 3B . . . Q1
CDS Versatile 4 . . . Q2
Columbia Data Products 8in. . A1
Columbia Date Products 5 26inS4
Compal 80 . . . Q2
Commodore CBM/PET w/SSE Box + 8050 . . . C2
Commodore CBM/PET w/Maddison Z-RAM + 8050C4
Compal 80 . . . Q2
Computer Dps N C HQ . . . S2
Control Data 110 . . . A1
CPT 8000 . . . A1
Cromemco System 3 . . . A1
Cromemco System 2 SD/SS . . R6
Cromemco System 2 DD/SS . .RX
Cromemco System 2 DD/DS .RY
CSSN Backup . . . T1
Datapoint 1550/2150 . . . A1
Datapoint 1550/2150 DD/SS .AA
Datapoint 1550/2150 DD/DS .AB
Datavue DU80-222 5.25in . . .M7
DECVI 1B X
Delta Systems . . . A1
Digi-Log Microterm II . . . RD
Digi-Log System 2000 . . . RD
Digi-Log System 1000 . . . RD
Digi-Log System 1500 . . . RD
Direct DA1000 . . . M2
DTC Micro 210A . . . SC
Durango F-85 . . . RL
Dynabyte DB8/2 . . . R1
Dynabyte DB8/4 . . . A1
Exidy Sorcerer + Lifeboat CP/M 80 5.25 in .RW
Exidy Sorcerer + Exidy CP/M 80 8in . . . A1
EXD . . . A1
Exxon 510 . . . M5
Exxon 520 . . . M5
Findex . . . P6
Godbout (MS-DDS) . . . E1
Heath H8 + H47 . . . A1
Heath H89 + Magnolia CP/M 80 . . . P7
Heath H89 + Heath CP/M 80 . P7
Helios II . . . B2
Heurikon MLZ SS/DD . . . SN
Heurikon MLZ DS/DD . . . SD
Heuristics HCC Spectrum . . . A1
HP-87 5.25in . . . 5B
Hewlett-Packard 125 5.25in . . SB
Hewlett-Packard 125 8in. . . . A1
IBEX 7100 . . . RQ
IBM Personal Computer . . . G2
ICDM2411 Micro Floppy . . . R3
ICDM3712 . . . A1
ICDM3812 . . . A1
ICDM 4511 5440 Cartridge CP/M 80 V1.4 . . . D1
ICDM 4511 5440 Cartridge CP/M 80 V2.X . . . D2
ICL PC10 . . . SD
IMS 5000 . . . RA
IMSAI VDP-40 . . . R4
IMSAI VDP-42 . . . R4
IMSAI VDP-44 . . . R5
IMSAI VDP-80 . . . A1
Industriel Microsystems 5000 .RA
Industrial Microsystems . . . A1
Intel IPDS DS/DD . . . M6
Intel MDS SD/DD . . . A1
Intersil Develop System . . . A1
Inter Systems Ithaca 800 . . . A1
Intartec Superbrain DDS0.1 . . R7
Intartec Superbrain DDS0.5-2x RJ
Intertec Superbrain DOS 3x . .RK
Intertec Superbrain QD . . . RS
ISC Intecolor 8063/8360/8963A1
Kaypro . . . S6
Lanier E 1 . . . M3
Lanier Super + 4 (AES) . . . M4
Lanier Super No problem (Lanier) . . . M4
Lexitron VT1303 DSDD . . . S8
Lexor Alphasprint Model S1 . . S1
Lexor Lexoriter . . . S1
Meca Delta 1 5.25in . . . P6
MICDM2001 . . . B3
MICOM2001E . . . B4
MICDM3003 . . . M1
Micromation . . . A1
MicroMega 85 . . . SC
Micropolis Mod I . . . Q1
Micropolis Mod II . . . Q2
MITS 3200-3202 . . . B1
Monroe OC 8820 DD/SS . . . SW
Morrow Discus . . . A1
Mostek . . . A1
MSD 5.25in . . . RC
MULTI-TECH-I . . . Q2
MULTI-TECH-II . . . Q2
Nascom (Gemini drives) . . . R3
Nascom II with Lucas Drives . SL
National MSC 6600 . . . A1
NCR81 40/9010 . . . A1
NEC PC-8001 . . . RV
Nicolet Logic Analyser Model 764 . . . SX
NNC 80/80W . . . A1
NNC 80 . . . A1
North Star SD . . . P1
North Star DD . . . P2
North Star QD . . . P3
Northern Telecom 603 . . . SM
Nylac Micropolis Mod II . . . Q2
Ohio Scientific C3 . . . A3
DKI IF-800 + MSA CP/M 80 . SP
DKI IF 800 + DKI/Lifeboat CP/M 80 . . . SR
(Above DKI entries replace catalog entry for DKI IF 800 format code RZ)
Osborne 1 5.25in . . . SA
Otrona Attache . . . MC
Pertec PCC 2000 . . . A1
PET/CBM w/Small Systems Engineering Box + 8050 . . C2
PET/CBM w/Madison Z-RAM + 8050 . . . C4
Philips MICDM 2001 8in. . . . B3
Philips MICOM 2001E . . . B4
Philips MICDM 3003 . . . M1
Philips P-2000 . . . MA
Processor Technology Helios II B2
Quasar QDP100 . . . A1
Quay 500 . . . RD
Quay 520 . . . RP
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RAIR SD . . . R9
RAIR DD . . . RE
Research Machines 5.25in . . .RH
Research Machines 8in . . . A1
Sanco 7000 5,25in . . . RQ
Sanyo MBC 1000 . . . SY
Sanyo MBC 2000 . . . SS
Sanyo MBC 3000 . . . A1
Seattle (16-bit) . . . E1
SD Systems 5.25in . . . R3
SD Systems 8in . . . A1
Spacebyte . . . A1
Tarbell 8in . . . A1
TEI 5.25in . . . R3
TEI 8in . . . A1
Televideo DD/DS Sys 1(801) . S5
Televideo DD/DS Sys 2 (806) . S5
Toshiba T200 6.25in . . . SF
Toshiba T250 8in . . . A1
Triumph Adler Alphatronic Model P2/64K . . . SV
TRS-80 Model I (Standard Model) . . . R2
TRS-80 I + FEC Freedom . . .RN
TRS-80 I + Omikron 5.25in . RM
TRS-80 Model I + Dmikron 8in . . . A1
TRS-80 Model I + Shuffleboard 8in . . . A1
TRS-80 Model II . . . A1
Vector MZ . . . Q2
Vector System 2800 . . . A1
Vector System B/VIP . . . Q2
Vista V089 5.25in SD . . . R8
Vista V200 5.25in DD . . . P6
Wangwriter . . . SE
WORDPLEX . . . SZ
XERDX 820 5.25in . . . S6
XERDX 820 860 8in . . . A1
ZEDA 580 . . . SH
Zenith Z89 + Magnolia CP/M 80 . . . P7
Zenith Z89 + Zenith CP/M 80. P7
Zenith DD/SS . . . SK
Zenith DD/DS . . . SJ
Zilog MC22-20, 25, 50 . . . A1

Note that Lifeboat programs have specific hardware and memory requirements but will run on most CP/M machines with 48KByte available.
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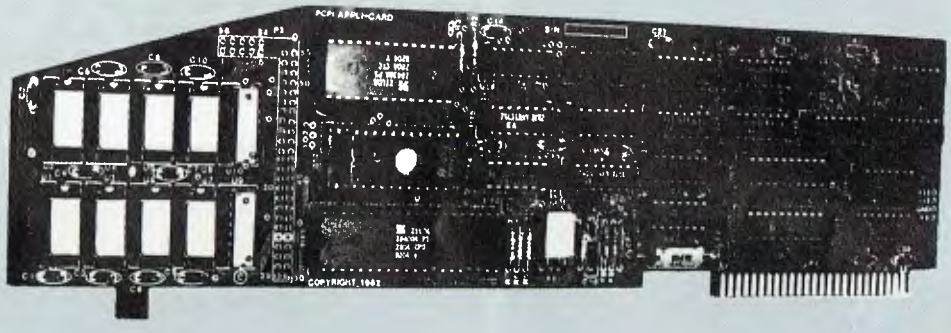

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Real time clock available on the card	No	No	Yes
Expansion interface on the card	No	No	Yes
70 col. upper & lower case	No	No	Yes
A self-contained Z-80A or Z-80B with memory	No	No	Yes
One-card WordStar* execution	No	No	Yes
63K available for program development or execution	No	No	Yes
Menu driven set up	No	No	Yes

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```
        DEC   C         ;(making 00H in C into          00
        INC   BC        ;0100H in BC)                   03
        ADD   HL,BC     ;point at displacement of File  09
        ADD   HL,BC     ;from DIFILE BASE               09
        LD    C,(HL)    ;get displacement               4E
        INC   HL        ;in                             23
        LD    B,(HL)    ;BC and                         46
        POP   HL        ;add to                         E1
        ADD   HL,BC     ;DIFILE BASE                    09
        LD    B,(HL)    ;get number of records          46
        INC   HL        ;and                            23
        LD    C,(HL)    ;length of Records and          4E
        INC   HL        ;point at Record 1, decrementing 23
        DEC   A         ;requested Record number to match 3D
        JR    Z,END     ;jump out if already there     28 14
        PUSH  BC        ;else                           C5
        PUSH  HL        ;multiply                       E5
        LD    L,0       ;requested Record number - 1   2E 00
        LD    B,L       ;by Record length               45
        DEC   C         ;getting result in HL           0D
        INC   BC        ;                               03
        LD    H,A       ;                               67
        LD    A,+8      ;                               3E 08
MUL:    ADD   HL,HL     ;                               29
        JR    NC,CNT    ;                              30 01
        ADD   HL,BC     ;                               09
CNT:    DEC   A         ;                               3D
        JR    NZ,MUL    ;                              20 F9
        POP   BC        ;restore Record 1 Address and   C1
        ADD   HL,BC     ;add to point HL at requested Record 09
        POP   BC        ;restore Number and Length      C1
END:    POP   AF        ;                               F1
        RET             ;                               C9
```

Using displacements to address the files allows for easy relocation of the entire set of files/tables. Only one absolute address is required by DIFA — that of DIFILE base address.

One of the main advantages of video output is the ability to produce visually attractive, changeable, moving graphics displays. 'Sub Set', however, has not made much of a show in graphics routines — probably because graphics are awkward to deal with and are usually program-specific.

The graphics package comprising the other four Datasheets is designed to be general purpose and easy to use. It requires only that shape tables be utilised giving x,y co-ordinates and an ASCII graphic value for each point. DRAW is written for a memory-mapped display with a 64-byte difference between lines and a maximum 64 characters per line, but can easily be adapted to other sizes. Because DRAW copies from an original shape table, multiple images can be entered in display RAM at different points whilst the original keeps its position in relation to the origin. Using signed numbers for the co-ordinates makes cut-off simple to program, as any negative value is actually greater than LINE or CHAR when using the unsigned Carry Flag result to jump out.

Datasheet

```
;=DRAW - Copy shape table figure to memory-mapped display
;/ CLASS:  1
;/ TIME CRITICAL?:  No
;/ DESCRIPTION: Uses vectors and ASCII graphic character from a shape table
;/              and an input translation vector to locate a figure on a
;/              memory-mapped-display.  The origin is located at bottom
;/              left of the display.
;/              Line difference must be 64 bytes.
;/ ACTION:      For each vector in shape table
;/                B <-- LINE - (y + Ty)
;/                IF B < 0 OR B > LINE - 1 then next vector
;/                C <-- x + Tx
;/                IF C < 0 OR C > CHAR - 1 then next vector
```

GOTO page 78

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BENCHTEST
BUSINESS SYSTEM

KAYPRO II

by Stephen Save

The Kaypro II is a recently released portable business computer. It is manufactured by a long-established instrument making company which had the advantage of being able to assess the market's reaction to the most popular portable, the Osborne 1. Obviously the greatest criticism the Osborne has received has been for its small screen and so, Non Linear Systems, the manufacturers of the Kaypro, have equipped their machine with a nine inch screen. Despite this increase the overall size is much the same and it still fits "under an airline seat", if you really want to put it there.

Hardware

The Kaypro II is manufactured with a metal case, and is finished in a combination of grey and blue, making the overall unit very attractive. The physical dimensions are 460mm wide, 385mm deep and 200mm high. The keyboard is a separate unit and during transportation is attached to the main unit with two clips, making the whole unit a robust portable. The main keyboard has 76 full function keys which includes a 14 key numeric keypad (with an enter key) and configurable directional keys.

The heart of the Kaypro is the Z80B CPU and 64k bytes of programmable RAM of which 2k is allocated for bootstrap ROM. Ancillary functions are handled by the other members of the Z80 family bringing the total memory used to 5k, including the Z80P10 and Z80S10. Disk storage is provided by two 5.25 inch Tandon disk drives which are configured for single sided double density, soft sectored, and contain 40 tracks per diskette (5 kbytes per track). Each diskette is therefore capable of holding 200 kbytes of information. Maximum seek time is 12 milliseconds from track to track and rotation time is 200 milliseconds.

The video display is 4k memory mapped and is the standard 80 columns by 24 lines produced on a green phosphor screen (making it a true green screen). The dimensions of the video area are 190mm horizontal by 135mm vertical. The brightness control button is located on the front panel making contrast adjustments easy. Power on, in the form of a small red light, is also located on the front panel. Two ports are provided at the rear of the unit – one for Modem/RS232 serial and one for parallel printer interface. The reset button, video output connector slot and on/off switch are also all located at the rear of the unit.

In use the hardware performed well. However, I would recommend using new diskettes rather than reformatting disks that have been used on other systems, as diskettes used in this way would not always format error free. The screen on the demonstration model produced a flickering when clearing,

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CITY PERSONAL COMPUTERS

Kaypro's keyboard: no prizes to readers spotting the flaw on the unit provided for the Benchtest.

but when static the screen was crystal clear and the screen characters easy to read. The keyboard is a delight to use with positive response each time a character was pressed. In fact, full key depression is not necessary and keyboard use could be maximised by a touch typist. An annoying feature of the Kaypro is the location of the cable that connects the keyboard to the main unit. In use, I found that the main unit rested well on the edge of the keyboard, but that then left the problem of routing the connecting cable so that it was not squeezed or pinched. A far more practical location for the video port would have been on the front of the unit, which would make initial set-up a much simpler operation.

Software

The Kaypro comes with a selection of package software which is included in the overall price of the unit. Packages supplied are:

(a) SBasic – structured basic language facility
(b) Select – wordprocessing system
(c) Profitplan – spreadsheet program
(d) Teach – how to use select

SBasic, according to the supplied manual, is the most advanced and comprehensive Basic available for microcomputers as it maintains the flexibility of Basic, yet includes the power of advanced structuring techniques. From tests that I ran it certainly is a usable Basic, but lacks the realtime compiling facility of MBasic. Instructions in the manual point to using Select for development mode rather than the CP/M editor, so before using SBasic it would be advisable to become familiar with Select. Additional statements provided by SBasic are Repeat-until, While-do, If-then-else, Begin-end, Case-of. There is no limit to the nesting of these statements, except the runtime memory of the machine.

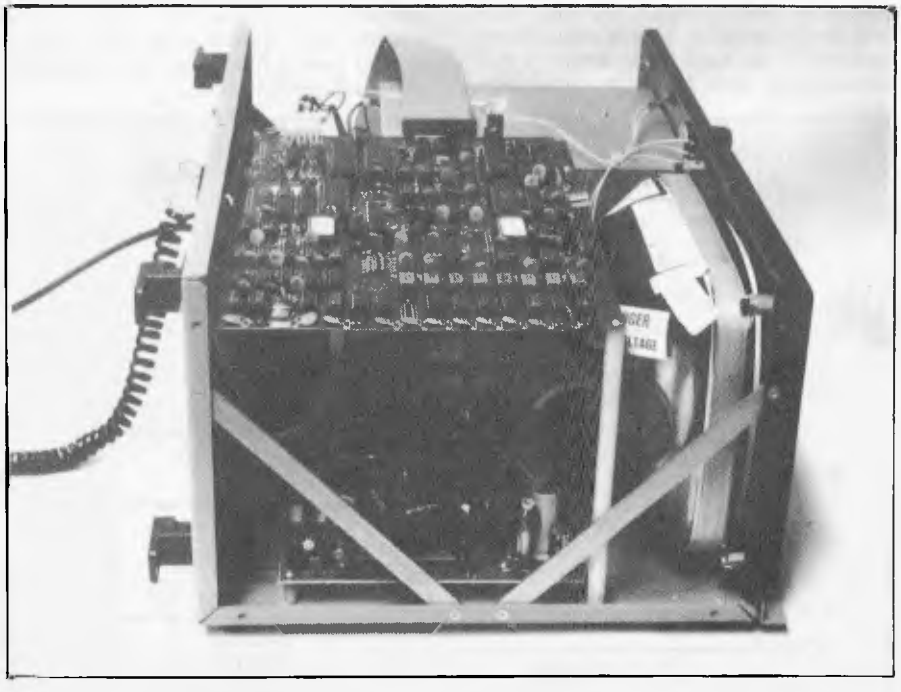
The Teach package is a novel concept and is an instruction package on how to use Select. A little time spent using Teach is well worth the effort as it instructs the user via menus and examples on how the various commands of Select are used. One has to give credit to Select Information Systems Inc for attempting to take user education head-on, rather than avoiding the issue and leaving users to wade through lengthy manuals. Teach therefore leads the user into Select – the word processing system. I found Select to be a viable system for word processing and excellent for program development. In normal word processing applications it tended to be slightly unwieldy, as separate modes were required for deletion and insertion; but all the features of a good word processing system were there, and they all worked.

Profitplan is a business planner developed by Chans Laboratories and is a spreadsheet program designed for data analysis, planning personal investments, etc. It is not difficult to use, and there is an excellent example in the manual to help you get started. A word of warning – it is very unforgiving if you make any mistakes! Profitplan is similar to Visicalc in that complex manipulations of data are possible with the use of formulas, but the available spreadsheet is not as wide as that provided by Visicalc. An obvious advantage of the Kaypro is that with a full 80 character screen the user can view more of the worksheet, and Profitplan also has the ability to generate files which can be used for word processing.

Other CP/M software will run satisfactorily on the Kaypro. Wordstar and Condor database as well as Software Solutions' Cash flow system all performed quite satisfactorily. Wordstar worked simulating a Soroc IQ – 120/140 terminal and Condor simulating a Lear-Seigler terminal. What this means is that although Wordstar and Condor have not yet been released with a configuration that caters for Kaypro, it is still possible to use them on the machine by making them simulate other terminals in the currently available menu list.

System software provided with the machine is excellent and consideration has been extended to the first time user. Of the 4 diskettes provided with the machine, it is only possible to boot the machine from the system disk. If you attempt to boot the system from any of the others, a polite message is produced on the screen which effectively tells you that you are using a library copy – and shouldn't be! At this point, the system is locked and further access to the diskette is refused.

Formatting and copying diskettes is a breeze and the software is reliable and easy to use. A feature of the system software which I found annoying was the baud rate which is set at system load to 300. Baud rates available with Kaypro are 110, 300, 600, 1200, 2400, 4800, 9600 and 19.2k. There is a baud program which enables you to get a varying baud rate up to 19.2k, but if you are not using Select, there is no way of permanently configuring a new baud rate into the system. This proved to be mildly annoying as, when not in Select mode, the baud rate program had to be called each time the system was booted, as my printer was set to 1200 baud. When using Select, the baud rate is



The interior is dominated by the full 9 inch screen's tube.

KAYPRO II

permamently configured when it is installed. So for normal user applications, the baud rate should be no problem.

Documentation

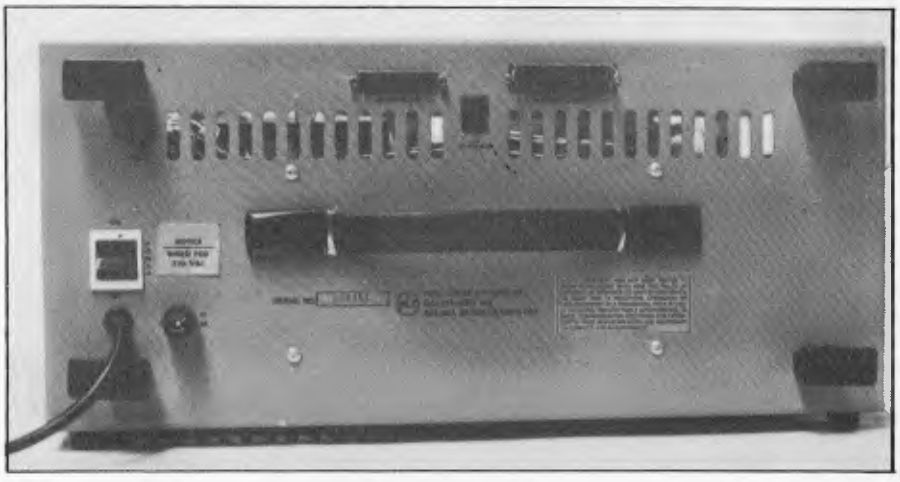
Documentation provided with the Kaypro is of a reasonable standard, with emphasis being placed on the first time user. Separate manuals are provided for SBasic and CP/M, with Select and Profitplan back to back in the same manual. The printing quality of the three manuals does leave a little to be desired – some of the pages are faint and difficult to read and the SBasic manual has several badly creased pages which were not guillotined properly at the printery. The fourth manual is a Kaypro II users' guide, which is really a "getting started" type manual and should be the first item read. A serious omission from a Bench-testing viewpoint was the lack of a hardware manual for the Kaypro, the provision of which would obviously be a great asset to those who are technically minded.

Options available

Currently available on the Kaypro (but not provided for the Benchtest) are a vinyl weatherproof cover which is padded and supplied with a velcro fastener to prevent damage to the machine during transit, a battery pack which would provide true portability and a Select spelling dictionary.

Future growth

There are several options for the Kaypro which are in the pipeline and these will certainly enhance the usability and power of the machine, eg, disk drives will be available in double sided/double density 5 in hard disk drive, K-NET Networking and graphics capabilities.



The "top" of the Kaypro showing handle and ventilation slots. Aesthetically, it leaves a littel to be desired.

Technical Specifications

Processor	–	Z80B, 4MHZ
Memory	–	64k RAM, 25 ROM
Screen	–	9 inch green screen 80 x 24 col.
Keyboard	–	76 Full function which includes 14 numeric keypad and 4 configurable arrow keys.
Disks	–	Two single sided, double density 5.25 inch Tandon drives, 200k bytes per drive.
Ports	–	Two 1. RS232 serial 2. Centronics Parallel
Operating System	–	CP/M 2.2
Languages	–	C-Basic, Cobol, P11, etc.
Supplied Software	–	S-Basic, Select, Teach, Profitplan.

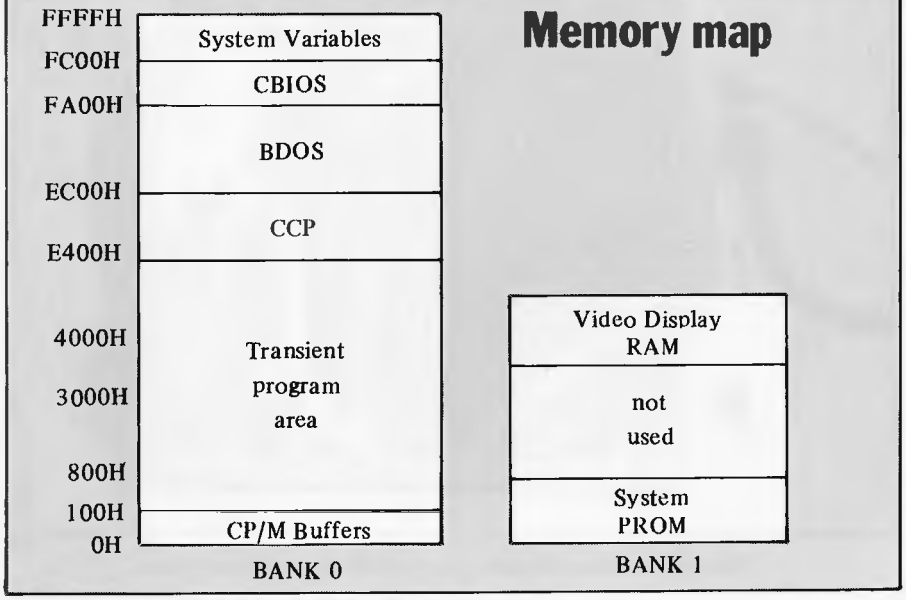
Conclusions

Priced at just under $3000 (including software) the Kaypro is excellent buying and would be an ideal tool for the small businessman, programmer, or for use at home where it would make a good learning tool for young children. The software and packages provided with the machine are all workable tools. I found the Kaypro a delight to use, extremely portable and due to its origins and future proposed options, should have a long standing relationship with the market place.

At a glance

FIRST IMPRESSIONS	
Looks	****
Setting Up	****
Ease of Use	****
HIGH LEVEL LANGUAGES	
SBasic	***
PACKAGES	
Select word processing	***
Teach	****
Profitplan	***
PERFORMANCE	
Processor	****
Disk	****
COMPATIBILITY	
Software	****
DOCUMENTATION	***
VALUE FOR MONEY	****

Memory map



Benchmarks

BM1	2.10
BM2	6.96
BM3	17.96
BM4	18.03
BM5	18.93
BM6	34.70
BM7	56.90
BM8	5.93

All times in seconds (See APC Vol 3 No 9 Sept '82).

Demonstration unit courtesy President Office Machines.

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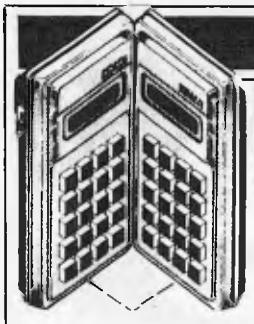


USING CALCULATORS

This month I am publishing two applications: a text processor for the HP-41C by Petter Hesselberg and a solar navigation program for the Casio fx702p by John Harvey — both illustrate the wide scope of applications which are amenable to hand-held calculator solution.
Dick Pountain

A text editor for the HP-41C

```
01 ☒ LBL "TEXT"      35    GTO "SHOW"
02    FIX 0          36 ☒ LBL "NEW"
03    CF 29          37    XEQ "TST"
04    "NO OF REGS?"  38    STO 01
05    PROMPT         39    2
06    2              40    *
07    -              41    CLA
08    2              42    AON
09    /              43    STOP
10    INT            44    AOFF
11    STO 00         45    ASTO IND X
12    1              46    ASHF
13 ☒ LBL "SHOW"      47    1
14    XEQ "TST"      48    +
15    STO 01         49    ASTO IND X
16    2              50    RCL 01
17    *              51    1
18    CLA            52    +
19    ARCL IND X     53    GTO "SHOW"
20    1              54 ☒ LBL "TST"
21    +              55    RCL 00
22    ARCL IND X     56    X<>Y
23    RCL 01         57    X<=Y?
24    PROMPT         58    GTO A
25 ☒ LBL "UP"        59    X<>Y
26    1              60    TONE 0
27    +              61    RTN
28    GTO "SHOW"     62    LBL A
29 ☒ LBL "DOWN"      63    X>0?
30    1              64    RTN
31    -              65    TONE 0
32    GTO "SHOW"     66    1
33    LBL "LINENO"   67    RTN
34    VIEW X         68    END
```

Listing 1 A text editor for the HP-41C

The model 41C computer/calculator from Hewlett-Packard is not the hardware people usually have in mind when thinking of text processing and such. Nevertheless, it is very easy to construct a text editor for the HP-41C. What's more, it can even be somewhat useful, at least in a sort of notebook application. The following deals with one possible design for such a text editor.

As the alpha register in the HP can hold up to 24 characters, it is tempting to use lines of 24 characters each. This, however, results in a lot of horizontal scrolling. Not only can't you see the whole line at one time, but it is also rather slow. So I decided to stick to what the display can hold — namely 12 characters per line. Thus, we need two data registers to hold one line of text, and 2n registers to hold n lines of text.

In addition, we need one register (R0) to hold the highest allowed line number, and one (R1) to hold intermediate results. This means that text line n is stored left part in register 2n, right part in register 2n+1. To have n lines of text, one needs 2n+2 or more free registers. The X-register is used as a pointer to the current line.

What functions are needed for such a notebook text editor? Obviously forward and backward line stepping, as well as the ability to create new lines. In addition, one should be able to jump directly to any line, and to find out the current line number.

It is tempting to endow the program with other and fancier attributes. One must, however, make trade-offs both on size and computing time, and the program functions surprisingly well as it stands. I added one function, but it is used only by the program and not directly by the user. It's called 'TST', and checks whether you're attemtping to access some non-existent line.

The first 12 lines are for initialisation only. The action starts at the segment labeled 'SHOW', which does just that. The number in the X-register is taken as the current line number; the function 'TST' is then used to test its validity. If it is lower or higher than allowed, a TONE is sounded, and the line number is set to the lowest or the highest allowed line number respectively. The relevant addresses are then computed from the line number, and their contents are fetched to the alpha register. In line 24 a PROMPT is executed, to allow one to view the line. This is the program's home base, so to speak; the control flow always ends up here.

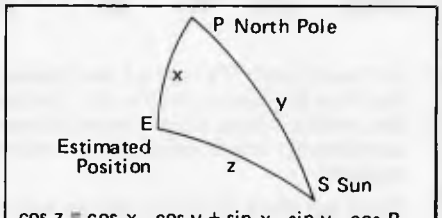
The functions 'UP' and 'DOWN' are more or less self-explanatory; they step one line forwards and backwards. 'LINENO' is even simpler: It allows you to see the current line number for the time it takes to execute 'SHOW' once.

'NEW' is used to input new text. The current line is cleared, and the HP awaits new text in alpha mode. R/S stores the new line in the proper registers, then positions the line counter to the *next* line. This is because one often inputs several lines at a time, but this can easily be changed by deleting lines 51 and 52.

Global labels have been used throughout the program as inbuilt comments. Changing these to local labels will result in a smaller and speedier program.

Some additional functions can easily be incorporated into this program, while others will be more difficult, or demand unreasonable amounts of computing time. There is, however, one other way, much faster and easier than my own approach: simply use the built-in program editor, for almost painless insertion, deletion, and variable line lengths. The disadvantage is that you get your display cluttered with line numbers whether you want them or not, and that display is quite small enough as it is. And besides, what fun would that be?
Petter Hesselberg

Marine navigation



$$\cos z = \cos x \cdot \cos y + \sin x \cdot \sin y \cdot \cos P$$

$$\cos E = \frac{(\cos y - \cos x \cdot \cos z)}{(\sin x \cdot \sin z)}$$

This program for the Casio fx702p programmable calculator computes the altitude and bearing of the sun. This is used to find the 'Position Line' of the observer in marine navigation. Hitherto the computation of the spherical triangle which is involved has been done using 4 or 5 figure tables of cosines, sines and logs which is both tedious and error-prone.

It is assumed that the observer has taken a Sun sighting, using a sextant. He knows the time of the observation correctly within two or three seconds, and has found the sun's GHA (Greenwich Hour Angle) and declination from one of the nautical almanacs.

Input:
F Sun's GHA
D Sun's Declination
I Observer's estimated Longitude.
J Observer's estimated Latitude.

The program computes and displays:
W Computed altitude of Sun above horizon (no corrections)
T Bearing (true) of Sun.

Three corrections are usually made:
1. Semi-diameter.
2. Height of eye.
3. Refraction.

John Harvey

END

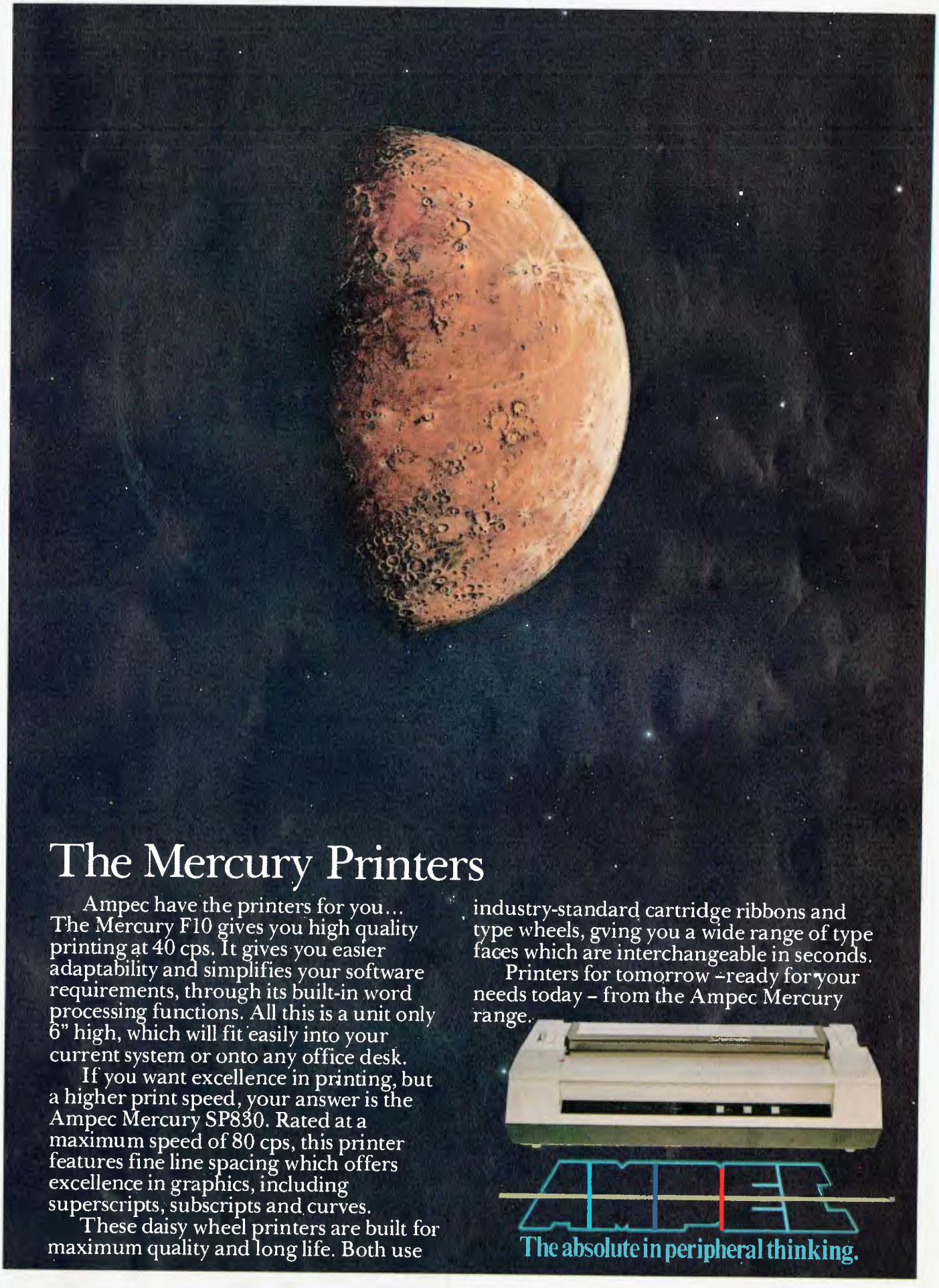
```
LIST ALL
*** PRG LIST

VAR: 26 PRG: 1688

PO:  54 STEPS
 5 MODE 7
10 WAIT 10
20 PRT "G.H.A.=?"
30 INP F
40 PRT "DECL.=?"
50 INP D
60 GOTO #3

P3:  281 STEPS
 10 WAIT 10
 20 PRT "EST.LONG.=?"
 30 INP
 40 PRT "EST. LAT.=?"
 50 INP J
110 P=F-I
115 IF P>180;P=P-360
120 X=90-D
130 Y=90-J
140 I=COS P
160 K=COS X
170 L=SIN X
180 M=COS Y
190 N=SIN Y
200 C=K*M+L*N*I
210 Z=ACS C
220 W=90-Z
224 PRT "ALTITUDE (
  MIDDLE,NO CORRN.)"
225 DMS W
226 STOP
230 Q=SIN Z
240 T=(K-C*M)/(Q*N)
250 T=ACS T
260 IF P>0; T=360-T
270 PRT "BEARING
    (TRUE)"
280 DMS T
290 STOP
300 GOTO 20
```

Listing 2 Marine navigation on the fx702p



The Mercury Printers

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Continued from page 68

APC SUBSET

```
;/              BC ← TOP LEFT DISPLAY + B * 64 + C
;/              A ← ASCII GRAPHIC for VECTOR
;/              (BC) ← A
;/ SUBr DEPENDENCE: DIFA
;/ INTERFACES:  None
;/ INPUT:       HL = DIFILE (see DIFA)
;/              A = Shape Table number
;/              D } Translation vector (Tx)
;/              E }                    (Ty)
;/ OUTPUT:      Figure copied to display
;/              HL = Table + 1
;/              DE unaltered
;/              A = ?
;/ REGs USED:   HL AF DE
;/ STACK USE:   4 (10 including CALL DIFA)
;/ LENGTH:      48
;/ TIME STATES: 200 + 175 per char. drawn  (82/108 per char. not drawn)
;/ PROCESSOR:   Z80
;
LINE    EQU  NN         ;number of display lines
CHAR    EQU  NN         ;number of characters displayed per line
DISPL   EQU  NN         ;low byte of Top Left Display Address
DISPH   EQU  NN         ;high byte of Top Left Display Address

DRAW:   PUSH BC         ;                                   C5
        LD   C,A        ;point at Table A                   4F
        LD   B,+1       ;first vector and                   06 01
        CALL DIFA       ;get number of vectors in B         CD XX XX
DRAWL:  PUSH BC         ;save count                         C5
        LD   C,(HL)     ;get x                              4E
        INC  HL         ;                                   23
        LD   A,(HL)     ;get y                              7E
        INC  HL         ;                                   23
        ADD  A,E        ;add Ty                             83
        CPL             ;change into displacement           2F
        ADD  A,LINE     ;from display top and               C6 NN
        JR   NC,NXTP    ;jump out if outside bounds         30 18
        LD   B,A        ;                                   47
        LD   A,C        ;get x in A                         79
        ADD  A,D        ;add Tx                             82
        CP   CHAR       ;test for inside side bounds and    FE NN
        JR   NC,NXTP    ;jump out if not                    30 11
        RLCA            ;BA ← B * 64 + A                    07
        RLCA            ;                                   07
        RR   B          ;                                   CB 18
        RRA             ;                                   1F
        RR   B          ;                                   CB 18
        RRA             ;                                   1F
        ADD  A,DISPL    ;add Top Left Display               C6 NN
        LD   C,A        ;address to displacement            4F
        LD   A,B        ;to give                            78
        ADC  A,DISPH    ;absolute address                   CE NN
        LD   B,A        ;in BC                              47
        LD   A,(HL)     ;get ASCII Graphic                  7E
        LD   (BC),A     ;to display                         02
NXTP:   INC  HL         ;point to next vector               23
        POP  BC         ;restore count                      C1
        DJNZ DRAWL      ;                                   10 D9
        POP  BC         ;                                   C1
        RET             ;                                   C9
```

Because sine/cosine values for 0°, 90°, etc are -1, 0, +1, the matrix multiplication in TFORM is very quick. Figure 1 gives the most useful transformations with the encoded matrices. Inputting a matrix table entry number instead of the actual encoded matrix allows for easier computation of the transformation required.

			Matrix coding for: i) TFORM	ii) QTFORM
1	Rotate a c	45°	59	0D
2		90°	DB	2F
3		135°	9A	5C
4		180°	BE	7E
5		225°	A6	49
6		270°	E7	6B
7		315°	65	18
8		360°	7D	3A
9	Reflect in	y = 0	BD	7A
A		y = x	07	2B
B		x = 0	7E	3E
C		y = -x	EB	6F
D	Shear that	x ← x + y	75	38
E		x ← x - y	79	3D
F		y ← y - x	6D	1A
10		y ← y + x	50	0A

Datasheet

```
;= TFORM - Transformation of Shape Table Figure
;/ CLASS:  1
;/ TIME CRITICAL?:  No
;/ DESCRIPTION: Performs matrix multiplication using a 2 x 2 unitary value
;/              (-1, 0, +1) matrix on vectors in a Shape Table to effect
;/              rotation, reflection or shearing.
;/              The 8-bit encoded matrices have the bit-pair values;
;/                              10  =  -1
;/                              11  =   0
;/                              00  =   0
;/                              01  =  +1
;/ ACTION:      Use DIFA to get matrix and point HL at Shape Table
;/              FOR EACH VECTOR
;/                C ← (HL)
;/                E ← (HL + 1)
;/                  ((HL))     ((10  32))   (C)
;/                  ((   )) ←  ((matrix bits)) * (  )
;/                  ((HL+1))   ((54  76))   (E)
;/ SUBr DEPENDENCE: DIFA
;/ INTERFACES:  None
;/ INPUT:       HL = DIFILE (see DIFA)
;/              C = Matrix Table number
;/              B = Matrix Entry Number
;/              A = Shape Table number
;/ OUTPUT:      Shape transformed
;/              HL = Shape Table + 1
;/              BC = 0003H   A = last y
;/ REGs USED:   HL AF BC
;/ STACK USE:   4  (12 max. including CALL DIFA)
;/ LENGTH:      51
;/ TIME STATES: 435/822 - 870 depending on matrix (see DIFA)
;/              + 280 to 288 per vector
;/ PROCESSOR:   Z80
;
TFORM:  PUSH DE         ;                                   D5
        PUSH HL         ;save DIFILE                        E5
        CALL DIFA       ;get matrix                         CD XX XX
        LD   D,(HL)     ;in D                               56
        POP  HL         ;restore DIFILE                     E1
        LD   C,A        ;point at                           4F
        LD   B,+1       ;first vector                       06 01
        CALL DIFA       ;of Shape Table                     CD XX XX
TFL:    PUSH BC         ;save vector count and              C5
        LD   B,+2       ;set count for two coordinates      06 02
        LD   C,(HL)     ;get x                              4E
        INC  HL         ;                                   23
        LD   E,(HL)     ;get y                              5E
        DEC  HL         ;point back at x                    2B
COORD:  XOR  A          ;0                                  AF
        RRC  D          ;plus -x/0/+x                       CB 0A
        JR   C,JMP1     ;                                   38 01
```

```
        SUB  C          ;                       91
JMP1:   RRC  D          ;                       CB 0A
        JR   C,JMP2     ;                       38 01
        ADD  A,C        ;                       81
JMP2:   RRC  D          ;plus -y/Ø/+y           CB 0A
        JR   C,JMP3     ;                       38 01
        SUB  C          ;                       91
JMP3:   RRC  D          ;                       CB 0A
        JR   C,JMP4     ;                       38 01
        ADD  A,E        ;                       83
JMP4:   LD   (HL),A     ;new x or y coordinate  77
        INC  HL         ;                       23
        DJNZ COORD      ;                       10 E7
        INC  HL         ;move past ASCII Graphic 23
        POP  BC         ;restore vector count   C1
        DJNZ TFL        ;repeat for all vectors 10 DC
        POP  DE         ;                       D1
        RET             ;                       C9
```

TFORM allows for a matrix setting either or both co-ordinates to 0, which reduces the figure to a line or a point. The transformations in Figure 1 use only eight combinations of (-1, 0, +1)x + (-1, 0, +1)y and can be encoded 3 + 3 bits. Bits 3 and 7 can be used to test the loop COORD. QTFORM is quicker by about 30 T. States per vector. The matrix codes are in Figure 1 and it is decoded:

```
COORD:  RRC   D
        JR    C, YLD
        LD    A, C
        RRC   D
        JR    C, TNEG
        ADD   A, E
        JR    TNEG
YLD:    LD    A, E
        RRC   D
        JR    C, TNEG
        SUB   C
TNEG:   RRC   D
        JR    NC, BACK
        NEG
BACK:   LD    (HL), A
        INC   HL
        RRC   D
        JR    C, COORD
```

TLATE moves a figure in Shape Table across the plane in relation to the origin. This is necessary for transformations about different points in the figure.

Datasheet

```
;= TLATE - Translation of Shape Table figure by vector addition
;/ CLASS:  1
;/ TIME CRITICAL?:  No
;/ DESCRIPTION: Moves a vector encoded figure in a Shape Table in relation
;/              to the origin.
;/ ACTION:      FOR EACH VECTOR
;/                x ← x + Tx
;/                y ← y + Ty
;/ SUBr DEPENDENCE: DIFA
;/ INTERFACES:  None
;/ INPUT:       HL = DIFILE (see DIFA)
;/              A = Shape Table number
;/              (D)  (Tx)
;/              (E) = Translation vector (Ty)
;/ OUTPUT:      Figure translated
;/              HL = Shape Table + 1
;/              A = last vector y
;/              DE unaltered
;/ REGs USED:   HL AF DE
;/ STACK USE:   2  (10 max, including CALL DIFA)
;/ LENGTH:      28
;/ TIME STATES: 200 + 67 per vector
;/ PROCESSOR:   Z80

TLATE:  PUSH BC         ;                       C5
        LD   C,A        ;point HL at Table A    4F
        LD   B,+1       ;first vector           06 01
        CALL DIFA       ;                       CD XX XX
TLTL:   LD   A,(HL)     ;get x                  7E
        ADD  A,D        ;add Tx                 82
        LD   (HL),A     ;replace new x          77
        INC  HL         ;                       23
        LD   A,(HL)     ;get y                  7E
        ADD  A,E        ;add Ty                 83
        LD   (HL),A     ;replace new y          77
        INC  HL         ;move point to          23
        INC  HL         ;next vector            23
        DJNZ TLTL       ;and repeat for all vectors 10 F5
        POP  BC         ;                       C1
        RET             ;                       C9
```

The Senior Lecturers in Mathematics among you will have noticed that not only do transformations 1, 3, 5 and 7 (Figure 1) result in a rotation about the origin but also increase the size of the figure by a factor of $\sqrt{2}$ linear. Two such rotations produce a twice linear scaling and so HALF will have to be called to reobtain the original size.

Datasheet

```
;= HALF - Half scaling (linear) of figure in Shape Table.
;/ CLASS:  1
;/ TIME CRITICAL?:  No
;/ DESCRIPTION: Divides each coordinate by two thus effecting a half linear
;/              scaling of the figure with the origin as centre.  Fractions
;/              are lost.
;/ ACTION:      FOR EACH VECTOR
;/              x                y
;/              ? ---> 0         ? ---> 0
;/ SUBr DEPENDENCE: DIFA
;/ INTERFACES:  None
;/ INPUT:       HL = DIFILE (see DIFA)
;/              A = Shape Table number
;/ OUTPUT:      Figure halved
;/              HL = Shape Table + 1
;/              A unaltered
;/ REGs USED:   HL AF
;/ STACK USE:   2  (10 max, including CALL DIFA)
;/ LENGTH:      18
;/ TIME STATES: 200 + 61 per vector
;/ PROCESSOR:   Z80

HALF:   PUSH BC         ;                       C5
        LD   C,A        ;point HL at Table A    4F
        LD   B,+1       ;first vector           06 01
        CALL DIFA       ;                       CD XX XX
HLFL:   SRA  (HL)       ;x ← x/2                CB 2E
        INC  HL         ;                       23
        SRA  (HL)       ;y ← y/2                CB 2E
        INC  HL         ;move point to          23
        INC  HL         ;next vector            23
        DJNZ HLFL       ;and repeat for all vectors 10 F7
        POP  BC         ;                       C1
        RET             ;                       C9
```

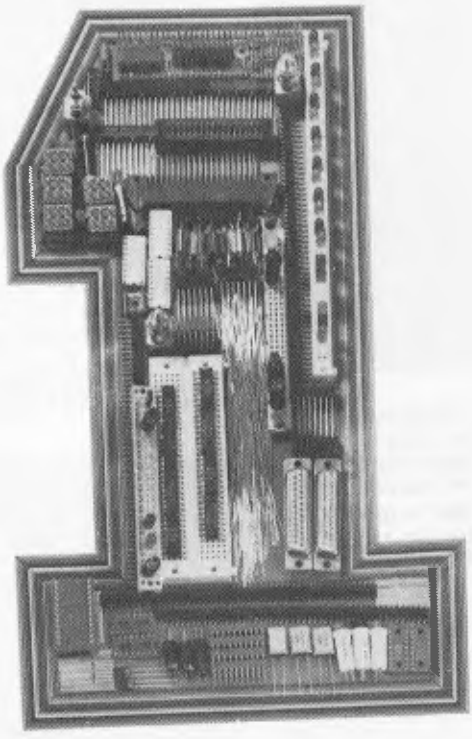
For explosive effects, substituting SLA (HL) for SRA (HL) in HALF produces DOUBLE with the same timing, etc. Any character of the figure which is situated at the origin will be unaffected.

Aces high

DIFA doesn't have any error checking to guard against the requested File/Record number being greater than the number of Files/Records. As 00H in DIFA stands for 256 (LD B,0 : DEC C : INC BC adjusts to correct 0100H), then any error test must allow for 00 > FF.

The sequence DEC A : CP r : INC A will set the Carry Flag if 0 < A ≤ r and sets the Zero Flag if A = 0, but this does not meet the requirements. I'm sure Ian would like to receive the shortest/quickest solution which distinguishes A ≤ r when 00H = 256, and any other useful test sequences. I certainly would.

END



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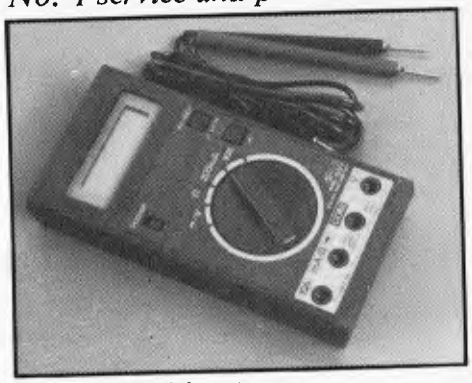

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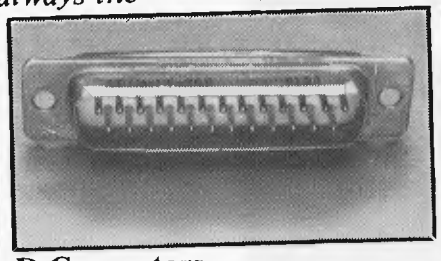

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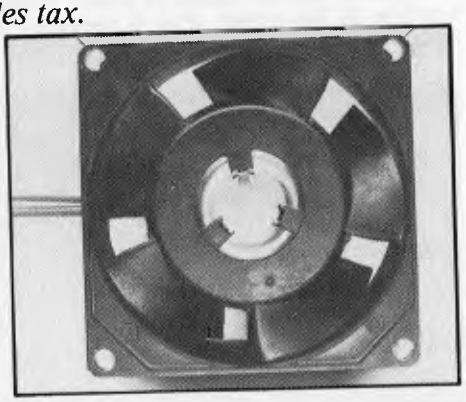

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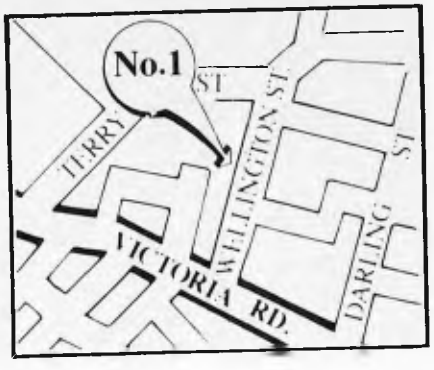

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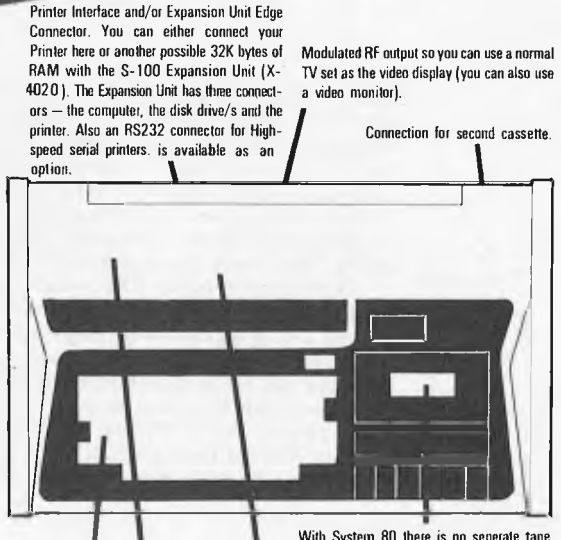

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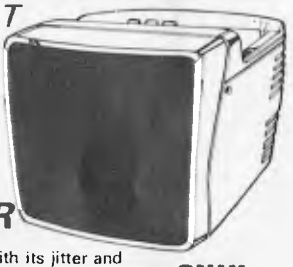

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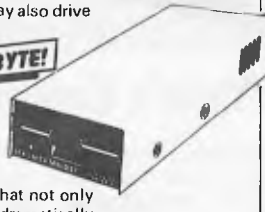

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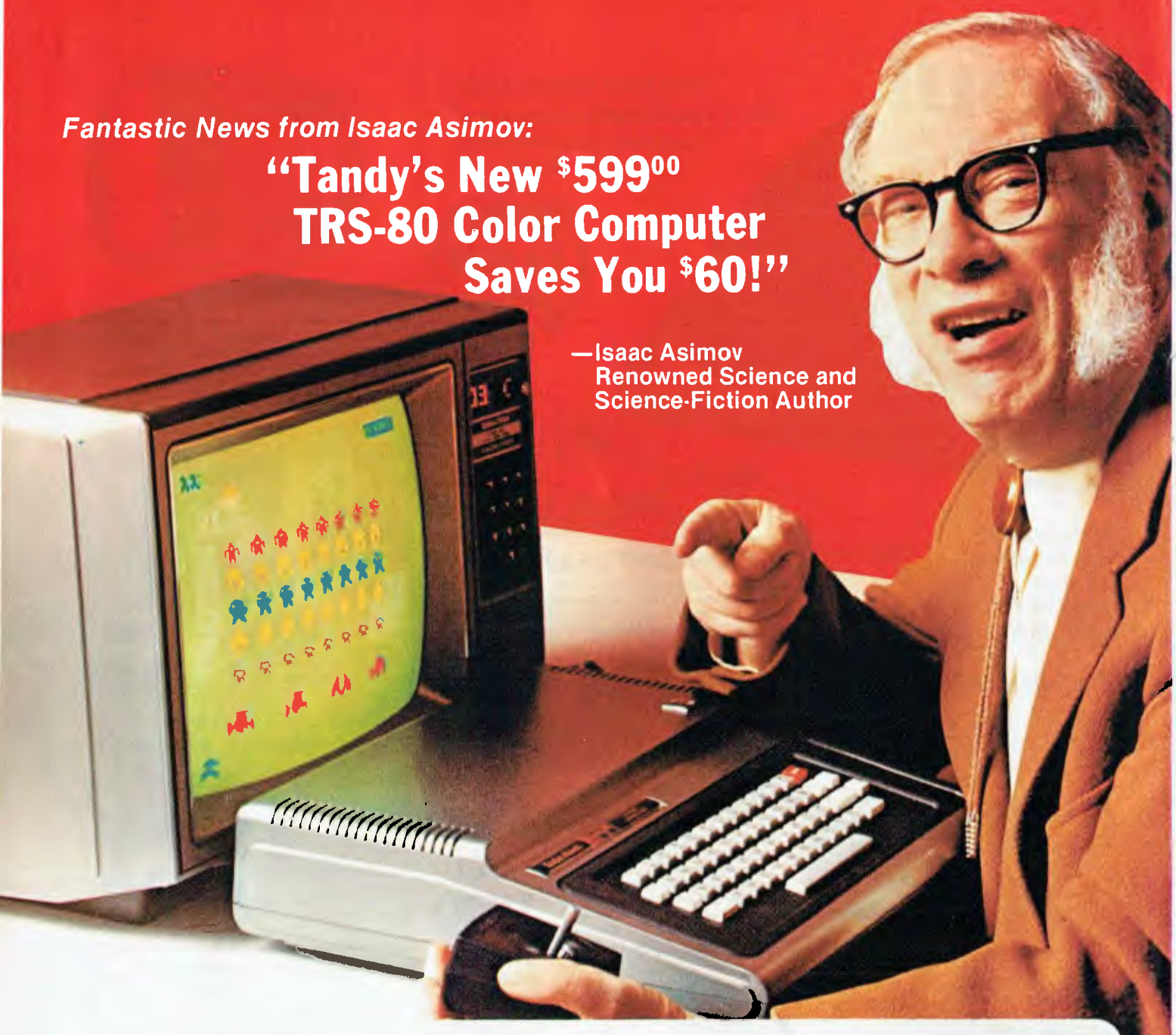

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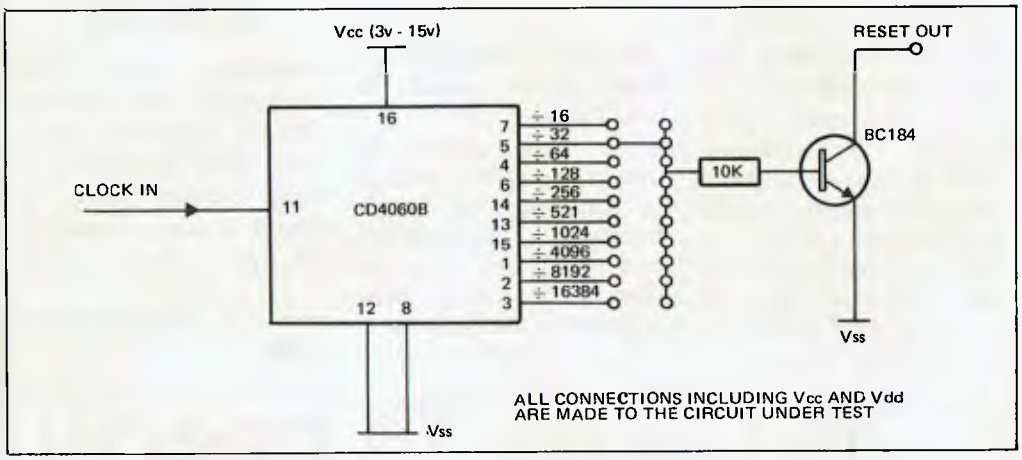
MICROPROCESSOR DEBUGGING AID

If you have ever built a microcomputer system, switched on the power, and found that nothing happened, this simple debugging aid may be of interest to you. The problem with troubleshooting microprocessor circuits is the lack of comprehensible signals when probing around the board with an oscilloscope.

The answer is simple: the operation of any microcomputer system is predictable, following a pulse applied to the reset line of that system. A 6502, for instance, will spend 6 clock cycles sorting itself out internally, then make two memory fetches from the reset vector at address FFFC and FFFD. Using the above circuit it is possible, when connected to a faulty microprocessor system, to examine the address bus, data bus and control signals for several clock cycles after a reset with a simple oscilloscope. (It will be necessary to trigger the oscilloscope timebase from the reset signal generated by the debugging aid.) The user should be looking for such things as broken printed circuit tracks, solder bridges or even high resistance links between tracks, many of which may be easily detected by tracing system operation during the first few clock cycles after reset.

The debugging aid consists of a CD4060 CMOS divider integrated circuit which is fed from the clock signal of the micro under test. The output of the CD4060 drives a transistor which in turn may be used to drive the reset line of the microprocessor. This debugging reset signal may be switched to any one of 10 outputs from the CD4060 allowing a choice of the number of clock cycles to be examined.

S.K. Garratt



TRS-80 EXIT

Re the Sept TJ 'TRS-80 Exit', why put the return address of subroutine B on the stack in the first place? Try:

```
100 [FIRST PART OF
SUBROUTINE A]
110 GOTO 200
120 [SECOND PART OF
SUBROUTINE A]
130 RETURN

200 [ACTION BY
SUBROUTINE B]
210 IF [CONDITION]
THEN 120
220 RETURN
```

Unless I've missed the point, this seems a lot easier and has the advantage of not being machine dependent.

You could put the condition into subroutine A — ie, delete line 210 and make 110 IF [CONDITION] THEN 200 ELSE GOSUB 200

R Hargrave

ATARI MYSTERY

Atari 400 owners should try out this little problem on their machines:

Firstly, put the computer into any graphics mode (mode 3 is most effective). Then press the 'CLR SET TAB' key (on its own) about 25 times. Type the keys 'GHHGGFDFD', press a few keys and watch the result.

Quite mysterious eh??!!

James Campbell

SORCERER INKEY$

Knowing that the Sorcerer's ROM Basic does not contain a routine to check if a key has been pressed, I decided to write the following, which is extremely useful in game software.

The routine is loaded at location zero. but is relocatable. It can be loaded from Basic with the following code.

```
100 FOR A=0 TO 6
110 READ C
120 POKE A,C
130 NEXT
140 DATA 205,9,224,50,7,0,
    201
```

And can be called using the following code, which echoes any key pressed until the ESC key is hit.

```
150 POKE 260,0 : POKE 261,0
160 A=USR(0)
170 IF PEEK (7)=0 THEN 160
180 KEY=PEEK (7)
190 PRINT CHR$ (KEY);
200 IF KEY <>27 THEN 160
210 END
```

L Rayson

```
EXIDY Z-80 ASSEMBLER

    ADDR OBJECT   ST#

                  0001  ;
                  0002  ;   KEY PRESS CHECK
                  0003  ;
                  0004
>E009             0005  GETKEY  EQU   0E009H  ;
                  0006
                  0007        ORG   00000H
                  0008
'0000 CD09E0      0009  START   CALL  GETKEY ;  GET KEY
'0003 320700'     0010        LD    (KEY),A ;  STORE KEY
                  0011
'0006 C9          0012        RET
                  0013
'0007 00          0014  KEY     DEFB  00H
                  0015
```

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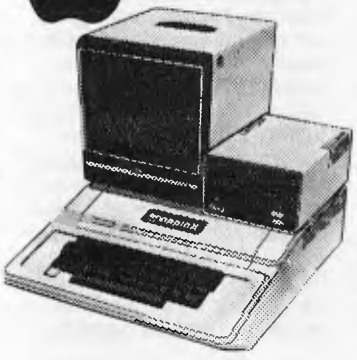

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TJ's WORKSHOP

PET KEYTEST

This machine code routine may be of interest to PET owners dissatisfied with the GET statement and keyboard PEEK (151/515) scan. The problem with these is that they can detect only one key pressed at a time and generally give a bad response speed.

The routine overcomes these problems by scanning the keyboard directly so that each key becomes independent from the rest. It is called through the USR function, returning 1 if the key in the argument is held down, or 0 if not. The argument must be in the range 1-80 inclusive and corresponds to the key code normally found by PEEK (151) or 515 on old ROMs. Figure 1 is a table of these codes in both decimal and hex and also gives the position of each key in the keyboard matrix.

For example, to test if the 5 key was being pressed you may write something like
500 IF USR(34) THEN 1000
instead of
500 IF PEEK(151)=34 THEN 1000

Try adding these lines to the end of the appropriate Basic loader program
500 P=33267 : PRINT "[CLS]"
510 D = USR(41) — USR(42) + 40*USR(18) — 40*USR(50)
520 POKE P, 32 : P = P + D : POKE P, 42 : GOTO 510

When the program is RUN an asterisk will appear at the centre of the screen; this can be moved in the usual manner using the keys 2, 4, 6 and 8. This is achieved in line 510 where the four USR functions can generate 1, -1, 40 and -40 (or 0) respectively and the sum is added to the present position P. Pressing more than one key gives a combined effect, so diagonal movement can be achieved without the need for the 1, 3, 7 and 9 keys.

However, pressing certain combinations of keys simultaneously can cause an image to appear elsewhere in the keyboard matrix. The result will be that some keys are activated without being pressed. To avoid problems I would advise you to use E, S, F, C and D as the left player's controls in a two player game instead of the obvious W, A, D, X and S.

The Basic loader program stores the routine in the second cassette buffer (starting at 826) but it can be relocated elsewhere by changing the value of KE in line 200 and re-running.

David McKeran

	7	6	5	4	3	2	1	0
0	crsr 73 49	home 74 4A	← 75 4B	(76 4C	& 77 4D	% 78 4E	# 79 4F	! 80 50
1	del 65 41	crsr 66 42		) 68 44	\ 69 45	' 70 46	$ 71 47	" 72 48
2	9 57 39	7 58 3A	↑ 59 3B	O 60 3C	U 61 3D	T 62 3E	E 63 3F	Q 64 40
3	/ 49 31	8 50 32		P 52 34	I 53 35	Y 54 36	R 55 37	W 56 38
4	6 41 29	4 42 2A		L 44 2C	J 45 2D	G 46 2E	D 47 2F	A 48 30
5	♦ 33 21	5 34 22		: 36 24	K 37 25	H 38 26	F 39 27	S 40 28
6	3 25 19	1 26 1A	ret 27 1B	; 28 1C	M 29 1D	B 30 1E	C 31 1F	Z 32 20
7	+ 17 11	2 18 12		? 20 14	, 21 15	N 22 16	V 23 17	X 24 18
8	— 9 09	0 10 0A	shft 11 0B	> 12 0C		] 14 0E	@ 15 0F	shft 16 10
9	= 1 01	. 2 02		stop 4 04	< 5 05	spc 6 06	[7 07	rvs 8 08

Fig 1 Keyboard matrix

```
 0 REM    NEW ROM DATA
 100 DATA 20,9A,D0,C6,62,A5,62,C9
 110 DATA 50,90,03,4C,23,D1,48,4A
 120 DATA 4A,4A,49,FF,18,69,0A,A8
 130 DATA 68,29,07,85,5E,A9,80,85
 140 DATA 5F,A9,00,85,60,85,61,85
 150 DATA 62,6A,C6,5E,10,FB,85,5E
 160 DATA AE,10,E8,78,8C,10,E8,AD
 170 DATA 12,E8,CD,12,E8,D0,F8,8E
 180 DATA 10,E8,58,25,5E,F0,03,A9
 190 DATA 00,2C,A9,81,85,5E,60
 200 KE=826
 210 POKE1,KE AND 255 :POKE2,KE/256
 300 FOR X=0 TO 78 :READ H$:L$=MID$(H$,2)
 310 POKE KE+X,16*(ASC(H$)-9*(H$>="A")AND15)
     + (ASC(L$)-9*(L$>="A")AND15)
 320 NEXT
READY.

 0 REM    OLD ROM DATA
 100 DATA 20,A7,D0,C6,B4,A5,B4,C9
 110 DATA 50,90,03,4C,30,D1,48,4A
 120 DATA 4A,4A,49,FF,18,69,0A,A8
 130 DATA 68,29,07,85,B0,A9,80,85
 140 DATA B1,A9,00,85,B2,85,B3,85
 150 DATA B4,6A,C6,B0,10,FB,85,B0
 160 DATA AE,10,E8,78,8C,10,E8,AD
 170 DATA 12,E8,CD,12,E8,D0,F8,8E
 180 DATA 10,E8,58,25,B0,F0,03,A9
 190 DATA 00,2C,A9,81,85,B0,60

READY.
```


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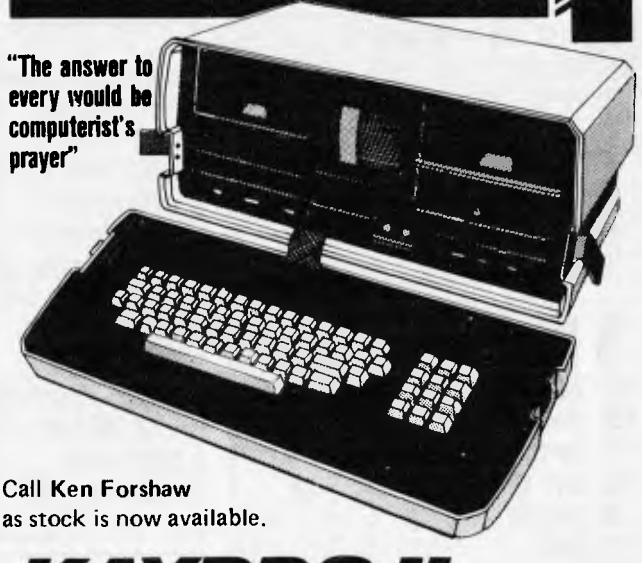

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BENCHMARKS SUMMARY

Presenting a bumper round of all the Benchmark Timings since APC began, with suitable warnings as to their significance from Dick Pountain

It's that time of year again and *APC* does its summary of Benchmark timings for all the machines tested during the past 12 months. This time, though, in response to a lot of readers' queries, we're including a full explanation and justification of the Benchmark tests. In addition, we offer a complete list of timings for *all* the machines tested since we began using Benchmarks, ranked in order of average speed.

The Benchmark programs (listed below) were first published by the US magazine *Kilobaud* in 1977 except for No 8 which was added by John Coll in *APC*. They are a set of Basic programs which test the speed of execution of certain crucial routines by the Basic interpreter or compiler under test by repeating them 1000 times to allow timing with a stopwatch. Apart from no 1 which tests an empty FOR . . . NEXT loop and no 8 which tests the transcendental functions ∧ , SIN and LOG, they are so structured that by subtracting the timing of the previous test you can isolate the time due to the particular routine under examination. So taking BM4 from BM5 should give the time for 1000 GOSUB and RETURNs, for example.

The timings obtained are affected by the clock-rate of the processor upon which they are run as well as by the implementation; MBasic running on a 2MHz Z80 will obviously give slower times than on a 4MHz Z80. In addition the timings will depend on the precision of arithmetic used; some Basics support several precisions such as Integer, Short Real and Long Real (or Single and Double precision) for their variables. In these cases the BMs may be run with all the types, time permitting. In any case the type used should be stated in the results; if it isn't then assume single precision real was tested.

The Benchmarks, then, are a test of the speed of a particular Basic interpreter running on a particular machine, which is what's wanted if you wish to use them to compare various machines and how fast, relatively speaking, they are likely to run your programs. They can of course only give relative information, and even then, to make a fair appraisal, you ought to consider all eight timings and weight them according to the sort of program you would want to run — ie, is it heavy on arithmetic operations or on array accesses or whatever? Some types of program are of course 'I/O-bound', that is they involve so much disk or printer I/O that the speed of communication with these peripherals is the crucial determinant of how fast they will run and totally swamps any differences in processing speed. There is a good discussion of the strengths and weaknesses of Benchmark tests as indicators of the speed of real applications in *Dr Dobbs Journal* (May 82). Of course it is possible in principle to produce I/O Benchmarks as well, but the differing hardware standards make it rather a nightmare. The *APC* Disk Benchmarks faded away for just this reason; it was found that, as written, they couldn't be run on many machines because of restrictions on record length or some other oddity. We may try again in the near future.

All you should realistically expect to gain from the Benchmark timings is knowledge of this sort; that a machine which has, say, a very slow timing for BM8 is likely to run graphics programs which involve a lot of trig sluggishly compared to one with a faster timing.

The Benchmarks have nothing at all to say about how fast the string handling, screen I/O or any graphics intrinsics might be and these may well be as important to you as any of the routines tested.

One anomaly must be mentioned at this point. As originally written and used up till now, BM8 tests only 100 loops instead of 1000. This was done in order to save Benchtesters time on really slow machines. However, in the ranked list of machines published here, I have multiplied the value of BM8 by ten to give it the same weight as the others in computing the average of the timings. These average figures are a somewhat arbitrary measure in any case, since as explained above, to indicate the relative speed of any real application the different BMs would have to be weighted according to the frequency of their

```
100 REM Benchmark 1
110 PRINT "S"
120 FOR K=1 TO 1000
130 NEXT K
140 PRINT "E"
150 END
```

```
100 REM Benchmark 2
110 PRINT "S"
120 K=0
130 K=K+1
140 IF K<1000 THEN 130
150 PRINT "E"
160 END
```

```
100 REM Benchmark 3
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K/K*K+K-K
150 IF K<1000 THEN 130
160 PRINT "E"
170 END
```

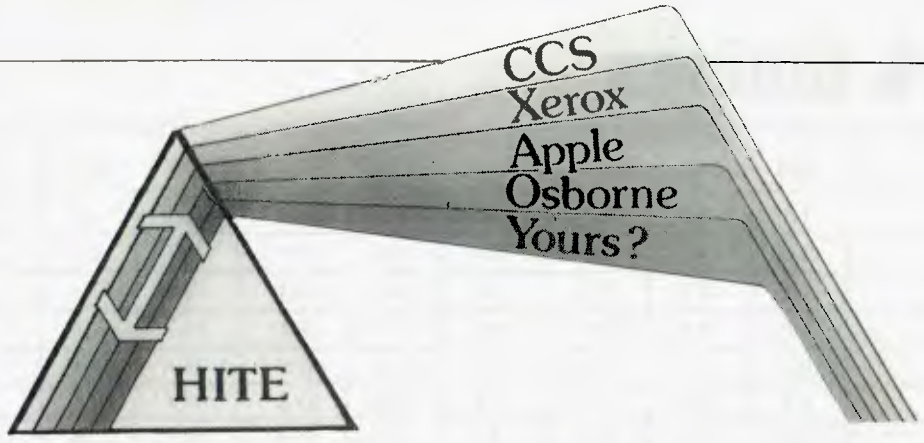
```
100 REM Benchmark 4
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K/2*3+4-5
150 IF K<1000 THEN 130
160 PRINT "E"
170 END
```

```
100 REM Benchmark 5
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K/2*3+4-5
150 GOSUB 190
160 IF K<1000 THEN 130
170 PRINT "E"
180 END
190 RETURN
```

```
100 REM Benchmark 6
110 PRINT "S"
120 K=0
130 DIM M(5)
140 K=K+1
150 A=K/2*3+4-5
160 GOSUB 220
170 FOR L=1 TO 5
180 NEXT L
190 IF K<1000 THEN 140
200 PRINT "E"
210 END
220 RETURN
```

```
100 REM Benchmark 7
110 PRINT "S"
120 K=0
130 DIM M(5)
140 K=K+1
150 A=K/2*3+4-5
160 GOSUB 230
170 FOR L=1 TO 5
180 M(L)=A
190 NEXT L
200 IF K<1000 THEN 140
210 PRINT "E"
220 END
230 RETURN
```

```
100 REM Benchmark 8
110 PRINT "S"
120 K=0
130 K=K+1
140 A=K↑2
150 B=LOG(K)
160 C=SIN(K)
170 IF K<1000 THEN 130
180 PRINT "E"
190 END
```



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Benchmark timings

MACHINE	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	AVERAGE
Olivetti M20	1.3	4.0	8.1	8.5	9.6	17.4	26.7	1.6	11.5
BBC Micro	1.0	3.1	8.2	8.7	9.1	13.9	21.4	5.1	14.6
Monroe 8820	2.1	4.2	9.9	10.5	11.0	20.1	32.0	3.3	15.4
Vector Graphics VIP	1.0	3.8	10.9	10.7	11.6	20.5	32.7	3.4	15.7
Sharp MZ80B	0.6	4.5	8.5	11.5	13.0	19.0	27.5	5.0	16.8
IBM Personal Computer	1.5	5.2	12.1	12.6	13.6	23.5	37.4	3.5	17.6
Sord M23 (compiler)	2.5	2.5	8.0	8.0	8.0	21.0	25.0	7.0	18.1
Osborne 01	1.4	4.4	11.7	11.6	12.3	21.9	34.9	6.1	19.9
Tandy TRS-80 Model II	1.0	5.0	13.0	13.0	14.0	23.0	35.0	6.0	20.5
Panasonic JB3000	1.0	6.0	13.0	13.0	26.0	27.0	41.0	4.0	20.9
Hewlett Packard HP125	1.7	5.0	12.5	12.5	14.0	26.0	40.0	6.0	21.5
Intertec Superbrain	1.6	5.2	14.0	13.9	14.8	26.3	43.2	5.6	21.9
ICL PC	1.5	4.5	13.0	13.5	13.5	25.5	40.0	7.0	22.7
Apple III	1.7	7.2	13.5	14.5	16.0	27.0	42.5	7.5	24.7
Sirius 1	2.0	7.4	17.0	17.5	19.8	35.4	55.9	4.3	24.8
Oki if8000	2.2	6.4	16.8	16.8	17.9	31.8	50.7	5.7	25.0
Ohio Scientific Challenger C2 4P	1.4	7.8	15.0	16.5	17.8	27.0	39.5	7.5	25.0
Xerox 820	1.7	5.5	15.5	15.1	16.2	28.9	46.1	8.0	26.1
NEC PC 8001	1.7	8.3	18.1	17.8	18.6	29.5	49.2	7.0	26.7
Philips P2000	1.9	5.9	15.8	15.7	16.7	29.8	47.2	8.5	27.3
Commodore VIC 20	1.4	8.3	15.5	17.1	18.3	27.2	42.7	9.9	28.7
NEC PC-8000	1.8	6.5	18.3	18.3	19.3	32.3	52.0	8.5	29.2
Sord M23 (interpreted)	2.5	7.2	18.5	18.5	19.3	35.0	52.0	8.5	29.8
Apple II	1.3	8.5	16.0	17.8	19.1	28.6	44.8	10.7	30.4
Hewlett Packard HP85	1.8	3.8	16.3	16.5	17.7	30.0	44.8	12.7	32.2
Exidy Sorcerer	1.8	10.0	20.7	22.2	24.3	37.6	53.7	9.6	33.3
Sharp MZ80A	1.5	9.2	16.4	22.8	25.6	37.7	55.0	10.1	33.7
Micro Bee	2.7	10.0	18.1	17.9	20.9	39.4	67.3	9.5 (est)	33.9
Commodore CBM 8032	1.7	10.0	18.4	20.3	21.9	32.4	51.0	11.9	34.3
Commodore PET 2001	1.7	9.9	18.4	20.4	21.0	32.5	50.9	12.3	34.7
Compucolor II	2.0	10.9	22.4	23.9	25.7	38.7	55.2	10.2	35.1
Hewlett Packard HP86	3.0	5.2	19.4	18.8	20.4	36.5	56.5	13.4	36.7
Hitachi Peach	2.0	11.0	26.0	26.0	27.0	46.0	78.0	10.0	39.5
Tandy TRS-80 Color Computer	2.0	11.3	22.2	23.9	27.0	41.5	61.1	13.0	39.9
Tandy TRS-80 Model I Level II	2.7	11.6	28.0	28.5	31.3	51.9	81.0	11.7	44.0
System 80	2.7	11.6	28.0	28.5	31.3	51.9	81.0	11.7	44.0
Cromemco System Three	1.7	4.6	14.9	17.8	19.4	30.2	41.9	22.9	44.9
Ohio Scientific Challenger C3 S1	1.7	13.1	21.6	23.7	29.2	39.6	58.3	17.6	45.4
Sinclair ZX81 (fast mode)	4.5	6.9	16.4	15.8	18.6	49.7	68.5	22.9	51.2
Sinclair Spectrum	4.8	8.7	21.1	20.4	24.0	55.3	80.7	25.3	58.5
Sharp PC3201	4.0	13.5	35.5	35.5	38.5	67.0	108.0	25.0	69.0
Casio fx9000	2.5	9.0	24.0	24.0	26.0	42.0	60.0	36.5	69.1
Canon CX-1	3.0	6.0	21.0	23.0	24.0	41.0	54.0	39.0	70.2
Atari 400/800	2.3	7.4	19.9	23.2	26.8	40.7	61.5	43.1	76.6
Texas TI 99/4	2.9	8.8	22.8	24.5	26.1	61.6	84.4	38.2	76.6
Texas TI99/4A (standard)	3.0	9.0	24.0	24.8	26.2	61.9	84.6	38.4	77.2
Texas TI99/4A (extended)	6.5	18.5	40.0	40.1	42.0	98.4	140.3	24.0	78.2

BENCHMARKS SUMMARY

use in the application (which would be different for every application). Even if this were possible, it would be stretching the significance of the figures way beyond their actual usefulness. Nevertheless, I felt that the result would be less arbitrary if BM8 were given its proper weight; not to have done so would be unfair to machines which have fast transcendental arithmetic, and maths is after all a not insignificant part of any computer's job. If your application will never require transcendental functions then take the ranking with an even larger pinch of salt than I already recommend; by taking such an average we are giving an overall measure of speed which favours no particular class of application. It can be argued that doing this is unfair to otherwise fast machines with slow arithmetic. Also keep in mind that BM8, more than any of the other Benchmarks, is crucially dependent on the efficiency of the algorithms chosen to implement the arithmetic rather than on the hardware, so a new release of an interpreter could dramatically alter a machines performance in it. It should also be borne in mind that some machines are computing more digits of precision than others in BM8.

To avoid this agonising decision in future BM8 from now on will count 1000 loops like the others (it's printed that way on this page) and the Benchtesters will just have to yawn and lump it.

Whither the Benchmark Tests in the future? At the time they were invented Basic and Assembler were the only languages of any importance on microcomputers. Since then Pascal, Forth, C,Cobol and to a lesser extent Fortran and Lisp have made their mark. Chris Sadler and Sue Eisenbach have already produced an excellent set of Pascal Benchmarks which will be published in *APC* shortly. I am in the middle of producing an equivalent set of Forth Benchmarks which will appear before too long. As to the other languages, if anyone out there feels strongly enough about it to produce a set of universally applicable programs then we'll be interested in seeing them. The problem is that, unlike Basic, these languages are almost never supplied as the principal or only language on a given machine and so the opportunities to run the tests will be few. Since most of them will be running under CP/M or some other DOS, they could be run purely as a test of the compiler/interpreter, but the results would only be comparable if run on the same hardware.

Since Basic is unquestionably still the most important microcomputer language (to the chagrin of its growing number of critics) I would like to see the Benchmarks extended eventually to cover string handling and graphics if any way can be found around the profound differences in the way different Basics do these jobs. A test for the speed of screen updating would also be of great value to users of word processors and spread sheets; this is really a hardware test but it might be done through a Basic program.

Notes on the table of Benchmarks

1) A few machines are not included in the table because the full set of Benchmark timings were not available. This may be because the machine has an unorthodox Basic (Acorn Atom) or integer only Basic (Sinclair ZX80) or because the original reviewer screwed up (no names, no pack drill).

2) For machines tested in the last year, all versions of Basic tested are included where applicable. For machines tested before Nov '81 one version only (single precision) is included.

3) Not all the machines in the list will still be on sale in Australia and a few listed have not yet been Benchtested but are included for interest.

4) The average timing column by which the machines are ranked is computed by summing BM1 to BM7 plus 10 times BM8 and dividing by 8.

5) In as much as the ranking is of any significance (see discussion above) the interesting things to note are that in the top four machines only one, the Olivetti, has a 16-bit processor, and that the ageing 6502 and 8080 are both represented. Surprising how important software is, eh? It's also intriguing to relate the rankings to price. With a couple of exceptions it appears that money *can* buy speed.

6) Don't buy a machine solely on the strength of its ranking in this table unless you're also prepared to buy a car solely on its 100 kph time.

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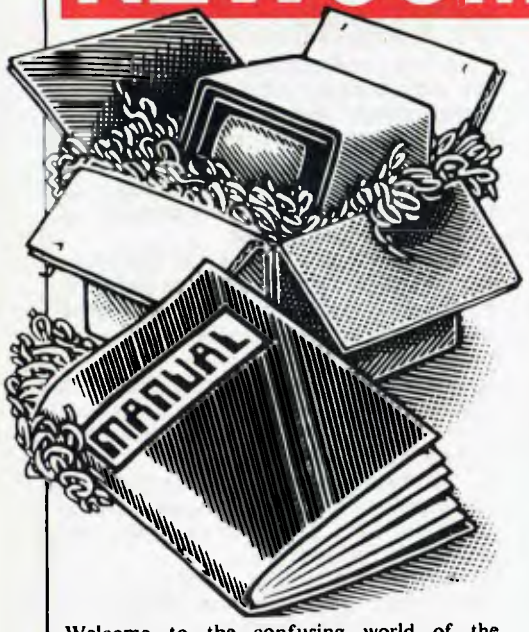

This is our unique quick-reference guide, reprinted every month to help our readers pick their way through the most important pieces of (necessary) jargon found in APC. While it's in no way totally comprehensive, we trust you'll find it a useful introduction. Happy microcomputing!

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 ten 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.

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PREVIEW

DEC'S DAZZLING RAINBOW

Creative Computing's David Ahl delves into his past, meets some old friends and brings us the first Australian preview of Digital Equipment's new super-micro.

It was with mixed feelings that I boarded the 7:00 am People Express flight to Boston. I was looking forward to returning to DEC, my employer from 1980 to 1974. I hoped to see some familiar faces and perhaps review some old memories. On the other hand, my main mission was to do an in-depth evaluation of the Rainbow 100 Personal Computer. Could I do an adequate job?

For the past few years I have been lulled into a sense of complacency by using the same few computers to meet most of my needs. In my office I have a TRS-80 Model III which I use mainly for word processing with Electric Pencil and financial chores with VisiCalc. At home I have an Apple on which I run mostly VisiPlot, Executive Briefing System and games. My kids have a TRS-80 Color Computer on which they are learning to program. At *Creative Computing* we have one or two of nearly everything else — Atari, IBM, Vic-20, Pet, Sinclair, NEC, and a bevy of S-100 CP/M systems.

However, with the exception of occasional use of an Altair 8800 (later hatched into an IMSAI) some three years ago, I have rarely touched CP/M — not that I was ever an expert on it. Hence, my trepidation facing a sophisticated new computer boasting CP/M as its operating system.

The weather in Boston did nothing to calm my stomach. Torrential rain and strong gusts of wind buffeted my rented Datsun as I drove out to the new Mt Royal (Marlboro) facility into which DEC had moved their Terminals and Personal Computer Groups just a few months earlier.

Pete Sanborn, manager of marketing communications for the new Personal Computer Group greeted me and showed me to the demonstration room. A light, airy room as big as any three of our offices was the home for four lonely-looking computers. The room is normally very busy with demonstrations, but I was fortunate to be visiting during Comdex and few demonstrations were scheduled. Thus, I had the place nearly to myself.

This was a mixed blessing. For an hour or more, Pete searched in vain for someone who could show me how the system worked. 'Never mind,' said I. 'I don't want a canned demo. Just give me a manual and let me learn it on my own.'

Unfortunately, that was even more difficult. As Bob Montemerlo, product marketing manager, explained to me later, the system is still in 'final development.' This means that the 'firmware' or the ROMs containing the system software are still being changed and modified, a process that will continue right up until volume shipments being in October.

This isn't as bad as it sounds. The current system works fine and is apparently bug free, but the software engineers are trying to wring the maximum performance from it. The bad news for me, however, was that virtually no documentation currently existed, and the little that did was in extremely preliminary form.

While Pete was searching for the 'right' people, I had the opportunity to speak with Andy Knowles, vice president group manager — whatever that means! It is a more pretentious title than Andy had when I worked for him some 12 years ago. In any event, Andy has the overall responsibility for the new personal computers at DEC. When asked why DEC hadn't entered the market earlier, he said it was simply a matter of the technology not having 'come together' to permit volume production of high quality systems with all the desired features.

Also, DEC has a history of producing as much as possible of its systems in-house. When entering a new technology, they occasionally buy components or peripherals outside, but by the time volume production is reached, DEC is usually producing the item(s). Andy was proud that virtually all the components of the personal computers are produced in-house, and he seemed almost apologetic that winchester disk drives were being furnished by Seagate.

DEC is entering the personal computer market with a rather different philosophy from practically any other vendor including IBM. From a hardware standpoint, DEC makes more peripherals and components internally than any microcomputer manufacturer.

A printer rolls off a DEC assembly line every 45 seconds, a CRT every minute. Make no mistake about it, this is high volume production! Hence, DEC has little need for other hardware or peripheral manufacturers, even on an OEM basis, in order to offer complete systems. Even giant IBM was forced to purchase printers from Epson on an OEM basis and, to this day, does not offer a letter-quality printer. DEC, on the other hand, was able to offer three printers when the systems were first announced.

Brief digression: Although this is a review of the Rainbow 100, I occasionally speak of systems (with an 's'). In fact, DEC announced four personal computers: the Rainbow 100, Decmate II, Professional 325 and 350. I hesitate to call them a family. While they use the same keyboard, CRT and system unit/disk housing, under the skin they are quite different. The Rainbow 100 uses two microprocessors (an 8088 and Z80), the Decmate II uses a 6120 (PDP-8 on a chip), and the Professional series is built around an F11 (PDP-11/23). Thus, while some hardware and peripherals can be shared, software is not compatible across the different machines.

Hardware

The first thing that impressed me upon seeing the IBM Personal Computer was the ergonomic design, particularly the low profile, separate keyboard, previously available only on upper end terminals and minicomputers. (Andy Knowles was quick to point out that DEC had been offering a detached keyboard for the past three years with the VT-100 terminal.) The IBM keyboard is nice, but in the DEC keyboard it has certainly met its match.

The low profile DEC keyboard unit measures a long 21 in x 6.75 in. It slants from 0.6 in in height at the front to 2 in at the rear. The extra length is necessary to hold at the far right a numeric keypad which includes four program functions keys, three punctuation marks, and an ENTER key. The program function keys may be defined in software as numeric operators, but don't have to be. In addition, between the alphabetic keyboard and the numeric keypad is a set of ten keys for cursor movement and word processing manipulation. Only the cursor control keys work with the Rainbow 100; the others are for the larger systems.

Along the top row of the keyboard are 20 function keys, above which is a removable label strip beneath a hinged plexiglass cover. In total, 36 keys are firmware or software driven. In all, the keyboard has 103 keys. Their matt finish dark-on-light legends diminishes glare and ensures positive finger placement. Although the DEC promotional literature boasts that proper arrangement of keys can help eliminate errors, I found that the 'extra' key (with greater and less than symbols) located between the SHIFT and Z at the bottom left kept masquerading as the SHIFT. As a result, before correction, this paragraph, as did most of the others, started '< along . . .' I also found it curious that the '5' on the numeric keypad was not identified by a raised dot for quick finger placement.

Other than those two minor glitches, the keyboard is as near perfect as I have seen. It is exactly the right height for those who prefer the low-fatigue, palm-on-table typing style and, indeed,

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meets the European standard of having the home row keys 30mm above the table surface. The keys all provide excellent tactile and aural feedback (a low-volume keyclick reproduced by the self-contained speaker).

The keyboard has its own 8-bit microprocessor, 4k ROM and 256 bytes of RAM. It connects to the CRT display screen with a coiled 6 in cable using telephone-type modular connectors.

Upon seeing the CRT display screen, I thought, 'gee, that's small.' However, it is not the screen that is small — it is a standard 12 in diagonal CRT — but the housing. The housing measures a diminutive 11.5 in high by 13.75 in wide by 12.25 in deep. Most other housings are 25% larger. A balancing leg on the bottom of the housing allows it to be tilted from 25 degrees back to five degrees forward (for use on an overhead shelf perhaps?).

Normal display mode is white characters on a black background. Yes, black. None of this light green on dark green or yellow on black. A reverse mode will display black on white. The surface of the screen is covered with a non-glare finish. While it needed an occasional wiping, the absence of glare was almost uncanny: I found myself wanting to touch it to reassure myself that it was really glass. However, it is highly susceptible to oily finger prints which destroy the non-glare property and are exceptionally annoying until wiped off.

The display generates 7 x 9 pixel characters including a two pixel descender for g, j, p, q, and y. Screen flicker is reduced by a 60-image-per-second refresh rate; I must confess that I could not see any difference between this display and the Model III or IBM. Normally, 80 characters by 24 lines are displayed; however, it is possible to select (in software) a 132-column width. While this is useful for looking at, say, 12 months of a spreadsheet, the 5 x 9 pixel characters used in this mode are tiring to view for long periods. Nevertheless, it is valuable to be able to preview the entire 14in line printer width.

Other software-selectable features include a split screen capability which allows portions of the 24-line screen to be scrolled separately for menu selections, messages or prompts. The Select word processing package (covered later) holds three lines of prompts at the top of the screen while 21 lines at the bottom hold the scrolling text.

Also available are full- and split-screen horizontal and vertical scrolling. Double-height lines and double-width characters let one add emphasis to sections of text. Or, for even more emphasis, bold, blinking, reverse-video and underline are available.

The standard Rainbow 100 includes monochrome 'character cell' video. For some extra dollars, it can be converted to a bit-map display for either

DEC RAINBOW

monochrome or colour output. This optional mode supports 16 colours simultaneously in the low resolution mode of 320 x 240 pixels or four colours from a palette of eight in the high-resolution mode of 800 x 240 pixels. Colour is via an RGB output (three separate outputs for red, green and blue) rather than NTSC composite video.

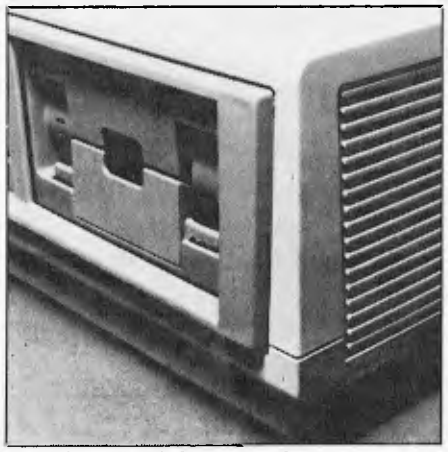
The system unit contains the microprocessors and logic circuitry power supply, disk drives, and slots for adding optional devices. The unit is designed to be positioned either horizontally on the floor or vertically on a desk or shelf. The unit is relatively large, measuring 19 in wide (shades of the rack mount days) by 15 in deep by 6 deep high (assuming vertical mounting).

The disk drives are unique. Looking like no others, each drive accommodates two single sided 5 1/4 in disks on a single spindle. Each disk stores 409.6 kbytes. With two disks on each drive, this gives a total of 819 kbytes of storage per drive, considerably more than any other currently-available small computer. Contrast this to the IBM Personal Computer, for example, which stores only 160 kbytes per drive; the Rainbow stores five times as much!

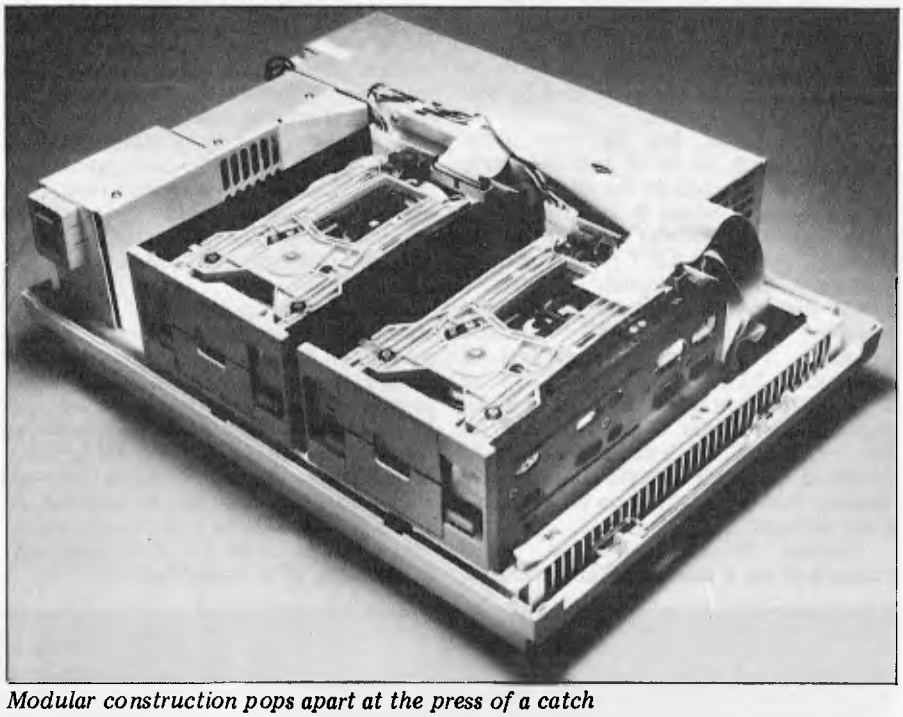
Each system unit can accommodate two drives (four disks). For those concerned with specifications, here they are: single-sided, 96 tracks per inch, 80 tracks used for storage, 10 sectors per track, 512 bytes per sector, 300 revolutions per minute.

The Rainbow 100 contains two microprocessors, an 8-bit Z80 and a 16-bit 8088. The two processors divide system function — disk operations are controlled by the Z80, while the display, keyboard, I/O port and options are controlled by the 8088. Both processors share 64 kbytes of main memory. This may be expanded to 128 or 256 kbytes (see Figure 1).

To take advantage of the dual processors, DEC created a hybrid 8-bit CP/M 80 and 16-bit CP/M 86 operating system called CP/M 86/80. This system features a capability called 'soft sense' which allows CP/M 80 and CP/M 86 application programs to run on the Rainbow 100 without operator intervention. The CP/M 86/80 operating system automatically determines if the application is an 8-bit or 16-bit program and executes the instructions with the appropriate processor and operating system.



Two doors and disks per drive



Modular construction pops apart at the press of a catch

Rainbow 100 has a built-in asynchronous/byte synchronous communications port that supports speeds up to 9600 baud with modem control. It is also equipped with a serial RS-232C printer port with programmable baud rates, parity bits, etc, for supporting a wide variety of printers as well as the three printers offered by DEC.

Construction of the main processor housing is quite unique and shows considerable thought has been applied to ease of servicing. The case top lifts off by releasing two catches at the sides; no screws are involved. Once inside the layout of the works is highly modular. Each major sub-unit — ie, power supply, disk drives, processor board and expansion cage — is separately mounted on the chassis. By depressing a small locking lever at the front of the chassis all these components are released and can be removed without the use of any tools at all. The power supply is encased in an alloy box which contains its own (quiet) cooling fan. Expansion memory and other modules slide on rails into their appointed slot as does the main board. All these components have self-aligning connectors so that refitting requires a minimum of fuss. All cable connectors used are 'foolproof'; they cannot be fitted the wrong way round.

The I/O panel displays seven LEDs which in the event of a malfunction will indicate which sub-unit is at fault. Additional fault tracing is performed by diagnostic routines in firmware which inspect the system on power up and display any errors detected on the VDU (if it's working). In the event of trouble you will have far more information available to you when you phone the engineers than on most micro systems and installing a new sub-assembly is within the capabilities of the least technical person.

Software

According to the DEC Guide to Personal Computing, 'CP/M — Control Program for Microcomputers — is characterized as a single-task, diskette-based operating environment that is well-suited to low-cost personal computer hardware. CP/M was one of the first disk operating systems not designed for a particular computer.

'CP/M provides basic computer services. It is perhaps best known for its simple and reliable file system used with diskettes. It has been improved and rewritten over the years as faster, more reliable disk drives were introduced.' New versions have also been written to take advantage of new 16-bit microprocessors.

The Guide continues, 'The widespread acceptance of CP/M has resulted in numerous software vendors offering thousands of ready-to-run CP/M application programs.' Very true. Every issue of *Microsystems*, a magazine devoted to CP/M, is filled with descriptions of new applications and utility software for the system.

But, bear in mind, at the moment this vast library of CP/M packages cannot simply be purchased from a local computer store, popped into a Rainbow 100, and run. A large portion of the CP/M software is available only on 8 in disks. Much that is on 5 1/4 in disks has had subtle modifications added so that it runs on a specific system, a NorthStar for instance. As soon as Rainbow 100 systems start to be shipped in volume, there no doubt will be scores of software vendors converting existing CP/M software packages and writing new ones specifically for the Rainbow.

DEC has started a software program which will evaluate, rate and, in some cases, market software from third-party vendors. The lowest category is 'Digital-Tested'. This means that DEC has checked all the details of the package and found it will run as specified in the documentation. It has no known 'bugs' and meets DEC's criteria for installation, ease of use, and performance consistency.

The second category is 'Digital-Serviced'. This is the same as 'Digital-Tested' but also meets the serviceability criteria set by the DEC Software Service organization. Service contracts will be offered on software in this category.

'Digital-Developed' is the seal applied to DEC's own software products, al-

though in some cases these products have been developed by outside organisations. The following packages are in this third category.

Standard Microsoft Basic (Version 5.26) is being offered with the Rainbow 100. It is the 8086 version and runs under CP/M 86. It is loaded from disk and occupies 29k of RAM. Assuming sufficient memory is available, Basic can use up to 64k. However, even if the optional 256k option is installed, Basic can still use just 64k.

The Basic is excellent with password-protected files, dynamic string space allocation and up to 40-character variable names. Structured statements include:
WHILE/END
IF/THEN/ELSE
nested IF/THEN/ELSE
Machine language calls, CHAIN and COMMON (Fortran, here I come!) as well as Trace and error trapping are also included. Table 1 shows selected characteristics.

However, given the excellent graphics of the Rainbow 100 hardware, I found it curious that DEC did not contract with Microsoft to include any graphics functions. I also wonder why the following features, all implemented in Microsoft Basic on the IBM PC, were not implemented on the Rainbow 100:
Graphics and music commands
Function keys
Device Independent I/O
TIME$ and DATE$
Screen editor

A spokesman from Microsoft told me that an extended Basic with these features *might* be offered by Microsoft at some future date to run under MS-DOS. The Rainbow 100 is available with MS-DOS (Microsoft Disk Operating System) as an alternative to CP/M 86/80. At this point the main advantage to MS-DOS is that under it industry standard disks can be read. Also, a few software packages are available for MS-DOS that are not available under CP/M.

Incidentally the people from DEC were prone to bragging that their Basic didn't have that nasty divide by 0.10 bug in IBM PC Basic. Sorry, guys, yes it did. But it doesn't anymore. The bug was in all Microsoft Basic implementations, and when they fixed one they fixed them all.

C, a structured language generally available under the Unix operating system, is also available on the Rainbow 100. I did not have an opportunity to use C — however, those familiar with the language will appreciate the full implementation (not Tiny C) on the Rainbow.

Characteristic	Implementation
Name length	40 characters
Integer arithmetic	Yes
Multi-statement functions	No
Function recursion	Yes
Statement numbers	0 to 65535
Floating point precision	7 single 16 double
Exponent	±38
Nested IF	Yes
Link to machine language	Yes
Maximum array dimension	255
CHAIN and COMMON	Yes
Error trapping	Yes
Trace features	Yes

Table 1. Selected features of Rainbow 100 Basic (Microsoft version 5.26).

Before describing the word processing program, it is important to 'set the stage'. Andy Knowles and Barry Folsom, Rainbow product manager, emphasised that the Rainbow WP package is aimed at managers and occasional users who need to prepare memos, letters, and reports. For heavier WP users, they strongly recommend the DECmate II system which runs DEC's time-tested WPS Word Processing System. That said, let's look at the Select WP package for the Rainbow 100.

Select Information Systems Inc of Kentfield, CA has been marketing a word processing system for CP/M, MP/M and CDOS systems for several years. It is a comprehensive system which requires at least two disk drives, an 80-character screen and 48k or more memory.

Select is a menu-driven system. After loading, the main menu appears on the screen Page 6 of the manual emphasises, 'The best way to learn Select is to *put the manual down now!* Type "T" for Teach and take the Select tutorial.'

That is exactly what I did. It took me about 90 minutes to work through the tutorial, which combines a friendly tutorial style with plenty of hands-on practice. Each command is fully described and illustrated on the screen. An example is then presented. This is followed by a practice problem with prompting so it is nearly impossible to go wrong. Finally, a second practice problem is presented with no hints or prompting (except what would normally appear on the screen). At the end of each command, the program asks if you would like a review or if you wish to go on.

Select has all the expected features of a modern personal computer word processing package such as headers, footers, page numbering, merging blocks of text or entire documents, justification and the like. However, it has two important features rarely found in small systems: Teach and Spell.

After my document got quite long (10-plus pages), the system started to act a bit flaky. I have no way of knowing whether this was hardware or software. At the end of a line when a long word is being typed, the software moves the word to the beginning of the following line, for example the word 'started' at the beginning of this paragraph was moved when I typed the letter 'e'. However, on the next line the letters were altered and it became 'uvctvgf'. This did not happen every time, perhaps one line in every 20 or 30. I noted that it tended to occur more frequently when I was typing quickly.

Multiplan is Microsoft's answer to VisiCalc and SuperCalc. Rather than describing the entire package, I will simply note some similarities and differences between it and VisiCalc.

Multiplan, on the Rainbow 100, offers a worksheet 255 rows long and 63 columns wide for words, numbers and formulas. The biggest difference between Multiplan and VisiCalc is the ability of one Multiplan worksheet to reference another. In other words, say one worksheet contains salary calculations consisting of employee names, regular and overtime hours, hourly rates and salaries, deductions, taxes, etc, while a second worksheet may be a summary of department expenses. In this case, the second worksheet can reference just the final department summary salary expenses from the first without having to create an intermediate file or re-enter the data.

Another difference between Multiplan and VisiCalc is that Multiplan allows the creation of up to eight windows within the display area compared with two for VisiCalc. While this may sound four times as good, in three years of fairly heavy usage of VisiCalc, I have rarely used the two-window capability and can't imagine needing three or four windows, much less eight.

A nice feature of Multiplan is the message line at the bottom of the screen which displays comments on the progress of any command, and the percentage of remaining storage.

A not-so-nice difference is the convention in Multiplan of numbering both rows and columns. Thus, in VisiCalc, a reference to Row 3 Column 2 is B3 whereas in Multiplan it becomes R3C2. Even worse is the handling of 'relative' references. This is done automatically in VisiCalc as rows and columns are shifted. Multiplan requires the user to define a relative reference in advance. For example, to add Row 1, Column 1 to Row 1, Column 2 and put the result in Row 1, Column 3 so that it may later be shifted to make room for another row requires the following commands:
VisiCalc @SUM(A1+A2)
Multiplan V SUM(R[-2]C+R[-1]C)
VisiCalc: 11 keystrokes. Multiplan: 19 keystrokes. And the winner is . . .

I was also not impressed with the method of assigning labels in Multiplan. Typing any alphabetic character in VisiCalc automatically indicates a label whereas Multiplan requires that A (for alphabetic) be typed preceding a label.

Other differences are relatively minor. In most respects Multiplan behaves as expected and, like VisiCalc, is an excellent tool for asking the all-important 'what if?' questions of business planning and financial modelling.

Microsoft includes two fat 192-page instruction manuals with Multiplan. Unfortunately, I can only describe the styles as 'written by programmers for programmers'. These will soon be available in 'DEC colours', presumably written in a more user-friendly style. In addition, Bob Montemerlo mentioned the possibility of adding a tutorial Teach mode similar to that of Select. Nothing definite yet.

Expansion

The Rainbow can be expanded by adding 64 or 192k RAM boards for a maximum of 256k. A second dual floppy drive may be added to the main processor unit, giving 1.6 Mb in all. If still more mass storage is required, a 5 Mb hard disk is offered (5¼in). This optional winchester disk is housed in a separate cabinet.

Average access time with the winchester disk is 95 msec and transfer rate is 5 Mbits/sec compared to 290 msec

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DEC RAINBOW

and 250 kbits/sec for the floppy disk system. Thus access time is three times as fast and transfer rate is 20 times as fast, a noticeable difference.

We are told that because of the sealed head/disk assembly the drive requires no preventive maintenance or adjustments. Furthermore, the winchester subsystem has firmware diagnostics that test and verify that all components of the system are working during power-up. These diagnostics also provide continuous error checking during normal operation.

The Rainbow 100 requires the extended communications option which contains a high-speed disk interface port to use the winchester disk option. This communications option also contains an additional communications port.

DEC offers a choice of three printers with the Rainbow 100: the LA50 Personal Printer, the Letterprinter 100, and the LQP02 Letter-Quality Printer.

Each printer can accommodate a variety of papers: single sheet (such as letterhead), fanfold continuous paper, multipart forms, roll paper and labels. Each printer also contains internal diagnostic tests that are performed automatically on power-up. Also, all three have a local-mode self-test.

The LA50 is a dot-matrix printer with two print modes: text mode and enhanced print mode. In text mode it prints at 100 characters/second. The enhanced mode prints at 50 char/sec and creates a crisper, more uniform character than text mode. The seven-wire printhead allows for underlines and full descenders. The LA50 also prints double-width characters.

In addition, the LA50 prints bit-map graphics at 144 x 72 dots per inch. These dots are printed exactly as the pixels are displayed on the screen.

The LA50 can be set to three character-per-inch spacings: 10, 12 or 16.5. Also, lines-per-inch can be set to 6, 8 or 12. Maximum paper width is 10in although, with the compressed character spacing, 132 characters can be printed (in 8 in). Normal print width is 80 or 96 columns.

The Letterprinter 100 is a highly versatile dot matrix printer with three user-selectable or program-selectable print speeds for different quality output.

For rough drafts, internal memos or data processing, 240 characters per second produces good, clear text and numbers. The 80-character-per-second mode uses a denser dot pattern for each character and provides higher definition. In the 30-character-per-second correspondence mode, the printer overlaps two sets of dots and produces letter quality text.

The Letterprinter 100 can be placed in graphics mode at any point under software control; this allows the mixing of text and graphics on the same page. In graphics mode it prints 133 x 72 dots per inch.

For maximum creativity in designing a document, you can specify characters per inch (5, 6, 6.6, 8.25, 10, 12, 13.2, or 16.5), lines per inch (2, 3, 4, 6, 8, or 12) as well as margins, tabs and form length. These parameters can be stored in the non-volatile memory of the Letterprinter 100.

A neat feature of Letterprinter 100 is its ability to handle up to five internal character fonts. Courier-10 and Orator-10 are built into all printers. Three additional fonts can be field installed (they are on ROM chips) or you can get additional fonts on plug-in cartridges. The fonts can be changed at any time during printing.

Thus by combining different fonts with expanded/compressed character widths and graphics printing — even on a single line — you can be very creative indeed.

The LQP02 is a daisywheel printer with a print speed of 32 characters per second. With a built-in 256 character buffer it has bidirectional printing capability and can operate at baud rates of up to 9600.

To produce bold characters, the LQP02 uses a technique called 'shadow bolding' in which characters are struck twice as in normal bold print. But unlike normal bolding, the second strike is slightly offset from the first. This makes the bold print more visible.

Characters per inch are software selectable (10 or 12) as are lines per inch (2, 3, 4, 6 or 8). Margins, tabs and form length also can be software controlled.

Maximum print width is 13.5 in or 15 in paper. With an optional forms tractor, the LQP02 can handle fanfold paper.

A graphics module is available which provides high resolution colour graphics, for which purpose a colour monitor is also included in the options.

In a very welcome break with microcomputer industry practice DEC is offering 23 months on-site service for the Rainbow, included in the purchase price.

Prices

Rainbow 100,64k RAM, 2x400k disk drives, CP/M 80/86 including monitor and 12 month service	$4040
Additional 2x400k disk drive	$1204
5 Mb winchester drive RD50	$4477
64k expansion RAM	$599
192k expansion RAM	$1325
Graphics module	$1022
Colour monitor	$1603
Floor stand for CPU/disk housing	$120
LA50 dot-matrix printer	$1053
LA100 dot-matrix graphics printer	$2536
LQP 02 daisy-wheel printer	$3300

all prices exclude tax and duty.

Conclusion

The Rainbow has to compete directly with the IBM PC and the Sirius. The price of an entry level system is well calculated to do just that; although the three systems don't compare exactly in features offered it is possible to make trade-offs. The IBM has less disk capacity on offer and lacks the second processor as standard fitting. The Sirius offers RAM as standard and more disk capacity but lacks the second processor and the colour graphics option. In other words the Rainbow offers at least as good value for money as its nearest rivals and as a bonus it carries the Digital name.

Some years ago, the IBM name was thought to be worth 20 to 25% of the price of a computer. In other words a competitor would have to be *more* than 20-25% lower than IBM to be in the running. In the miniworld, the same is true with DEC today although the differential is probably more like 15%. However, as a result of the enormous mini customer base and excellent reputation of DEC, it is likely that the DEC personal computers will find a ready market.

Will the DEC entries harm Apple, IBM or Tandy? I doubt it. If anything, the biggest effect will be to further legitimise the personal computer itself as another blue chip name is added to the field.

Perhaps the most significant feature of the Rainbow 100 is the incorporation of both an 8-bit Z80 and 16-bit 8088 processor along with a 'soft-sense' operating system, CP/M 86/80, to automatically run applications software on the correct processor.

Selecting CP/M as an operating system instead of the more Unix-like Oasis or a proprietary DEC system is also significant since it immediately makes available a large number of practically off-the-shelf applications software packages. Having a 16-bit processor built in ensures that this will continue to be true.

Hardware-wise, the keyboard is outstanding. I also like the idea of two double density floppy disks on one drive spindle. The immediately available optional 5 Mb winchester disk means that storage should be ample for virtually any application.

I find the Select Word Processing package and Multiplan spreadsheet package curious choices. However, given the comparatively high prices of these packages, I would guess it will not be long before other software vendors jump in and widen the range of choices in these two most important areas.

Bottom line: the Rainbow 100 should have a long successful life.

END

TECHNICAL SPECIFICATIONS

Processors:	Z80 and 8088
Memory:	64k RAM, expandable to 256k
Keyboard:	103 keys, including numeric pad, cursor controls and 20 function keys
Screen:	12in black on white, 24x80 or 132 chars. Optional graphics 800x240 pixels
Disk:	One double 5¼in drive built in. 2x400k
Ports:	RS232 printer, 9600 baud bi-directional async/sync comms
Operating systems:	CP/M-80, CP/M-86, MS-DOS
Languages:	Microsoft Basic, Mark Williams 'C'

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Video Display	Type	Memory mapped into system RAM.
	Mode	Text, low-resolution graphics, high-resolution graphics (three modes are mixed).
	Screen	960 characters (24 lines, 40 columns).
	Character Type	5 x 7 dot matrix.
	Character Set	Upper case ASCII, 64 characters.
	Graphics Capacity	1920 blocks (low resolution) in a 40 by 48 array. 53760 dots (high resolution) in a 280 by 192 array.
	Numbers of Colours	6 colours.
Keyboard		49 alphanumeric and function keys.
Cassette Interface		Use various cassette tapes and cartridges as data storage units.
Software Cartridge Interface		
Printer Interface		Connects to printers with Centronics interface.
Display Interface		Connects to colour home TVs or video display.
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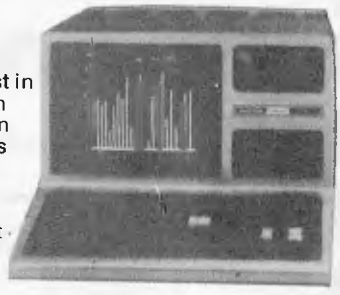

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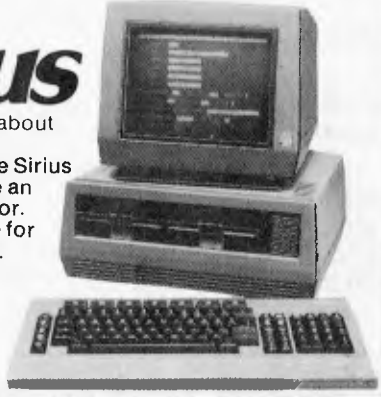

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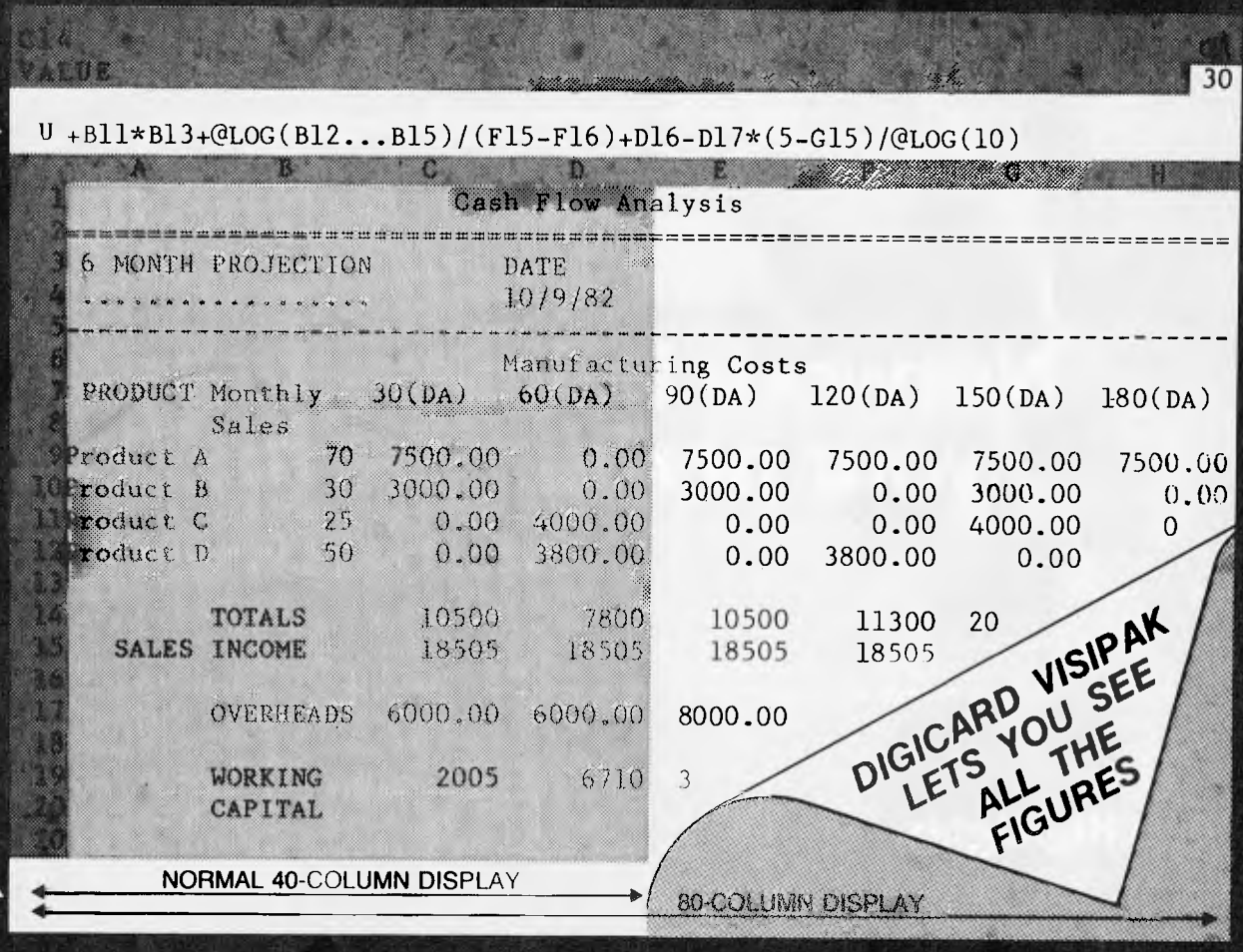

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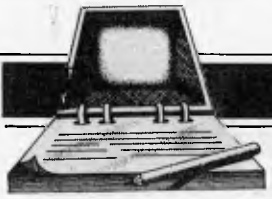
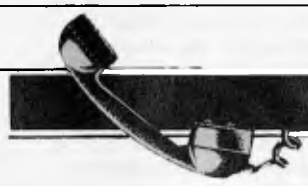


DIARY DATA

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'.

Las Vegas	Las Vegas Convention Centre. Contact: Interface Group 160 Speen Street, Framingham, MA01701 USA	November 29 – December 2, 1982
Brisbane	Computers Business Equipment Exhibition. Contact: US Marketing Centre, Sydney (02) 929 0977	November 29 – December 3, 1982
Sydney	The 1st Australian Personal Computer Show, Centrepoint. Contact: Australian Exhibition Services	March 10–12, 1983



NETWORK NEWS

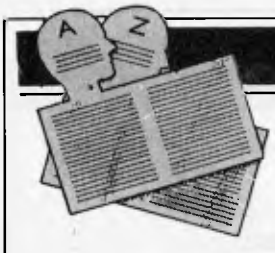
Here is a list of all Australian personal computer networks. As more networks appear – and as more facilities are added to existing ones – we'll report them in this section, which appears monthly.

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 list of alterations and additions to the list of user groups published in the August issue. The next full listing will be published in the January '83 issue of APC.

A whole pool of New Zealand micro clubs has come to our attention and are listed below.

COMBINED MICRO-COMPUTER USERS GROUP (CMUG)
This is an association of micro-computer 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 MICROCOM-PUTER 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 MICROCOM-PUTER 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 MICROCOM-PUTER 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 MICRO-COMPUTER USERS GROUP
Bob Brady, Pirimai Pharmacy, Pirimai Plaza, Napier, (070) 439 016.

CHRISTCHURCH MICRO-PROCESSOR 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.

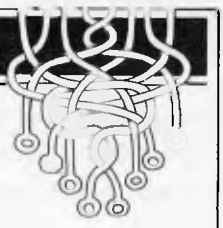
COMPUCOLOR USER GROUP
Meetings are held on the 2nd Wednesday of every month at Panatronics, 691 Whitehorse Road, Mont Albert. For further information contact Neil Brandy on (03) 890 0579.

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

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.

END

LAZING AROUND



by J J Clessa

Quickie

No prizes, no answers. Name two Olympic events in which the winner crosses the finish facing backwards.

Prize puzzle

36,894 one cm diameter ball bearings are stacked in the form of a pyramid. The pyramid can be one of three types:
(a) A triangular pyramid which has one ball on top, and thereafter has each ball resting on three balls beneath it.
(b) A square pyramid which has one ball on top, and thereafter has each ball resting on four balls beneath it.
(c) A rectangular pyramid which has a line of six balls on top and thereafter has each ball resting on four others.

All the ball bearings must be used. What type of pyramid is used – and assuming it has more than one layer, how many layers does it have, and what area of ground does it cover?

Answers on postcards please to November Prize Puzzle, *APC*, P.O. Box 280, Hawthorn, Vic 3122, to arrive not later than 30 December 1982.

BLUDNERS

Well, the most popular section of *APC* is back again with an error in line 100 of 'System 80 Extended Basic' in the September issue. The third '127', should be deleted.

Secondly, in October *APC*, TJ's Workshop contained an article called 'PET Camera Tester'. Line 10 of the program listing should contain POKE 59459 instead of 49459. In the machine code program, the words 'must not be delayed' should read 'must not be omitted'. This should make the commentary more intelligible.

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There are a couple of languages which *APC* has covered in recent articles for which I'd welcome programs from anyone who feels qualified to write them. These are Logo and Forth. Basic and Pascal are all very well, but as we've publicised these two languages and they seem to be catching on in some quarters, some follow-up in the form of real programs would seem appropriate – and interesting. In the meantime, for those who program only in Basic or Pascal, keep the contributions rolling in. I'd also like some volunteers to referee programs for the Peach, Apple and expanded VIC-20. If you think you can provide me with an informative second opinion on other readers' programs then drop me a line – I'd love to hear from you.

I know keying-in is a tedious exercise at the best of times and I also know that the potential for error is enormous. Therefore, if you type in a program from *APC* – or any other magazine for that matter – and find it doesn't work, please check it thoroughly against what is in the magazine before calling to complain. All of the programs printed in *APC* are checked and I'd stake my life on the fact that a good 90 percent of them are error-free. However, it's a human failing to think yourself right and everyone else wrong and I'm certainly not one to boast about my talents as a typist. Please, if you think there's a bug in one of our programs, don't just get on the phone about it – check your typing first and make sure you haven't missed out a DATA item or got a POKE wrong. Finally, if we do discover something wrong in a program, a Bludner will always follow within a couple of months.

Sean Howard

PianoComputer

by A Lake

If there are any Apple II users about who fancy themselves as Rick Wakeman or Jean-Michel Jarre, this program could put them on their way – sort of. It converts the Apple keyboard into a musical instrument with keys arranged much like those on a piano and even puts a picture of a more realistic piano keyboard on the screen to tell you where you are.

```
10  REM  ***************************
20  REM  *                         *
30  REM  *   PIANOCOMPUTER II      *
40  REM  *   (C) A.LAKE  1982      *
50  REM  *                         *
60  REM  ***************************
70  REM  LENGTH:5201 ($1451) BYTES
100  LOMEM: 16384: TEXT
101 TUNE$ = "ADGHUHGDADGHUHGDFHKLPLKHADGHUHGDGJL;FHKLADGHUHGD"
110 NV = 23:NH = 28:TV = 21:TH = 28
120 SOUND = 770:FR = 768:DUR = 769
130  ONERR  GOTO 1500
140 OC$(0) = "LO":OC$(1) = "HI"
150  GOTO 520
160  VTAB 22: HTAB 28: PRINT OC$(OC)
170 MODE = 1: GOTO 990
175  REM  ****** LOOP START ******
180  VTAB 24: HTAB 1: GET R$: HCOLOR= 0
190 R =  ASC (R$)
200  IF R$ =  CHR$ (27) THEN OCTAVE =  NOT OCTAVE: VTAB 22: HTAB 28: PRINT
     OC$(OC);: GOTO 180
210  IF (R = 44 OR R = 60) AND MODE = 2 THEN N$(NN) =  LEFT$ (N$(NN), LEN
     (N$(NN)) - 1): POKE FR,30: POKE DUR,255: CALL SO: GOTO 180
220  IF R > 48 AND R < 53 THEN MODE = R - 48: GOTO 990
230  XDRAW 1 AT (T(R) + 8 * OC - OC) * 14 - 7,Y( FN Y(T(R)))
240 NO = NO + 1: VTAB NV: HTAB NH: PRINT NO;"  ";
250  IF MODE = 1 THEN 270
260 R =  ASC (R$):N$(NN) = N$(NN) + R$: IF  LEN (N$(NN)) > 250 THEN NN = N
     N + 1
270 TE = 1 +  POL (0)
280  IF TE > 256 THEN TE = 255
290  VTAB TV: HTAB TH: PRINT TE;"  ";
300  POKE FR,A(R,OC): POKE DUR,TEMPO: CALL SOUND
310  XDRAW 1 AT (T(R) + 8 * OC - OC) * 14 - 7,Y( FN Y(T(R)))
320  GOTO 180
325  REM  ****** LOOP END ******
330  REM  ****** PLAY BACK *****
```

PROGRAMS

```
340  IF  LEN (N$(0)) < 1 THEN  VTAB 24: HTAB 1: INVERSE : PRINT " NO TUNE
     IN MEMORY ";: FOR T = 1 TO 2000: NEXT :MODE = 1: VTAB 24: HTAB 1: NORMAL
     : PRINT "                    ";: GOTO 990
350  GET R$
360  VTAB NV: HTAB NH: PRINT "    ";
370  FOR MM = 0 TO NN
380  FOR T = 1 TO  LEN (N$(MM))
390 OC = 0
400  IF MO$ = "AUTOPLAY" THEN 410
401  VTAB 24: HTAB 27: GET Y$: IF Y$ = "H" THEN OC = 1
410 R =  ASC ( MID$ (N$(MM),T,1))
420  XDRAW 1 AT (T(R) + 8 * OC - OC) * 14 - 7,Y( FN Y(T(R)))
430 NO = NO + 1: VTAB NV: HTAB NH: PRINT NO
440  VTAB 22: HTAB 28: PRINT OC$(OC)
445 TE =  PDL (0): IF TE = 0 THEN TE = 1
446  VTAB TV: HTAB TH: PRINT TE;"  ";
450  POKE FR,A(R,OC): POKE DUR,TE: CALL SOUND
460  XDRAW 1 AT (T(R) + 8 * OC - OC) * 14 - 7,Y( FN Y(T(R)))
470  NEXT T,MM
480  VTAB NV: HTAB NH: PRINT "END": VTAB 22: HTAB 7: GET R$
490 NO = 0:R =  ASC (R$)
500  IF R < 52 AND R > 48 THEN MODE = R - 48: GOTO 990
510  GOTO 330
520  REM  ** INITIALISATION **
530  HOME : PRINT "PIANOCOMPUTER          (C) A.LAKE 1982": PRINT : INPUT "D
     O YOU WANT THE INSTRUCTIONS ?";R$: IF  LEFT$ (R$,1) = "N" THEN 550
540  GOTO 1090
550  REM
560  DIM G(21),A(90,1),T(100)
570 MODE = 1
580  HCOLOR= 3: SCALE= 1
590 G(3) = 1:G(7) = 1:G(10) = 1:G(14) = 1:G(17) = 1
600 Y(0) = 143:Y(1) = 120
610  DEF  FN Y(X) = 2 * (X -  INT (X))
620 MC$ = "204;??;=20<0;=30<088=005<>0103?009<;=0?5;>00034<0503203???608=1
     302;<0103;>0103;90420;8?<;=20<0>8=0?=88=0>?<>0003=0>7600100040037?3820
     640<2=150>361>1>0700"
630  FOR T = 1 TO  LEN (MC$) STEP 2
640 X = ( ASC ( MID$ (MC$,T,1)) - 48) * 16 + ( ASC ( MID$ (MC$,T + 1,1)) -
     48)
650  POKE 769 + ((T + 1) / 2),X
660  NEXT
670  POKE 232,61: POKE 233,3: SCALE= 1: ROT= 0
680  FOR T = 1 TO 12 STEP 0.5
690  IF T <  >  INT (T) AND G(T - .5) = 1 THEN 710
700  READ A: READ B:A(A,0) = B:T(A) = T
710  NEXT
720  FOR T = 8 TO 21 STEP .5
730  IF T <  >  INT (T) AND G(T - .5) = 1 THEN 750
740  READ A,B:A(A,1) = B
750  NEXT
755  REM  *** DRAW KEYBOARD ***
760  HGR
770  FOR T = 0 TO 279: HPLOT T,100 TO T,160: NEXT
780  HCOLOR= 0
790  FOR T = 14 TO 279 STEP 14: HPLOT T,100 TO T,160
800  HCOLOR= 0
810  IF G((T) / 14) = 1 THEN 830
820  FOR Y = T - 4 TO T + 4: HPLOT Y,101 TO Y,130: NEXT
830  NEXT
840  HOME : VTAB 21
860 M$ = "READY>          MODE"
870  HOME : VTAB 21
880  PRINT " MODE   PLAY       TEMPO"
890  PRINT "        RECORD     RANGE"
900  PRINT "        PLAY-BACK  NOTE #"
910  GOTO 160
920 :R = 7
930  FOR A = 1 TO 100: IF T(A) = R THEN  PRINT A","A(A)",";
940  NEXT : NEXT
945  REM  ** NOTE FREQUENCY DATA **
950  DATA   65,250,87,235,83,220,69,210,68,200,70,185,84,175,71,165,89,155
     ,72,144,85,135,74,128,75,120,79,114,76,108,80,104,59,98
960  DATA     8, 90,21,80,21,80
970  DATA 65,120, 87,114,83,108,69,104,68,98,70,90,84,80
980  DATA 21,196
990  FOR T = 21 TO 24: VTAB T: HTAB 7: PRINT " ";: NEXT
995 MO$ = ""
1000  VTAB MODE + 20: HTAB 7: PRINT  CHR$ (186);
1010 NO = 0
1020  IF MODE = 2 THEN  VTAB 24: HTAB 1: PRINT "IS THIS A NEW TUNE  (Y OR
     N) ?  ";: GET R$: IF R$ = "Y" THEN  FOR T = 0 TO 5:N$(T) = "";: NEXT
1030  VTAB 24: HTAB 1: PRINT "                                        ";
1040  ON MODE GOTO 180,180,330,1041
1041 N$(0) = TU$ + TU$:MO$ = "AUTOPLAY": GOTO 330
1050  DATA  71,81,89,77,72,73,85,69,74,65
1060  DATA     ,,75,60,79,57,76,53
1070  DATA      80,50,59,47,,,8,43,,,21,39
1080  DATA  ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,
1090  HOME
1100  INVERSE
1101  REM  *** INSTUCTIONS ***
1110  PRINT "                PIANOCOMPUTER            ": NORMAL
1120  POKE 34,2
1130  SPEED= 150
1140  PRINT "  YOU MAY USE THE APPLE AS A SYNTHESISER"
1150  PRINT "BY USING THE MIDDLE ROWS ON THE KEYBOARD"
1160  PRINT "AS YOU WOULD A PIANO KEYBOARD."
1170  PRINT
1180  PRINT : PRINT "  THE WHITE PIANO KEYS CORRESPOND TO THE"
1190  PRINT "ROW OF KEYS 'A' TO THE RIGHT-ARROW."
1200  PRINT : PRINT "THE SHARPS & FLATS ARE ON THE ROW ABOVE."
1210  PRINT : PRINT "PRESSING A NUMBER KEY FROM 1 TO 4 WILL"
1220  PRINT : PRINT "CHANGE THE MODE OF OPERATION."
1230  PRINT
1240  PRINT "MODE 1   YOU CAN PLAY WHAT YOU LIKE AND"
1250  PRINT "         THE COMPUTER WILL NOT REMEMBER"
1260  PRINT "         WHAT YOU HAVE DONE."
1270  PRINT : PRINT "MODE 2   YOU CAN ENTER A TUNE AT ANY "
1280  PRINT "         SPEED AND THE COMPUTER WILL"
1290  PRINT "         REMEMBER THAT TUNE FOR YOU TO"
1300  PRINT "         PLAY BACK LATER."
1310  PRINT "         IF YOU MAKE A MISTAKE,PRESSING"
1311  PRINT "         '<' WILL DELETE IT FROM MEMORY"
1330  PRINT : PRINT "MODE 3   THE COMPUTER WILL PLAY BACK THE";
1340  PRINT "         TUNE YOU RECORDED IN MODE 2"
1350  PRINT "         TO A RHYTHM YOU TAP OUT USING"
1360  PRINT "         ANY KEY (EXCEPT RESET)."
```


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PROGRAMS

```
1361  PRINT : PRINT "MODE 4   THE COMPUTER WILL PLAY IT'S"
1362  PRINT "         FAVOURITE TUNE FOR YOU.    "
1370  PRINT : PRINT "YOU CAN CHOOSE BETWEEN TWO NOTE RANGES"
1380  PRINT : PRINT "  LOW - FROM MIDDLE-C TO HIGH-G"
1390  PRINT : PRINT "  HIGH - FROM HIGH-C TO VERY HIGH G !"
1400  PRINT : PRINT "TO SWITCH BETWEEN THESE TWO RANGES,HIT"
1410  PRINT : PRINT "<ESC>."
1420  PRINT : PRINT : PRINT "DURING PLAY-BACK,USING 'H' WILL GIVE A"
1430  PRINT : PRINT "HIGH-RANGE NOTE,ANY OTHER GIVING A LOW  "; PRINT "ONE
      "
1440  PRINT
1450  PRINT "IF YOU CONNECT AN AMPLIFIER TO THE "
1460  PRINT : PRINT "CASSETTE-OUT SOCKET,YOU WILL BE ABLE TO"
1470  PRINT : PRINT "ENJOY HIGHER QUALITY SOUND."
1480  PRINT : PRINT "IF YOU HAVE A CASSETTE ATTATCHED,YOU CAN"
1490  PRINT "RECORD YOUR OWN MUSIC."
1500  PRINT : PRINT "I RECOMMEND,FOR TWO PART TUNES,RECORDING"
1510  PRINT "ONE VOICE ON CASSETTE AND THEN PLAYING  "
1520  PRINT "THE OTHER VOICE ALONG WITH THE RECORDING"
1530  PRINT : PRINT "YOU CAN USE THE APPLE'S INTERNAL SPEAKER"
1535  PRINT ",THE CASSETTE PORT OR FOR THE ULTIMATE IN  "
1536  PRINT "COMPUTER SYNTHESISED CAT'S CHORUS,BOTH !"
1550  PRINT : PRINT "YOU CAN CHANGE THE LENGTH OF NOTE USING "; PRINT "PAD
      DLE (0)."
1560  SPEED= 255: POKE 34,0
1570  GOTO 560
1580  REM  **** ERROR HANDLING ****
1581  REM  ** PRESSED WRONG KEY (IGNORE)
1590  IF  PEEK (222) = 53 AND  PEEK (218) +  PEEK (219) * 256 = 190 THEN 1
      80
1595  IF  PEEK (222) = 53 AND  PEEK (218) +  PEEK (219) * 256 = 230 THEN 1
      80
1600  PRINT "ERROR CODE "; PEEK (222);"  IN LINE "; PEEK (218) +  PEEK (21
      9) * 256
1605  REM  (UNEXPECTED ERROR)
1610  STOP
```

Moon Module

by Quentin King

Okay, okay, I confess — it's lunar lander really, but it's a good lunar lander. It took me ages to win and I really enjoyed playing it. It's for the Apple II and uses a shape table to define a rather neat little module which you steer using one of the joysticks. Steering the ship in the right direction is a little hard to get used to as it's done by positioning a tiny dot under the ship which determines the angles of thrust — which is applied with the joystick button. The aim is, of course, to land your module on a flat part of the moon surface but the difference is that you have to take off again and fly through a hole at the side of the screen. This is barely large enough to admit the module so precise control is necessary. To alter difficulty you can alter the amount of fuel you have, the

```
20  REM
30  REM  ************************
40  REM         MOON MODULE
50  REM
60  REM  *                      *
70  REM  * COMPLETED ON 9/8/82 *
80  REM  ************************
90  REM
94  REM ************************
95  REM ** SET UP CONSTANTS **
96  REM ************************
100 B% = 1:D% = 3:J% =  - 16287:H% = 10:C% = 28672:G% = 128:V% = 33:Z% = 15:T% =
 6:R% = 273:E% = 13:Q% = 6:C = 6.9999999:D = 81.169021:B = .448799:P = 3.141592:
D$ =  CHR$ (4)
110  ROT= 0: SCALE= 1: TEXT : HOME : IF  PEEK (232) = 25 THEN 200
120  DATA 162,0,134,249,162,32,134,250,160,0,177,249,73,255,145,249,200,208,247,
232,224,64,208,238,96,1,0,4,0,45,36,63,36,45,36,45,54,45,54,63,54,45,5,0
130  FOR I = 768 TO 811: READ A: POKE I,A: NEXT : POKE 232,25: POKE 233,3: POKE
C% + B%,0: HGR : TEXT : HOME
194  REM *****************
195  REM ** INSTUCTIONS **
196  REM *****************
200  PRINT  TAB( 13)"MOON MODULE": PRINT : PRINT
210  PRINT " YOU ARE IN CONTROL OF A  LUNAR  DECENT"
220  PRINT "MODULE.  YOUR  MISSION  IS TO LAND ON A"
230  PRINT "FLAT SITE, TAKE OFF AND FLY OUT OF  THE"
240  PRINT "ENTRY  HOLE. YOU MAY ONLY LAND ONCE AND"
250  PRINT "ON TOUCH-DOWN, YOUR VERTICAL SPEED MUST"
260  PRINT "BE LESS THEN 15.": PRINT
270  PRINT " YOU CONTROL YOUR  CRAFT  BY  VECTORING"
280  PRINT "ITS  ROCKET  MOTOR  (USE PADDLE 0), AND"
290  PRINT "FIRING PULSES OF THRUST (USE BUTTON 0)."
300  PRINT "A DOT UNDERNEATH YDUR  CRAFT  INDICATES"
310  PRINT "THE DIRECTION OF THE THRUST.": PRINT : PRINT
344  REM *********************
345  REM ** ENTER VARIABLES **
346  REM *********************
350  INPUT "ENTER THRUST PER UNIT OF FUEL";A$: IF  STR$ ( VAL (A$)) <  > A$ OR
VAL (A$) > 100 OR  VAL (A$) <  - 100 THEN 350
360 T =  VAL (A$): INPUT "ENTER GRAVITATIONAL CONSTANT ";A$: IF  STR$ ( VAL (A$)
) <  > A$ OR  VAL (A$) > 100 OR  VAL (A$) <  - 100 THEN 360
370 G =  VAL (A$): INPUT "ENTER UNITS OF FUEL (20-250) ";A$: IF  STR$ ( VAL (A$)
) <  > A$ OR  VAL (A$) < 20 OR  VAL (A$) > 250 OR  VAL (A$) <  >  INT ( VAL (A$)
) THEN 370
380 FF% =  VAL (A$)
394  REM **********
395  REM ** MENU **
396  REM **********
400  HOME : PRINT  TAB( 18)"MENU": PRINT : PRINT
410  PRINT  TAB( 12)"1. START GAME.": PRINT
420  PRINT  TAB( 12)"2. CREATE MOON.": PRINT
430  PRINT  TAB( 12)"3. LOAD MOON.": PRINT
440  PRINT  TAB( 12)"4. RE-ENTER THRUST ETC...": PRINT
450  PRINT  TAB( 12)"5. EXIT PROGRAM.": PRINT : PRINT  TAB( 12)"SELECT O
PTION : "
```

PROGRAMS

```
460  POKE  - 16303,0: GOSUB 630: VTAB 15: HTAB 28: POKE 216,0
470  GET A$: IF A$ < "1" OR A$ > "5" THEN 470
480  PRINT : PRINT : ON  VAL (A$) GOTO 500,900,800,350,490
490  TEXT : HOME : PRINT "THANK YOU FOR PLAYING.": END
494  REM ****************
495  REM ** START GAME **
496  REM ****************
500  IF  PEEK (C% + B%) = A% THEN  PRINT  TAB( 12)"NO MOON IN MEMORY";: FOR I =
1 TO 1000: NEXT : HTAB 1: CALL  - 868: GOTO 460
510  POKE  - 16297,0: POKE  - 16304,0:P% = 0:F% = FF%: GOSUB 630: PRINT : PRINT
 TAB( 8)"FUEL : "F% TAB( 23)"V.SPEED : 0": VTAB 22
520  HCOLOR= 0: HPLOT 0,1 TO 0,E%: HCOLOR= 3:X = 0:Y = 8:X1 = 1:Y1 = 0:X% = X:Y%
 = Y: XDRAW B% AT X,Y: FOR I = 1 TO 1000: NEXT
524  REM ****************
525  REM ** MAIN LOOP **
526  REM ****************
530 A =  PDL (A%) / D:D1% = C - A / B:Y1 = Y1 + G: IF  PEEK (J%) < G% OR F% = A%
 THEN  HTAB V%: PRINT  INT (H% *  - Y1)"  ";: FOR JJ = 1 TO 10: NEXT : GOTO 550
540 X1 = X1 + T *  COS (A + P):Y1 = Y1 + T *  SIN (A + P):F% = F% - B%: HTAB Z%:
 PRINT F%" ";: HTAB V%: PRINT  INT (H% *  - Y1)"  ";
550 X = X + X1:Y = Y + Y1:X1% = X:Y1% = Y: IF X1% > A% AND X1% < R% AND Y1% > T%
 AND  PEEK (C% + X1%) > Y1% AND  PEEK (C% + X1% + D%) > Y1% AND  PEEK (C% + X1%
 + Q%) > Y1% THEN  HCOLOR= A%: HPLOT X% + L%,Y% + B%: XDRAW B% AT X%,Y%: XDRAW B%
 AT X1%,Y1%: HCOLOR= D%: HPLOT X1% + D1%,Y1% + B%:L% = D1%:X% = X1%:Y% = Y1%: GO
TO 530
555  REM ** HIT SOMETHING! **
560  ON P% GOTO 600
565  REM ** LANDED ? **
570  IF  INT (H% *  - Y1) <  - Z% THEN 610
580  FOR I = C% + X1% TO C% + X1% + Q%: IF  PEEK (I) = Y1% THEN  NEXT : GOTO 650
590  GOTO 610
595  REM ** FINISHED ? **
600  IF X1% < B% AND Y1% > T% AND Y1% < E% THEN 700
604  REM *************
605  REM ** CRASHED **
606  REM *************
610  FOR I = 1 TO 18: CALL 768: NEXT : XDRAW B% AT X%,Y%: HCOLOR= A%: HPLOT X% +
 L%,Y% + B%: GOSUB 620: GOTO 750
615  REM ** SUBROUTINES **
620  HCOLOR= D%: FOR I = B% TO 278: HPLOT I, PEEK (I + C%): NEXT : RETURN
630  VTAB 21: HTAB 1: PRINT  SPC( 159);: VTAB 20: PRINT : RETURN
644  REM *************
645  REM ** LANDED **
646  REM *************
650  VTAB 21: HTAB 1: FLASH : PRINT "          THE EAGLE HAS LANDED          ":
NORMAL : VTAB 20: PRINT : HCOLOR= A%: HPLOT X% + L%,Y% + B%: GOSUB 620
660  IF  PEEK (J%) < G% THEN 660
670  PRINT  SPC( 40): XDRAW B% AT X%,Y%:Y% = Y% - 1:X = X%:X1% = X%:Y = Y%:Y1% =
 Y%: XDRAW B% AT X%,Y%:Y1 =  - 1:P% = 1: GOTO 530
694  REM ***************
695  REM ** FINISHED **
696  REM ***************
700  XDRAW B% AT X%,Y%: HCOLOR= A%: HPLOT X% + L%,Y% + B%: GOSUB 630
710  PRINT : FLASH : PRINT "     CONGRATULATIONS !!! YOU DID IT.     ": NORMAL
FOR I = 1 TO 5: PRINT  CHR$ (7);: NEXT : GOSUB 620
744  REM ******************
745  REM ** END OF GAME **
746  REM ******************
750  GOSUB 630: HTAB 15: PRINT "GAME OVER": PRINT : PRINT  TAB( 10)"PRESS BUTTON
 0 TO RESTART": PRINT  TAB( 10)"PRESS SPACE FOR MENU";: VTAB 20: PRINT
760  IF  PEEK (J%) > G% THEN 510
770  IF  PEEK ( - 16384) = 160 THEN 460
780  GOTO 760
794  REM ***************
795  REM ** LOAD MOON **
796  REM ***************
800  HGR : VTAB 21: HTAB 15: PRINT "LOAD MOON.": PRINT : PRINT  TAB( 10)"ENTER M
OON'S NUMBER "
810  VTAB 23: HTAB 30: CALL  - 868: INPUT A$: IF A$ <  > STR$ ( VAL (A$)) OR  V
AL (A$) <  >  INT ( VAL (A$)) OR  VAL (A$) < 0 THEN 810
820  ONERR  GOTO 840
830  PRINT D$"BLOAD MOON£"A$: GOTO 850
840  VTAB 23: HTAB 1: CALL  - 868: PRINT  TAB( 10)"MOON£"A$" DOES NOT EXIST.": F
OR I = 1 TO 1500: NEXT : POKE C% + B%,0: GOTO 460
850  HCOLOR= D%: FOR I = B% TO 278: HPLOT I,159 TO I, PEEK (C% + I): NEXT : HPLO
T 0,159 TO 0,0 TO 279,0 TO 279,159: GOTO 460
855  REM ** GET YES/NO **
860  GET A$: IF A$ <  > "Y" AND A$ <  > "N" THEN 860
870  RETURN
894  REM ******************
895  REM ** CREATE MOON **
896  REM ******************
900  HOME : HTAB 14: PRINT "CREATE MOON": PRINT
910  PRINT 'INSTRUCTIONS : USE PADDLE 0 TO MOVE THE"
920  PRINT "FLASHING  DOT  UP  AND  DOWN.  PRESSING"
930  PRINT "BUTTON 0 WILL CAUSE  THE  DOT  TO  MOVE"
940  PRINT "FROM  LEFT  TO  RIGHT ACROSS THE SCREEN"
950  PRINT "DRAWING IN THE LINES BENEATH IT.": PRINT
960  PRINT "WHEN YOU WISH TO MAKE  A  FLAT  LANDING"
970  PRINT "SITE,  PRESS  BUTTON 1. THIS WILL CAUSE"
980  PRINT "LINES OF CONSTANT LENGTH  TO  BE  DRAWN"
990  PRINT "UNTIL THE BUTTON IS RELEASED.": PRINT
1000  PRINT "ENTER DRAWING SPEED (10-FAST , 60-SLOW)"
1010  VTAB 16: CALL  - 868: HTAB 19: INPUT A$: IF A$ <  > STR$ ( VAL (A$)) OR
VAL (A$) < 1 OR  VAL (A$) > 100 OR  VAL (A$) <  >  INT ( VAL (A$)) THEN 1010
1020 K% =  VAL (A$): HGR : HCOLOR= D%: HPLOT 0,159 TO 0,0 TO 279,0 TO 279,159: F
OR I = B% TO 278
1030  IF  PEEK (J% + B%) > 127 THEN  HCOLOR= D%: GOTO 1050
1040 H = 9 +  PDL (A%) * 150 / 255: HCOLOR= D%: HPLOT I,H: FOR J = 1 TO K%: NEXT
 : IF  PEEK (J%) < G% THEN  HCOLOR= A%: HPLOT I,H: GOTO 1030
1050  HPLOT I,159 TO I,H: POKE C% + I,H: NEXT
1060  HOME : VTAB 22: PRINT  TAB( 14)"RE-DRAW (Y-N) ?";: GOSUB 860: HTAB 1: CALL
 - 868
1070  IF A$ = "Y" THEN A$ =  STR$ (K%): GOTO 1020
1080  PRINT "    DO YOU WANT TO SAVE IT ? (Y-N)";: GOSUB 860: IF A$ = "N" THEN 4
00
1090  HTAB 1: CALL  - 868: PRINT  TAB( 14)"ENTER NUMBER ";
1100  INPUT B$: IF B$ <  > STR$ ( VAL (B$)) OR  VAL (B$) <  >  INT ( VAL (B$))
OR  VAL (B$) < 0 THEN  HTAB 27: VTAB 22: CALL  - 868: GOTO 1100
1110  ONERR  GOTO 1140
1120  PRINT D$"VERIFY MOON£"B$: HTAB 1: VTAB 22: CALL  - 868: PRINT "MOON£"B$" A
LREADY EXISTS. OVERWRITE?";: GOSUB 860
1130  IF A$ = "N" THEN  HTAB 1: CALL  - 868: GOTO 1080
1140  IF  PEEK (222) <  > 6 THEN 1170
1150  VTAB 1: PRINT : ONERR  GOTO 1170
1160  PRINT D$"BSAVE MOON£"B$",A"C%",L280": GOTO 400
1170  VTAB 22: CALL  - 868: HTAB 10: FLASH : PRINT "     DISK ERROR     ": NORMA
L : FOR I = 1 TO 2500: NEXT : GOTO 400
```


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PROGRAMS

Walls

by Bartin Stiby

The object of this game is to avoid three marauding walls which are hell-belt on destroying you. It's a rather eccentric variation on the breakout theme and will run on any Atari with a joystick. You use this to position your man, who has to dodge through the holes in the walls for as long as possible. It includes instructions and should be pretty straightforward to use. The "}" is the clear screen character (ESC CTRL CLEAR) and all text underlined in this listing should be in inverse video. Some of the lines on this listing run on by one or two characters to the next line.

```
1 GOTO 4000
10 X=USR(W1,RND(G)*55):P1=L:M1=G:IF RND(1)>0.5 THEN P1=LL:M1=-G
11 IF T=G THEN SC=SC+400
15 SC=SC+100:POSITION 7,F:? #6;SC:POKE 707,14:T=G:M1=M1$(RND(G)+SP):RETURN
20 X=USR(W2,RND(B)*55):P2=L:M2=G:IF RND(F)>0.5 THEN P2=LL:M2=-G
25 SC=SC+100:POSITION 7,F:? #6;SC:M2=M2$(RND(G)+SP):RETURN
30 X=USR(W3,RND(G)*55):P3=L:M3=G:IF RND(F)>0.5 THEN P3=LL:M3=-G
35 SC=SC+100:POSITION 7,F:? #6;SC:M3=M3$(RND(1)+SP):RETURN
100 P1=P1+M1:IF P1<L OR P1>LL THEN GOSUB 10
110 P2=P2+M2:IF P2<L OR P2>LL THEN GOSUB 20
120 P3=P3+M3:IF P3<L OR P3>LL THEN GOSUB 30
130 POKE H1,P1:POKE H2,P2:POKE H3,P3:SOUND F,P1,TN,P1:SOUND G,P2,TN,P1:SOUND H,P3,TN,P1
150 A=STICK(F):IF A=14 OR A=10 OR A=6 THEN IF VT>G THEN X=USR(UP):VT=VT-G
160 IF A=13 OR A=9 OR A=5 THEN IF VT<112 THEN X=USR(DOWN):VT=VT+G
170 IF A=11 OR A=10 OR A=9 THEN IF MP>47 THEN MP=MP-G:POKE MN,MP:IF STRIG(F)=F THEN IF T=G THEN
D=-1.5:GOSUB 500
180 IF A=7 OR A=6 OR A=5 THEN IF MP<210 THEN MP=MP+G:POKE MN,MP:IF STRIG(F)=F THEN IF T=G THEN D
=1.5:GOSUB 500
190 IF PEEK(HIT)<>F THEN 600
200 GOTO 100
500 T=F:SOUND G,F,F,F:SOUND H,F,F,F:MP1=MP
510 SOUND F,MP1,TN,P1:MP1=MP1+D:POKE MN,MP1:IF MP1<L OR MP1>LL THEN 580
515 IF PEEK(HIT)=F THEN 510
520 S=PEEK(HIT):IF S/2=INT(S/2) THEN 540
530 FOR A=BS+VT-3 TO BS+VT+8:POKE A,F:NEXT A:S=S-G
540 IF S/4=INT(S/4) THEN 560
550 FOR A=BS+VT+125 TO BS+VT+136:POKE A,F:NEXT A:S=S-2
560 IF S/8=INT(S/8) THEN 580
570 FOR A=BS+VT+253 TO BS+VT+264:POKE A,0:NEXT A
580 POKE 707,8:FOR A=MP1 TO MP STEP SGN(MP-MP1):POKE MN,A:SOUND F,A,TN,P1:NEXT A:POKE CL,F:RETUR
N
600 SOUND G,F,F,F:SOUND H,F,F,F
610 POSITION F,F:FOR A=G TO 30:PRINT #6;"aaaargh!";:FOR B=F TO 14 STEP H:SOUND F,A+B,12,8:POKE 7
07,B:NEXT B:NEXT A
620 SOUND F,F,F,F:POKE H1,F:POKE H2,F:POKE H3,F:POKE MN,255:GRAPHICS 18:POSITION 2,2:PRINT #6;"f
inal score was"
625 POSITION B,3:PRINT #6;SC:IF SC>HI THEN HI=SC
630 POSITION H,5:PRINT #6;"highest score is ":POSITION 8,6:PRINT #6;HI
635 POSITION H,9:PRINT #6;"PRESS FIRE BUTTON":POSITION H,10:PRINT #6;" FOR ANOTHER GO!"
640 IF STRIG(F)<>0 THEN 640
650 IF STRIG(F)=0 THEN POKE CL,F:GOTO 4170
4000 R=PEEK(106)-64:GRAPHICS 0:GOSUB 5000:FOR A=1536 TO 1690:READ B:IF B=34 OR B=35 THEN IF A<>1
542 THEN B=B+R
4010 POKE A,B:NEXT A:POKE 764,255
4020 POKE 54279,R+32:POKE 53277,2:POKE 623,1:POKE 704,56:POKE 705,206:POKE 706,106
4050 DATA 104,104,104,105,3,141,34,6,105,54,141,37,6,162,120,169,51,157,3,34,169,204,157,4,34,20
2,202
4060 DATA 208,242,162,12,169,0,157,16,34,157,75,34,202,208,247,96
4070 DATA 104,104,104,105,131,141,77,6,105,54,141,80,6,162,120,169,36,157,131,34,169,219,157,132
,34,202,202
4080 DATA 208,242,162,12,169,0,157,16,34,157,75,34,202,208,247,96
4090 DATA 104,104,104,105,3,141,120,6,105,54,141,123,6,162,120,169,85,157,3,35,169,170,157,4,35,
202,202
4100 DATA 208,242,162,12,169,0,157,16,35,157,75,35,202,208,247,96
4110 DATA 162,119,189,131,35,157,132,35,202,208,247,104,96
4120 DATA 162,138,189,252,34,157,251,34,232,208,247,104,96
4130 R=(R+32)*256:FOR A=R+900 TO R+1019:POKE A,0:NEXT A:FOR A=R+958 TO R+964:READ B:POKE A,B:
     NEXT
4135 DATA 28,28,8,62,8,20,20
4140 W1=1536:W2=1579:W3=1622:HI=53248:H2=53249:H3=53250:L=40:LL=220:SP=1.5:TN=10:P1=8:HI=0:F=HI:
G=1:H=2
4150 CL=53278:BS=R+517:VT=58:HIT=53263:MN=53251:DOWN=1665:UP=1678:PRINT "ARE YE READY ?";
4160 IF PEEK(764)=255 THEN 4160
4170 GRAPHICS 18:POKE 559,42:FOR A=G TO 30:PRINT #6;"theWallS";:NEXT A:POSITION 6,F:PRINT #6;"
     ":MP=120
4180 SC=F:P1=F:P2=F:P3=F:POKE MN,MP:POKE CL,F:T=F:GOTO 100
5000 SETCOLOR 2,0,0:PRINT "}":PRINT "  the walls  by Martin Stiby "
5010 PRINT "":PRINT
5020 PRINT "  You are living sometime way in the"
5030 PRINT "future. Walls have rebelled against"
5040 PRINT "their human masters and are set on"
5050 PRINT "killing you."
5060 PRINT "  You must dodge the three walls,"
5070 PRINT "which are trying to make you touch"
5080 PRINT "the lethal wallpaper they are covered"
5090 PRINT "in, for as long as possible."
5100 PRINT "  There will always be two holes in"
5110 PRINT "a wall, which you can pass through."
5120 PRINT "Also you have super-human strength"
5130 PRINT "with which you can knock out a hole"
5140 PRINT "in a wall. This you can only use when"
5150 PRINT "you are strong enough i.e. when you"
5160 PRINT "are bright white in colour. To use"
5170 PRINT "this strength - press the joystick"
5180 PRINT "button and move in the direction you"
5190 PRINT "want to go, but you score more points"
5200 PRINT "if you don't make use of this. Score"
5210 PRINT "is at the top.    ";:RETURN
```

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It is always with a degree of solace that we read of any microcomputer company's demise. But upon reading in a UK trade magazine that Arfon had gone into liquidation, our reaction changed to one of mirth. Not because the company had gone bust – but because a certain Aussi micro magazine – not us – was unfortunately in the middle of a competition which has as first prize . . . you guessed it . . . an Arfon product.

The happy ending – Arfon has been rescued by an electronics company called Torch which will prove to be the light at the end of Malcolm Fraser's tunnel for all the computer parties involved.

IBM's release date for its PC continues to be a topic of speculation. Said Pacific Weekly: "The official Australian launch of the IBM personal computer is still a secret . . . or, at least, IBM Australia is not saying anything. However, the company has booked enough floor space at the First Australian Personal Computer Show to launch a rocket". We're not taking bets, but if we were, the Show would be a short-priced favourite for the big day.

Spotted what's amiss with the keyboard on page 73? . . . 2 Gs and no K.

The new US season has started for the popular TV show, Dallas. And guess what's new at Ewing Oil? There is a computer in the President's office. It is impossible to tell whether it is a terminal or a stand-alone computer, but whatever it is, it's used regularly by the man himself.

Pictured is Futuretronics new 'flying saucer' H.Q. It was officially opened recently at an impressive show held in the warehouse at the rear, attended by such notables as the Governor of Victoria and Deren Hinch. Wonderfully clad female ET's abounded at one of the best – and crowded – Australian launches ever seen.

While on the subject of Ataris (Futuretronics distribute Ataris in Australia), after filing lawsuits against the world and his brother for use of the themes behind several of their games, it's rumoured that Atari International now find themselves locked in a legal wrangle with the Pacman Peanut Co (honest!) of the USA.

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INEXPENSIVE, EASY-TO-LEARN SOFTWARE. SUNDANCE is available with the two most versatile operating systems. Chances are, either CP/M or OASIS based programs can handle any computer application you require. With today's programming costs, this alone could save you more than the price of the system.

COMPLETE IN ONE UNIT. SUNDANCE eliminates the clutter of peripherals. All you need add is the printer, and SUNDANCE handles all popular types: low-cost dot matrix, letter-quality for word processing, or high speed printers.

SUNDANCE IS BEAUTIFULLY DESIGNED to sit at Management's right hand. The keyboard, on a five-foot coiled cord, can be conveniently placed on the desk or meeting table, ready for on-the-spot word processing, data entry or retrieval.

If you've been waiting to buy a computer, wait no longer.

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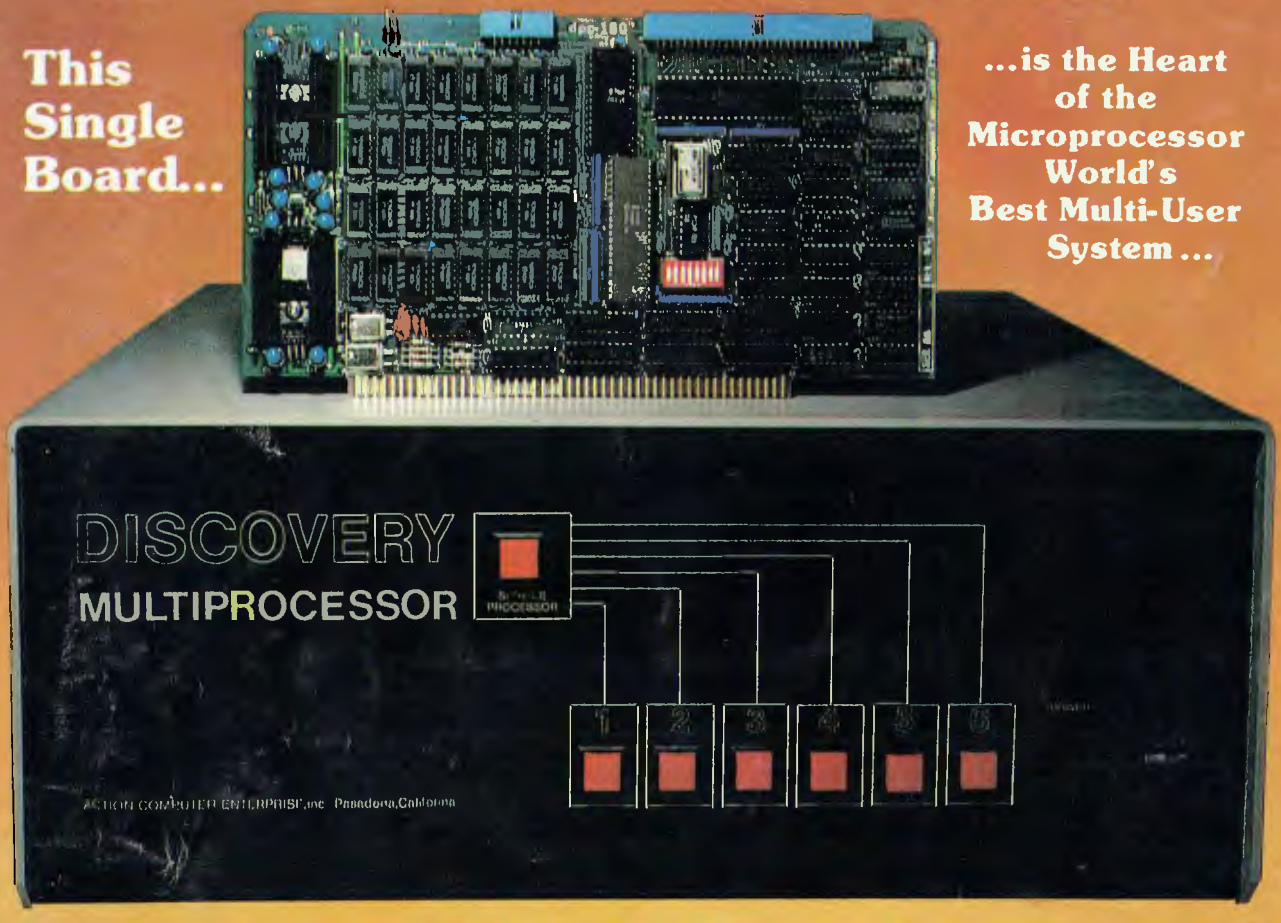
THE AUSTRALIAN BUSINESS SOLUTION

This Single Board...



...is the Heart of the Microprocessor World's Best Multi-User System...

THE DISCOVERY MULTIPROCESSOR

The dedicated power of this complete single board computer is provided to each user, making the DISCOVERY MULTIPROCESSOR unique among multi-user systems. With the power and expandability of distributed processing ● With the economy of shared peripherals ● With the flexibility of shared and private files ● And all of this with full CP/M* and S-100 compatibility.

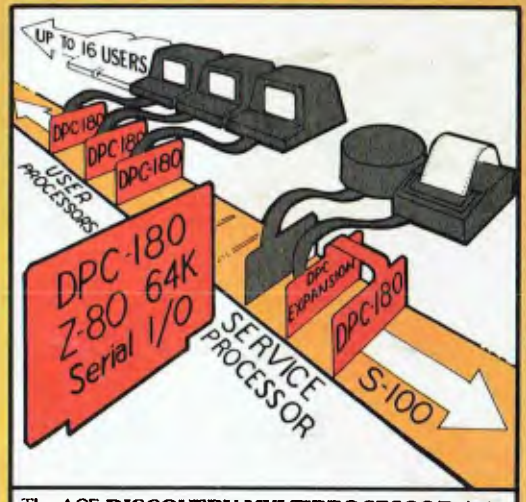
Multiprocessing Software

Our Distributed Processing Operating System, **dpc/os**©, resides in the Service Processor, establishing a CP/M environment for each user and managing access to the shared system resources. Multiuser facilities are provided for print spooling, for interprocessor communication and for private, public and shared-update files. Several processors can be employed concurrently by a single user via the enhanced batch submit facilities. And with **DISCOVERY** all CP/M compatible programs will execute without modification, thus protecting your software investment.

Multiprocessing Hardware

The ACE 64K Distributed Processing Single Board Computer, the **dpc-180**™ gives the **DISCOVERY** MULTIPROCESSOR its own unique architecture. One DPC is dedicated to each user providing exclusive use of the onboard Z-80, 64K ram and serial I/O. Access to the shared resources is provided by an expanded DPC used as a Service Processor. Additional users can be added at any time by simply inserting additional DPC's into the standard S-100 bus — up to a total of sixteen user processors in a single chassis!

*CP/M is a registered TM of Digital Research, Inc.



The ACE **DISCOVERY MULTIPROCESSOR** dedicates a complete 64K Z-80 Distributed Processing single board Computer, the **dpc-180**™ to each user. An expanded DPC coordinates all of the system activities.

DISCOVERY has been proven in installations throughout the World. If you need the Power of Multiprocessing... it's time you discovered us!

Multiuser mainframes with 192K ram start at under **$6600** The 64K **dpc-180**™ is priced at **$1424** Immediate delivery. A complete line of standard peripherals including a 33M byte hard disk subsystem can be supplied on request. Dealer and OEM inquiries are invited.

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SYDNEY OFFICE 59th floor MLC Centre, Martin Pl. NSW, 2000. Tel 235 1151 or 1141 Telex COHQ AA73114 (Sydney)