Australian Personal Computer

NEW DEVELOPMENTS IN THE AUSTRALIAN BEGINNING SEE SPECIAL SUPPLEMENT

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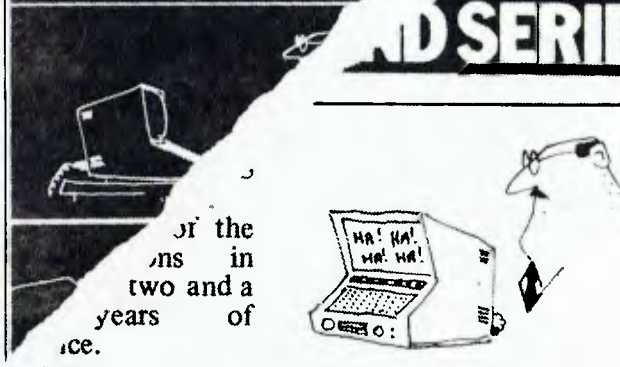
$2·50*

AUSTRALIA'S TOP SELLING COMPUTER MAGAZINE

'It took you precisely eight minutes 47.09 seconds to open this parcel – you certainly do need me!'

'I'm afraid your father's down to 600 lines of memory.'

'I still think it's a bit of a risk, leaving it on the doorstep all day.'



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The new HITACHI PEACH out-performs any small business/personal system you may now be considering, but only costs $1495 plus sales tax if applicable

Includes numeric key pads, ten programmable function keys (5 with shift), clock, speaker, the power of 6809 CPU, (RS232, centronics, light pen, audio, video) connections, six expansion slots for peripherals, 32k to 96k RAM, 24k ROM, advanced MICROSOFT BASIC, machine language, complete documentation, main frame TERMINAL capabilities, 640 by 200 dot byte – addressable graphics, eight colours, upper/lower case, 40/80 columns and much more. Monitors, diskette drives, hard disks, CIS-COBOL, PASCAL, FORTRAN, etc. are also available to complement the high standards and unequalled quality of this, the most powerful small computer in the world.

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inside

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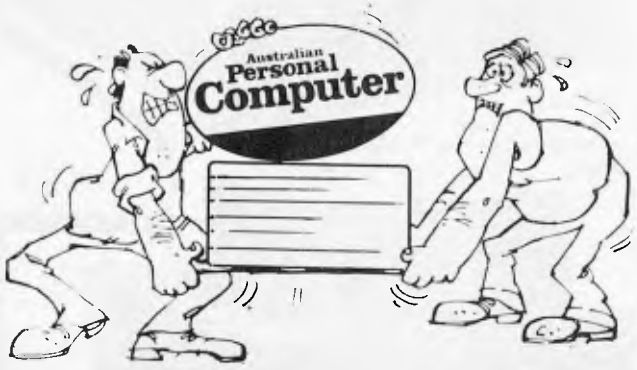

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NOTE TO READERS

Commiserations to readers suffering the agonies of the dammed waiting for the (late) arrival of this issue. Our recent move to new offices threw operations into a state of confusion; though we should point out that our late arrival does not mean old news. We've kept the news columns open as long as possible – long enough even to report such events as streakers at the VFL Grand Final.

Next issue we'll be back on schedule with what will be our best issue ever. Editorial features include a look at 3-D displays for micros, another instalment of APC-80, a Benchtest of HP's new low cost microcomputer, a comparison of CP/M-86 vs the new MS-DOS, and more, as well as our regular features.

While our new address is 500 Clayton Road, Clayton, 3168, correspondence should be addressed to the existing P.O. Box 280, Hawthorn, 3122. Our new telephone number is (03) 544 8855.

REGULARS

Volume 3 No. 9 1982

APC

FEATURES AND SERIES

BENCHTESTS & REVIEWS

HUGE SAVINGS
UNHEARD OF PRICES
HITACHI PEACH SYSTEMS

SYSTEM A

Peach Computer
16K Ram Expansion
High Resolution Green Phosphorus Monitor
Pair of Hitachi Single Sided Single Density Drives
Dos & Microsoft Software, Full Documentation.

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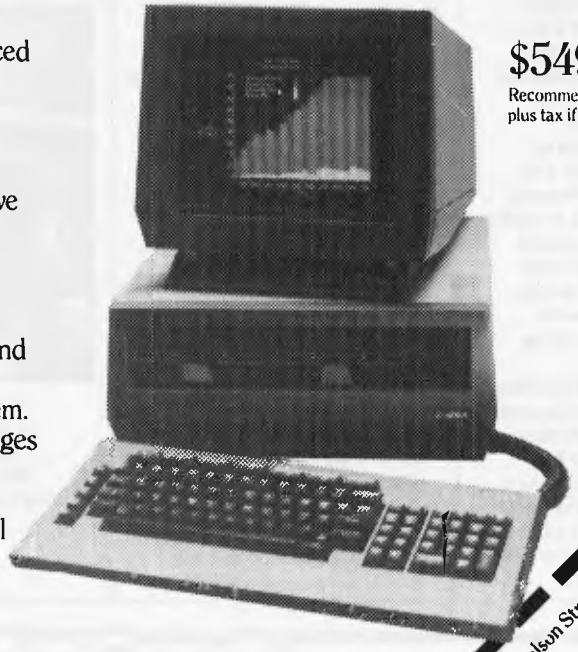

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1 1142

PRINTOUT

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

Big names back 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 are provided with a specialised event aimed at the multi-million dollar Australian microcomputer market, conservatively predicted to expand at least 4-fold in the next 4 years.

The organiser, Australian Exhibition Services Pty Ltd, is a member of the UK's Andry Montgomery group, established in 1895 and responsible for exhibitions spanning 14 countries and 5 continents. The Andry Montgomery programme includes The Personal Computer World Show, recently staged in London to a record-breaking audience of 47,460. This event is the most successful microcomputer show in Europe and the largest of its type in the world.

In a statement to Australian Personal Computer, 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 has long been apparent overseas and is recognised as the most effective method of attracting a precise audience.'

Companies wishing to exhibit should contact: Australian Exhibition Services Pty Ltd, 1250 Malvern Road, Malvern, Victoria, Australia 3144. Telephone: (03) 20 1208. Telex: AA 39329 AUSEXH.

Micro courses

P J Prentice & Associates has announced a range of microcomputer courses lasting from three to six weeks. Each course will cater for a maximum of six people to enable "hands-on" instruction with micros. The five topics are: Which computer do I buy?, The Basics of Basic, Advanced Basic Programming, Tips and Techniques, Pits and Pitfalls of Computer Purchase.

For further information contact Peter Prentice after hours on (03) 795 3113 or by writing to P J Prentice & Associates at 10 Police Road, Rowville 3178.

Multi-pen plotter

National has released a lightweight, 6 pen intelligent multicolour digital plotter. With a high speed writing rate of 400mm to 200mm/sec and 600mm/sec for pen replacement, it lends itself to quick, efficient, graphic presentation for illustrations and trend analysis etc.

It features GPIB, RS232 or ASCII 7 bit parallel interface with versatile intelligent software as a linear interpolation function, circle drawing, x and y drawing, X-Y axis drawing and labelling.

In the print mode, the plotter functions as a 58 character by 40 line printer. A complete self check of the plotter software and hardware can be performed at any time.

There are several options available, including a chart transport mechanism which can be remotely controlled to feed through up to 300 sheets of A4 size fanfold paper.

For further information telephone Scientific Devices Australia on (03) 579 3622.

Before the Spectrum

Melbourne House appears to be the early-bird with their release in October of "Over the Spectrum", as the name suggests, a book for the newly released Sinclair Spectrum. It contains 30 programs and a course for the beginner on Sinclair's latest. For more information on this and other products soon to be released for the Spectrum, phone Compshop on (03) 690 5336.

Sorcerer kit

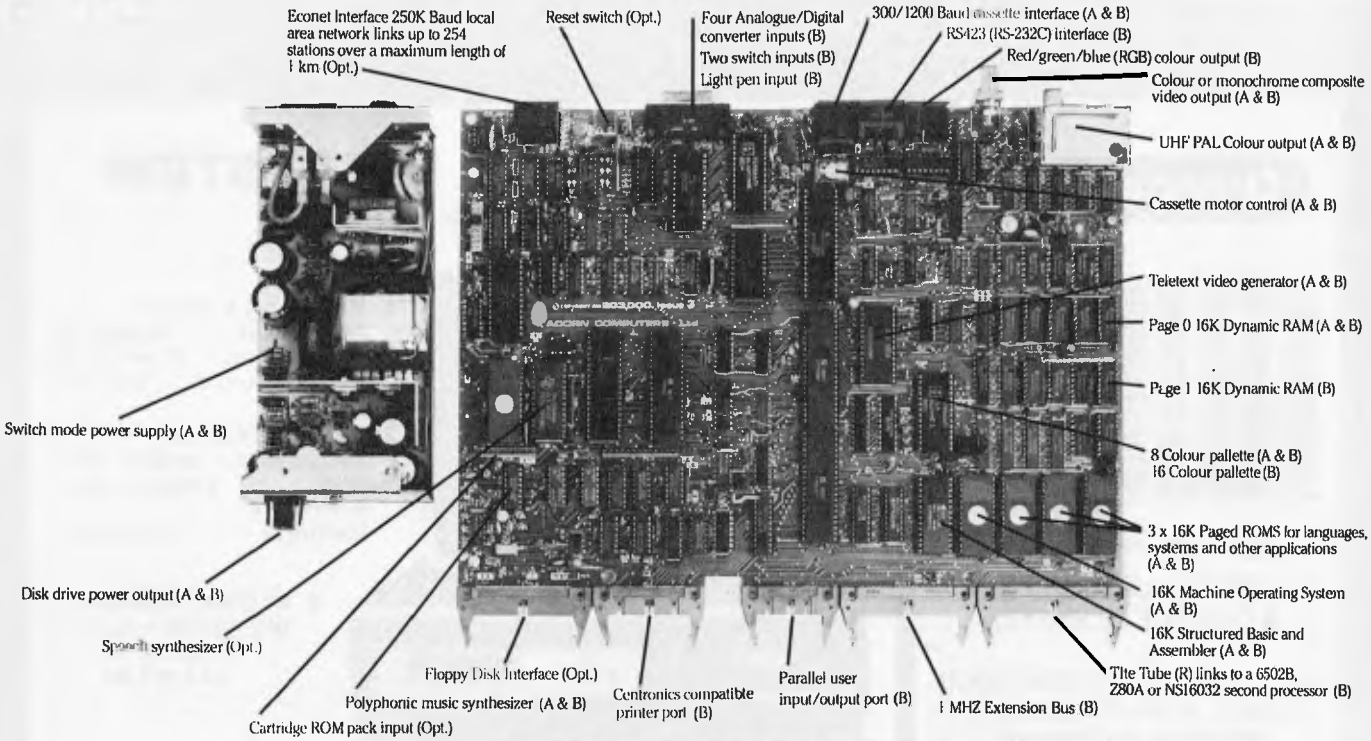
Suitable for Micropolis (Mod 1 or 2) or Exidy FDS disk drives, the kit provides several new features including "auto boot of disk, easy entry to monitor, entry to standard Basic ROMPAC and full 48k with standard Basic."

The unit is available from PJB Systems, P.O. Box 252, Forestville, 2087.

New Sharp MZ-2000

A new low cost alternative to the popular MZ-80B has been released in Japan. The new model is sold in Japan as the MZ-2000 and the retail price of Y218,000 buys a complete table-top micro with built-in screen, cassette drive, full keyboard with key-pad and 64 kbytes of system RAM.

Acorn BBC Microcomputer –
all the expansion you ever dreamed of, and it doesn't cost a fortune



CODE:
Model A and B = (A & B)
Model B = (B)
Optional = (Opt.)

The BBC Microcomputer offers a vast array of interfaces (not those costly add-on cards). Its highly structured Basic Interpreter positively encourages good program design.

Linked into the super-fast Acorn Basic is an extremely friendly interactive and relocatable Assembler.

The available range of compatible operating systems, which may be co-resident, includes 300/1200 Baud Cassette, 5¼"/8" Disk, Network, Teletext, Prestel and Cartridge filing systems.

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WA: W. J. Moncrieff (09) 325 5722
Amicro, Williams Street, Perth
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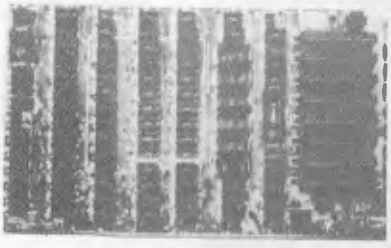

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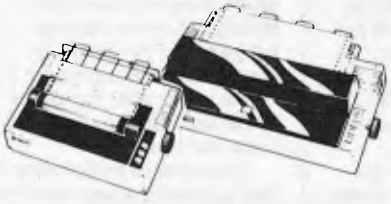

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EXCLUDING CONTROLLER $445.00 EX TAX
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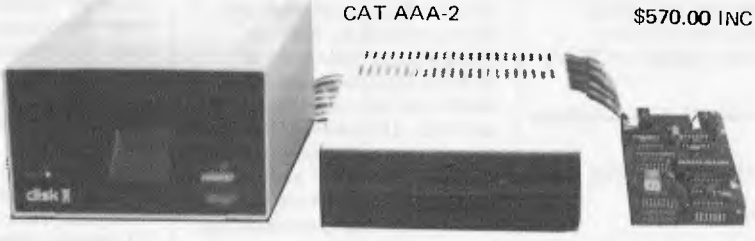

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PRINTOUT

Lazy market

Since the recent closure of CISA Microcomputing, one of the American companies for which it was distributing products has issued an invitation to Australian users to contact its head office in Michigan.

ABC Sales, producer of the Lazy Writer word processing system, has announced that it will continue to sell its products to the Australian market. The group is interested in making new arrangements with Australian dealers, but in the meantime any queries about its products can be directed to ABC's head office, located at 13349 Michigan Avenue, Dearbon, Michigan, USA, 48126.

The company says it now has a number of extensions to the Lazy Writer system, and a new version of the original program.

ABC has also apologised to Australian users for the inconvenience caused by CISA's closure.

Osborne denies rumours of $500 computer

Rumours started by a Sol Libes item in Byte magazine that Osborne is due to announce a personal computer retailing at $500 have been flatly denied by Osborne spokesperson Sandy Taylor. Modest Adam has been seen lunching with 'Uncle' Clive Sinclair, however . . .

Faster NEC static

Production has just started on what is claimed to be the world's fastest 4k static RAM chips. The new devices from NEC, designated the uPD2147AD-25, utilise NMOS technology, are configured as 4096 words x 1 bit and have an access time of just 25nsec. Production for 1983 is planned at 150,000 units a month and bulk prices will run at about Y3,000 each.

Apple II can run IBM programs

Coprocessors of San Jose, California, has announced an 8088 plug-in card for the Apple II that allows it to run software for the IBM Personal Computer. The card has a quasi-16-bit Intel 8088 running at 5MHz, 64 kbytes of RAM and various control functions, upgrading the Apple to a 16 bit machine with 128 kbytes of RAM for a retail price of US$899. The card is fully compatible with Apple peripherals and operates from the Apple's internal power supply.

New business Commodore

The Commodore B128 is the first of a new series of business machines. The standard configuration comes with 128 kbytes of user RAM and 40 kbytes of ROM. An 80 character by 25 line green phosphor 5¼ inch display and dual disk drives are built in. The keyboard is detachable and has 94 keys, including a double sized enter key, double-zero and clear, 10 function keys plus editing and cursor control keys. Both RS-232C and IEEE-488 interfaces are provided, plus a real time clock and a three-voice, 9-octave music synthesiser chip. RAM can be expanded to 256 kbytes internally or 640 kbytes externally. An optional Z80 board gives CP/M compatibility. The basic US cost is $1695.

NEC-TEAC tie-up

Although TEAC does manufacture micros, and is well known for its FD-50 series of floppy disk drives, the company is associated in most people's eyes with audio equipment, open reel and cassette decks being most noteworthy. Sales figures and company profitability have been very disappointing over the last few years. Rumours of a big tie-up between French giant Thomson and TEAC a year and a half ago boosted morale and stock prices on the Tokyo Stock Exchange, but the deal failed to materialise and the company's fortunes have been looking gloomy ever since. Massive expansion in audio sales during the Vietnam war has fallen flat and it's an open secret that it's only sales of disk units, data cassettes and instrumentation recorders that has been keeping the company going.

Fresher-looking Osborne after recent face lift.

Wunderkind Yanase, the company president brought in from the commercial world has been 'reappointed' as Vice President while the more conservative Mr Tani – who used to be President – has been reinstated.

This move was part of the deal that brought in NEC's sister company, New Japan Electronics (Shin Nippon Denki) who will be cooperating with TEAC from now on in both manufacturing and marketing. Shin Nippon is the consumer electronics division of NEC. NEC audio products, like those from TEAC, have been slipping in popularity charts over recent months. By pooling their resources, the two companies hope to reverse the trend imposed by a depressed market. Shin Nippon's President Sasaki will head the NEC side of the enterprise. Manufacturing and marketing of the Computer Products Division of TEAC are thought to be unaffected by the deal with NEC.

Osborne upgrade

Osborne diskettes are to be upgraded to double-density after all, and an 80-column display will also be added in January.

A new machine, offering a bigger screen, an 80-column display as standard, and slim-line floppy disks, will also be announced to the trade in the near future.

The double-density diskette option for users of the CP/M portable has been delayed by quality assurance problems since its announcement in March, but Adam Osborne has given the go-ahead this month. The announcement comes weeks after the arrival of the first injection-moulded cases (see picture).

Expected to be free with the disk upgrade is a new operating system, the UCSD p-system. This allows Osborne users to run programs written in Pascal. This is free because the University of California's agent, Softech, has supplied it free to Osborne. "They virtually fell down the stairs giving it to us," Osborne said. But the Pascal compiler which produces p-code will not be free, so users who wish to actually create Pascal programs will have to buy that product. Pricing on the compiler is not known yet.

Osborne also promised that the long-awaited improvement to the narrow screen (only 52 characters displayed) will be offered in January. "We will be offering an 80-column upgrade in the new year, as well as the new machine with 80-columns as standard," he said.

Fast static RAM from Toshiba

Toshiba has announced a new line of faster, energy saving 16k static RAMs using N-channel MOS technology. The new static RAMs come in two sizes and three speeds, run asynchronously, need no clock and boast access times of 90, 100 and 120nsec. Power

THE ICL PERSONAL COMPUTER. A LITTLE BEAUTY FROM COMPUTER GALERIE.

The release of another personal computer is not really big news. But the arrival of this personal computer at Computer Galerie is.

Computer Galerie has chosen the new ICL Personal Computer from the 137 also rans for very good reasons.

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Computer Galerie also chose ICL because of thoughtful programs. The ICL Personal Computer has a Bill of Materials program for manufacturers. That is quite something in a machine at $45,000 let alone one at a fraction of this cost. The ICL has a "design your own invoice" facility. The 'Aged Debtors' gives you phone numbers and contact names as well as a free line to write in their excuses. The general ledger even has a 35 choice Report Writer. Computer Galerie has the skill to advise you on thoughtful programs.

One last point: Computer Galerie didn't get to be one of Sydney's longest surviving small computer dealers by pricing themselves out of the market.

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The new Vector 4, see'VECTOR A VICTOR?"

consumption during operation is claimed to be 30 per cent down compared with previous designs and is typically about 50mA per device. The TMM2016AP series comes in 0.4 inch DIP packages and the TMM2017AP series are in the standard 0.6 inch DIPs. The devices require only a single +5V supply and are configured as 2k words x 8 bits. Prices for the standard DIPs are Y2,000, Y1,700 and Y1,500.

Microsoft's Europe scheme . . .

Microsoft's release of MSDOS Version 2.0 points clearly towards an upgrade path from single user systems like the IBM PC to multi-user Xenix machines.

A variety of Xenix – and therefore Unix – features have been included in MSDOS 2, and MSDOS files and programs can be transported to Xenix systems using an MSDOS networking package and Xenix 'shell' called Xendos. A new Xenix library has also been written to let Xenix programs written in C to be transferred to MSDOS working.

Bob O'Rear of Microsoft, claims that the new version corrects the "many weaknesses" and "recognised deficiencies" of the original MSDOS release. These weaknesses included poor memory management of large RAM spaces, lack of background printer spooling, disk directories tailored to small capacity disks, and inadequate handling of I/O devices.

Features have been pulled in from Xenix to correct things, and in fact O'Rear describes MSDOS as "the bridge to Xenix" as Xenix-compatible system calls have been built-in.

NCR chips

NCR's microelectronics division says it has become the first systems supplier to offer other manufacturers a set of microprocessor chips which they, in turn, can use in future small-to-medium power mainframe computer systems.

Called NCR/32, the set of chips uses a 32-bit, VLSI (very large scale integration) implementation which packs tens of thousands of microcomponents onto a single three-eighths of an inch square silicon chip.

This high-density microcomponent packaging significantly reduces the system's physical size and cost while greatly increasing performance and reliability.

According to microelectronics division vice president, James H Van Tassel, "We are offering manufacturers of computers, process control systems, military equipment and others a way of applying this advance in microelectronics technology to their future systems".

Using the chip set, Van Tassell says computer manufacturers will be able to shrink the size of a central processing unit of a medium power computer to "breadbox size". In spite of its dramatically reduced size, he continued, the processor would offer four times the computer power for about the same price. In addition, it would use one-seventh of the electricity of its predecessor, and provide greater levels of operational reliability.

Because of a unique emulation feature of the chip set, manufacturers will be able to build new, more powerful systems that are "architecturally identical" to their previous systems.

Mr Van Tassel says: "Drawing on three generations of NCR mainframe design experience, we were able to offer this unique 'computer look-alike' feature that no one else has on the market currently".

Mr Van Tassel says the market for such chip sets is just now emerging, and he expects that total demand will exceed over $100 billion by 1984. Sample NCR/32 chip sets, each comprising five chips, will be available during the first quarter of 1983, with volume deliveries to begin in the second half of the year.

NCR entered the merchant semi-conductor market in mid-1981 after 10 years experience in providing microcomponents for internal use only.

QIT workshop

The Queensland Institute of Technology is offering an advanced microcomputer workshop during April next year. The institute is now calling for papers for this workshop, with papers to be related to the following subjects:

Techniques for good program structuring practice; development of operating

systems; comparison of high level languages for real-time operation; use of microprocessor development systems; practical techniques for hardware debuggung, using logic state analysers etc; practical techniques for software debugging; DMA techniques; multiprocessor systems; examples, with demonstrations, of practical applications of 6502 and 6809 microcomputing systems.

Inquiries and correspondence should be directed to Dr C J Chesmond, senior lecturer — control engineering, Department of Electrical Engineering, Queensland Institute of Technology, G.P.O. Box 2434, Brisbane, Qld, 4001. Ph: (07) 223 2484.

Vector a victor?

Dicker Data Projects has announced the new Vector 4 computer system, an advanced 8/16 bit desk-top computer which allows the user to take full advantage of the existing base of the 8-bit CP/M programs while providing for the move up to the power of 16-bit processors.

The Vector 4 has an architecture which can run either the Z80 or 8088 at full speed, or "swap" between them under program control. The CP/M operating system uses this concept to improve the performance of existing 8-bit applications. This dual processor architecture also makes it easy to upgrade to new 16-bit operating systems and applications programs as they become available, Dicker says.

In addition to the dual processors, Vector 4 comes standard with 128k of main memory using 64k RAM chips, and it is expandable to 256k. A single chip video controller manages the generation of the CRT display.

A unique feature of the Vector 4 is that the main memory is time-sharing between the CPU and the video display controller. Software control of the display controller allows fast access to screen memory for high resolution graphics and also allows the screen memory to be moved anywhere in the main memory. Memory mapping circuits give the Z80 CPU access to all 128k or 256k of main memory and can be mapped in increments as small as 2k.

The keyboard has its own microprocessor, making it easy to program individual keys for different languages, alphabets or special characters.

The Vector 4 display has a resolution of 640 x 312 pixels for high resolution graphics and a high density 16 x 13 matrix for alphanumeric characters. A high screen refresh rate produces a flicker free display which is enhanced by a grey neutral density screen cover that cuts glare and increases contrast, according to Dicker.

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(IEE standard 488-1978 compatible)
3 RS-232C interface

The model VP-6801A, A4 type multicolor intelligent digital plotter is designed for use in graphic writing and recording in combination with personal computers and measurement systems with micro processors.

It features high speed writing of 200mm/sec, 6-color graphic functions and versatile intelligent software such as interpolation function, circle drawing, X and Y grid drawing, and X and Y axis drawing. Various marks and alphabet drawing are also available with desired size and direction. The print mode is useful as a printer with 60 characters x 40 lines for LIST print out and self check of the plotter.

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Come to where the values are . . .

Computer Country, in Melbourne, is having a clearance sale on a large number of items before its next inventory.

According to the company, prices are "Extremely good". The sale applies to current stocks only and it will end on October 8. According to a company statement: "This is a good opportunity to buy big and save a lot of money." It is also, of course, an opportunity for Computer Country to make a lot of money, particularly if you buy big!

The showroom is now open until 8pm on Thursdays.

Country capers

Before we forget Computer Country, another item of interest has hit the APC news desk. Computer Country Holdings, of Western Australia, has despatched a statement clearing up some apparent confusion between its own operation and that of the Melbourne based Computer Country Pty Ltd. "To clear that up is simple," the statement explains, "There is no connection at all."

The company adds: "We at Computer Country in Perth make clear that we have no nor do we intend to have any trading or otherwise relationship with the Victorian firm of the same name either express or implied." Well there you have it – tortured sentence construction and all!

Charge it!

The Western Australian parent of Computer Country Holdings, Computer Products (W.A.) Pty. Ltd. (I hope you're still with us) has just released a useful addition to the Osborne 1 micro.

The addition is a battery pack which can be used as an emergency back-up for the unit. And at a mere $349, plus tax, it should give Osborne users quite a charge.

Apple bites back

In the latest chapter of the continuing saga of the bogus Apples, a restraining order has been issued in the Supreme Court of Victoria against Micro Pro computers.

Micro Pro has been selling microcomputers which Apple Computer believes are deliberate imitations of its own top selling model. David Strong, general manager of Apple Computer Australia, says the Victorian order is the first action to result from the extensive investigations his company has been conducting over recent weeks.

"We will continue to seek out and identify not only stockists of fake Apple machines, but also the sources from which they are coming," Mr Strong says, in an obvious attempt to live up to his name.

The Supreme Court order, according to Apple, restrains Micro Pro from selling the Apple-like micros and requires the company to provide the names of all its suppliers.

Similar action has been underway in the US. Customs Service officers have been detaining and destroying imitations of the Apple II which have been coming from Hong Kong and Taiwan.

In August Apple filed a number of law suits in Taiwan, Hong Kong and New Zealand in an effort to stop the manufacture and export of "bogus Apples". Since then, Apple says the maker of the Apolo II computer, Sunrise Computer, of Taiwan, has agreed to cease production. In New Zealand, Orbit Electronics, which was selling Orange brand computers from an unknown Taiwanese manufacturer, has also ceased trading.

Apple says it intends to seek court action against all stockists of what it calls fake Apples "to protect the investment of existing Apple II users (and) to protect potential buyers who may unwittingly purchase one of the bogus products". Mr Strong says buyers of the imitation Apples will not be able to obtain after sales service and support, and their machines will have almost no resale value.

The latest actions by Apple, and the company's eagerness to publicise them, indicate its serious concern with imitation machines. The company is hoping to frighten potential distributors and retail purchasers with publicity at least as much as it is trying to dissuade them with legal sanctions.

The supplier is caught in an unenviable situation. The problem of the bogus Apples is adding insult to injury at a time when the supplier's market

share is already being attacked by a proliferation of new micros from traditional mainframe companies.

Fruitful business?

On a more cheerful note, Apple has launched its heaviest ever promotional campaign in national and metropolitan newspapers. Both by negative means (in the story above) and by positive means the company is determined to maintain its claimed number one position in the personal computer market.

Interestingly, the latest campaign is aimed squarely at professionals and business people.

Apple's David Strong, explains the promotional message this way: "The Apple is not just another piece of computer hardware, but rather a business tool designed to increase efficiency and productivity. We are trying to show how it can free the business executive from time consuming tasks, and provide more time to enjoy leisure pursuits and family life."

The advertising campaign has been developed by The Campaign Palace.

Knowledge piracy

Returning to negative matters: Australian authorities should be planning swift and decisive action to stop a spill-over here of the growing international market in pirated computer software, according to Australian Computer Society fellow, Dr Bill Caelli.

"We can only estimate the problem here at this stage, but reliable, industry estimates rank the piracy problem in Australia with the United States," he says. And that means that around nine copies are pirated for every one software program that is marketed legitimately."

Dr Caelli, chariman of the A.C.S. national hardware technology and hardware industry committee, is also president of the Eracom group of companies which designs and manufactures a range of small computers on Queensland's Gold Coast.

Dr Caelli said his comments on the piracy problem had been prompted by "disturbing reports" during discussions at last month's Australian Computer Conference in Hobart.

"During the conference, we heard of surveys around the world which suggest that software piracy is beginning to rank with drug running in terms of direct profits in the international crime scene," Dr Caelli said. Software packages being marketed at around $500 in Australia could be picked up illegallly on the international market for $60.

"It's the theft of knowledge and while it may be difficult to relate to bank robbing and such, it is theft none the less," he says.

"And, of course, it means that programs designed for a special reason, for a company's security and so on, may be duplicated thousands of times, making security useless," Dr Caelli said.

He said surveys indicated that in the huge South East Asian market, 14 pirate copies were sold for every one software package marketed legitimately. In Europe the ratio was around 5 to 1.

"Similarities between the Australian computer industries and the U.S. suggest that the piracy figures here are about par with America," Dr Caelli said.

He said software packages were covered by general copyright laws here and in the United States, "But the laws just aren't effective enough.

"Australian Federal Government legislators should be getting to work without delay to tighten up our controls. Otherwise, as in so many other areas, Australia will inherit law breaking and more corporate crime from overseas," Dr Caelli said.

Adding a plug for his own company, he added that recent reports had sparked "tremendous interest" in Eracom's small computer data security system – the Era-230 Data Encryption Module. Eracom officially launched its encryptor in Brisbane a few days before the Hobart conference. "It is a specially designed board providing encryption and decryption to secure data in storage, being processed or being transmitted across a computer network.

"We were delighted by the response at conference to the encryptor."

Dr Caelli said it was now clear throughout the computer industry – backed by the piracy figures – that traditional data security measures, such as the password system built into software programs, was "full of holes".

"What we have come up with in the Era-230 encryptor is a hardware insert to guarantee a protective shield for any software package in use," he said.

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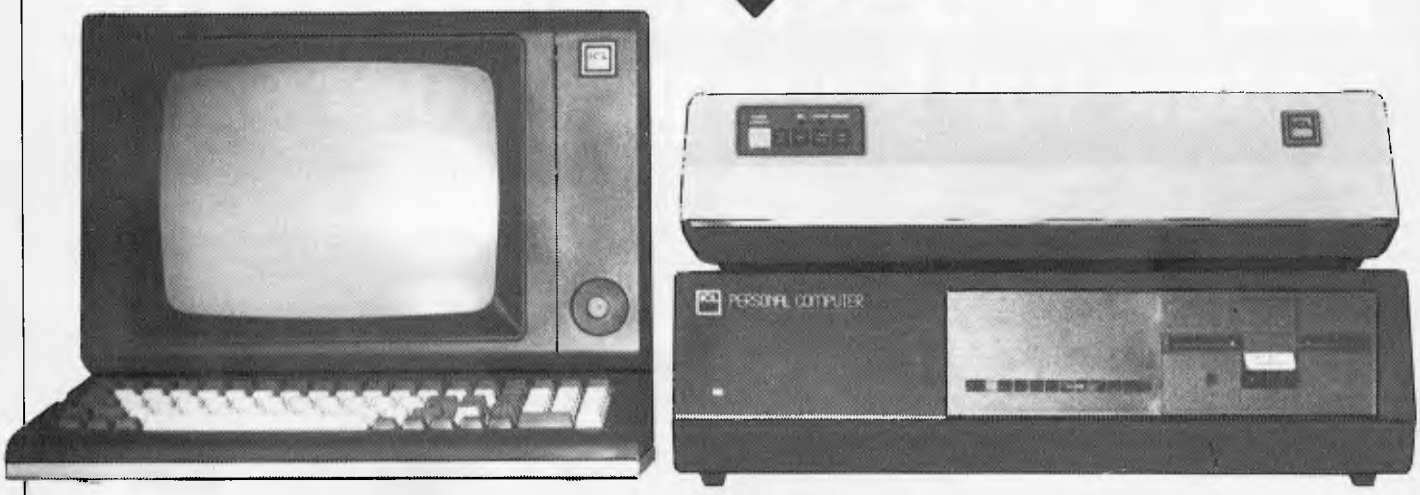

ICL PERSONAL COMPUTER

by Stephen Withers

The last few months have seen the long awaited entry of mini and mainframe computer manufacturers into the micro market. The announcement of the IBM Personal Computer probably caused the most excitement, but several other 'big name' microcomputers have appeared, one of them being the ICL Personal Computer. Four versions are available, starting with the Model 10 (64k, two floppies, two serial ports). Replace one of the floppies with a Winchester and you have a Model 30. There are two multi-user systems: the Model 31 (128k, four serial ports) and the Model 32 (256k, eight ports). The system supplied for this benchtest was a Model 32.

Hardware

The PC is a prime example of badge engineering – it was originally made and sold by Rair (another British company), who called it the Black Box. The colour scheme has been changed to an attractive brown and beige, but this and the new nameplate are about the only differences.

Opening the case reveals eight printed circuit boards plugged into an 84-way bus. One board carries the 8085 processor and its support circuits, while another provides the eight RS-232 serial ports. A slightly messy feature is that the 25 way sockets for these ports are not mounted directly on the back panel, instead a small port expansion box is connected to the computer by a ribbon cable and 37 way connector. Four 64k blocks of RAM occupy a card each (if 64k chips had been used, only one card would have been necessary), and there are separate floppy and hard disk controllers. The hard disk is a 5in Seagate Technology drive giving 5Mb, while the 40 track double sided Tandon drive adds another 250k of storage. A nice touch is that a dual position reset switch allows the system to be booted from either drive (on powering up the system loads from the hard disk). I'm not sure of the precise source, but some part of the computer caused severe television interference. This came as a surprise, as I have not experienced this before with a metal-cased micro.

This may seem an unexciting list of components, and it certainly isn't "the very latest in hardware technology, [and] sophistication" that ICL promise in their newspaper advertisements, but being well-tried, reliability should be no problem.

The recommended terminal for use with the PC is ICL's 6402 VDU. With a colour scheme toning with the PC, it offers just about every feature you are likely to want on a non-graphics terminal (although some graphical characters are present, including some which would be useful for producing forms on the screen). Cursor control, protected fields, editing capabilities, even underlining can be achieved. The 12 inch green screen gives a clear, sharp display (24 rows of 80 characters, plus a status line). Unfortunately, the detachable keyboard does not have a very pleasant action, and typing causes quite a clatter. In addition to the usual keys, there are cursor and editing controls, a numeric keypad, 11 programmable function keys, and two unusual keys. FUNCT, when depressed simultaneously with another key generates the sequence control-A/KEY/carriage return, where KEY is the other key pressed. It seems that this sequence is used with some (mainframe?) text editors. The other strange key is PRINT, which dumps the display through the terminal's printer port. I doubt that this feature will be used by many PC owners. Keys which correspond to printable characters are all cream in colour, while the remainder are brown. This makes the array of 100 keys seem less monolithic, but I prefer numeric keypads and cursor control clusters to be set apart from the main keys.

As the function keys are shiftable, a total of 22 code sequences may be stored. 256 bytes of memory are used to hold the sequences, allowing for reasonably sized messages. A user-configurable program to load the function keys would be a useful addition to the system.

ICL offer a small range of printers comprising the Oki Microline 82A and 83A dot matrix printers, plus the Qume Sprint 5 and Ricoh RP1600 daisy-wheels. All four are sold under the ICL label. The Microline 83A accompanying

the test machine had most of the features normally found on printers of this type, plus adjustable tractors to handle paper up to 14 inches wide. At 120 characters per second, it prints reasonably quickly. Although it is no noisier than similar printers, the noise it does make is particularly unpleasant – something like a slowed down dentist's drill.

If my description seems negative, it is because there is nothing unusual or innovative for me to get excited about. There is also nothing to justify serious criticism, but even the multi-user capability is insufficient to make it stand out from its rivals.

Software

All PCs are supplied with CP/M and Microsoft Basic version 5, while Models 31 and 32 also include MP/M for multi-user operation. Microsoft Basic is so well known that I shall do no more than give the benchmark timings, which are respectable without being earth-shattering, although the disk tests demonstrate the speed of a Winchester disk.

While installing CP/M, Rair added some features and facilities that increase the flexibility of the system, at the cost of some simplicity. First of all, they have provided a clock and calendar option, but the only way to access the current date or time is through the TIME and DATE commands – no information is given to allow their use within a program.

One feature that I have not seen before is a command which assigns physical disks to logical drives. Normally the first drive is A, the second is B, but this command allows the allocation to be reversed. If a hard disk were added to an existing system, it would take only a few moments to make it drive A, while the floppies are reassigned to drives B and C.

REP is a modification of the SAVE command, the difference being that REP deletes any existing file with the specified name before saving. This would be particularly useful when a disk is almost full. Another addition is LIST which simplifies the printing of files. It is interesting to note that all these commands are built into the operating system, and not transient programs loaded from disk.

Some extra transients have been provided. FORMAT is (naturally) used to format floppy disks, and MAKECPM writes the operating system onto the reserved tracks of a disk with the option of changing certain parameters. An auto-load command may be entered in order to automatically execute a program whenever the system is booted, but for some reason SUBMIT and XSUB do not work in this context. This is a pity, because a SUBMIT file would be useful to set up the terminal when the system is switched on.

The third extra transient is SET, which alters certain characteristics of the serial ports. The ports are labelled TTY0: to TTY7:, and CP/M's four logical devices may be assigned to any TTY, e.g. SET TTY7: LIST assigns the list device to port 7. The next set of options specifies the physical characteristics of a port:

The ICL Personal Computer keyboard.

Option	Effect
SPEED	sets baud rate
PARITY	sets parity on output
FILL	allows nulls to be sent after carriage returns, etc.
WIDTH	breaks long lines by inserting carriage return/line feeds. If WIDTH 0 is set, lines are never broken
DTR	causes the DTR line to be monitored, allowing the peripheral to control the flow of output.

If programs employing control characters for input or output are used, the following options may need to be set or reset at different times:

XON	XON/XOFF characters are used to control input from a peripheral
STALL	As XON, but to control output
ECHO	If set, received characters are echoed to the sending device
VDU	If set, DELETE is echoed as backspace, space, backspace (giving true deletion)
FORM	If set, formfeeds are expanded to four blank lines
TAB	If reset, tabs are expanded to spaces
UPARROW	If set, most control characters will be echoed as printing characters (e.g. control-C appears as ^C).
BINARY	If set, disables WIDTH, VDU, FORM, TAB, and UPARROW. Allows control and escape codes to function properly.

Setting BINARY is not always the complete answer. As STALL is left active, typing control-S (XOFF) will stop output to the terminal, and control-S is used by MicroPro software as a cursor left command. Another problem is that unless XON is set, the terminal can send function key messages faster than the PC can process them, resulting in lost characters. As no information is provided about changing these settings from within a program, it is necessary to use SUBMIT files to ensure that they are correctly set before and after a program, hence my remarks about the inability to use SUBMIT as an auto-load command.

Having to keep changing the settings can be irritating, but there is an important advantage in the approach Rair adopted – full compatibility with other CP/M implementation is maintained.

As only one terminal came with the review system, it was not possible to carry out a serious evaluation of MP/M running on the PC, but by connecting the VDU to several ports in turn, some observations could be made.

To start with, MP/M offers two main advantages over CP/M when a single terminal is connected to the system. The first is that a print spooler is included, so a file can be printed while another program is being run. The second point concerns system files. Although CP/M is a single user system, a user number between 0 and 15 may be set in order to reduce the number of active files on a large capacity disk. User numbers can relate to different individuals who use the system at varying times, or perhaps to different projects. Anyway, the snag is that it is only possible to access files held under the current user number (not strictly true, but effectively the case), so each user area must hold its own copy of the system files. The advantage with MP/M is that files belonging to user 0 may be accessed regardless of the current user number. These benefits come at the cost of 11k of usable memory, and a marginal reduction in speed, which is unlikely to be noticed.

The effectiveness of the system with more than one active console depends on what the users are doing. In particular, a program making heavy use of the disk has a marked detrimental effect on other users. Judging by my necessarily limited investigation, I think two users would normally get reasonable response times from the system, and in certain circumstances, all five users could get some useful work done. The five user limit is the result of the memory organisation, the 256k of memory present in the system being mapped into six banks, one of which is occupied by MP/M.

I should point out that these remarks refer to MP/M version 1.1. Version 2, reputed to be a superior product, is currently being field tested by ICL.

Goto page 90.

...and SIGMA/OKI made it happen!

other people said it had to happen, but SIGMA/OKI made it happen with the SIGMA/OKI IF800 personal computer

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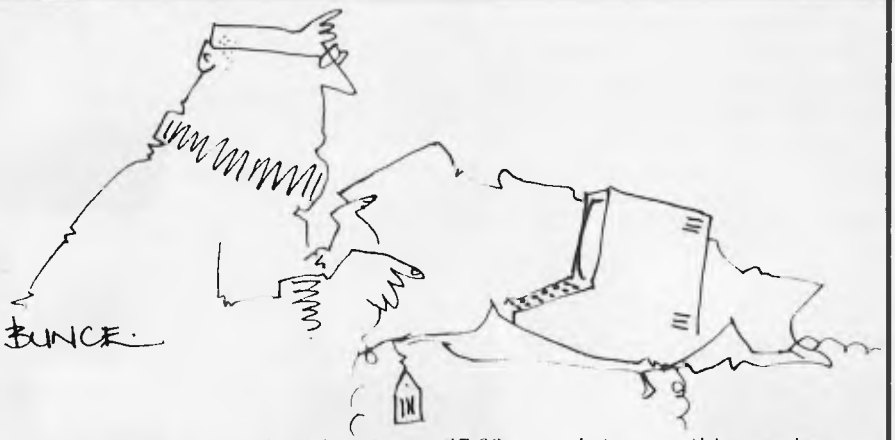


'It took you precisely eight minutes 47.09 seconds to open this parcel — you certainly do need me!'

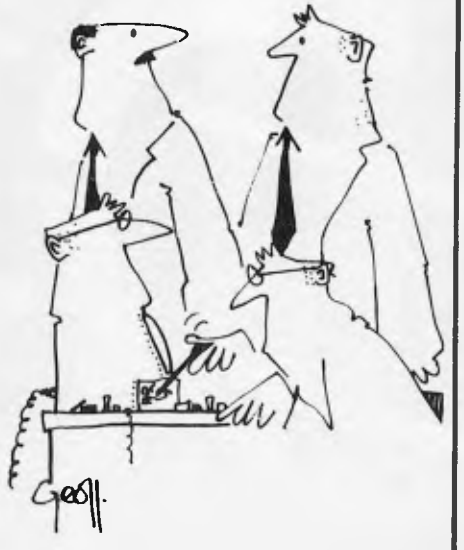
'I'm afraid your father's down to 600 lines of memory.'

'I still think it's a bit of a risk, leaving it on the doorstep all day.'

'It's the first batch of documentation for our new 'paper-free' office.'

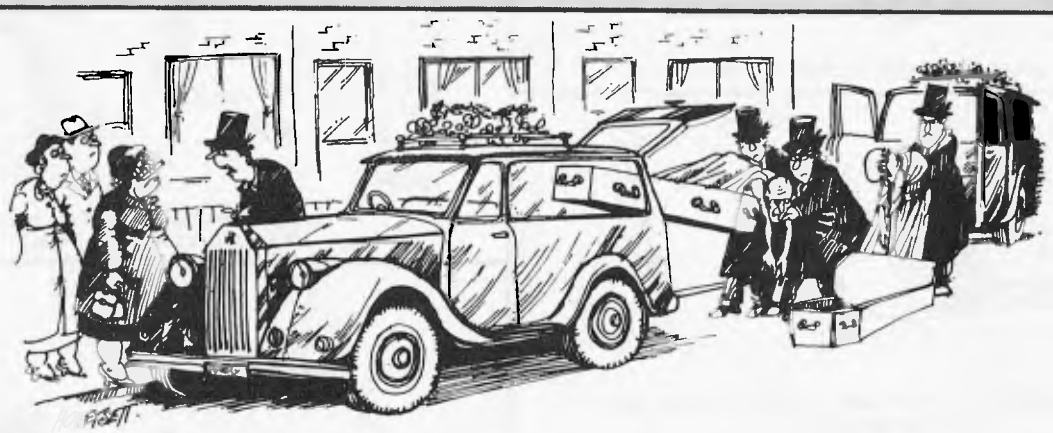
'I left a whole slab of chocolate right there on my desk'...

'It's so infallable it's like having your own Pope!'



"He creates them in his own image"

APC'S FUNNIES



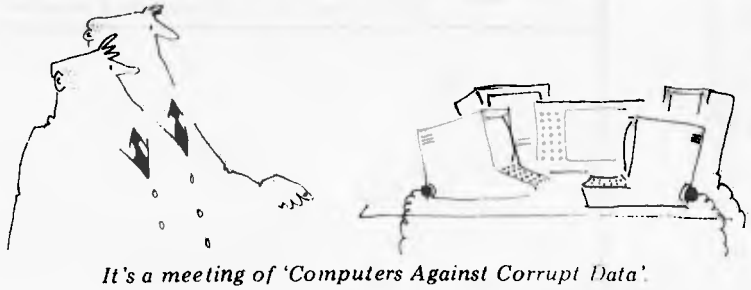
"I'm most terribly sorry about this, Mrs Kewbeer, we've had no end of trouble since we installed a computer in the office."

"We can't prevent him from looking but surely we can do something to stop him changing the channels"

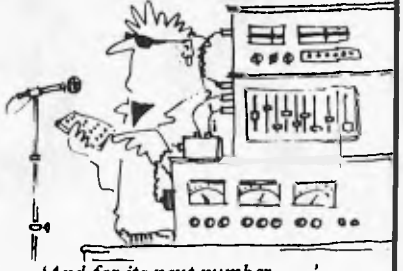
'Isn't that sweet! Mother says she's knitting you a floppy disk'

'Honestly mum he never speaks to me these days. He just leaves me the occasional floppy disk.'

'It's either an elaborate hoax or they were more advanced than we thought.'



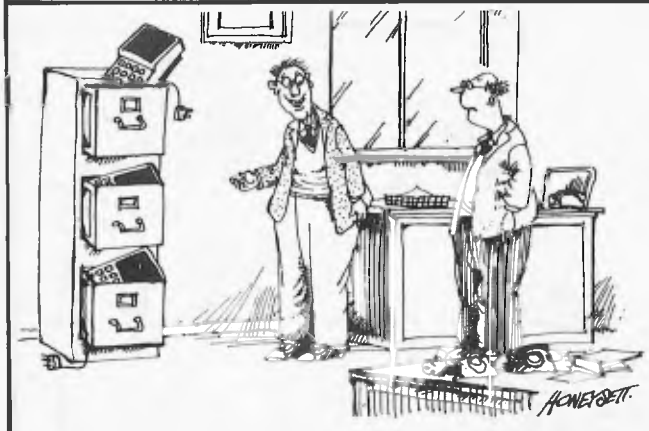
It's a meeting of 'Computers Against Corrupt Data'.



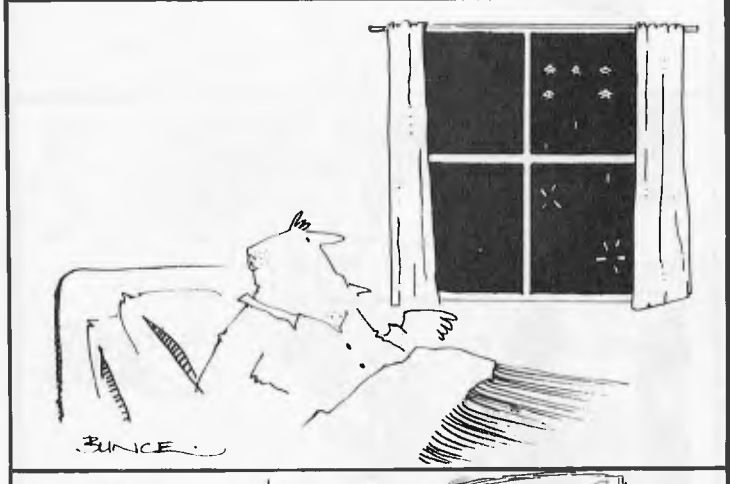
'And for its next number . . . '

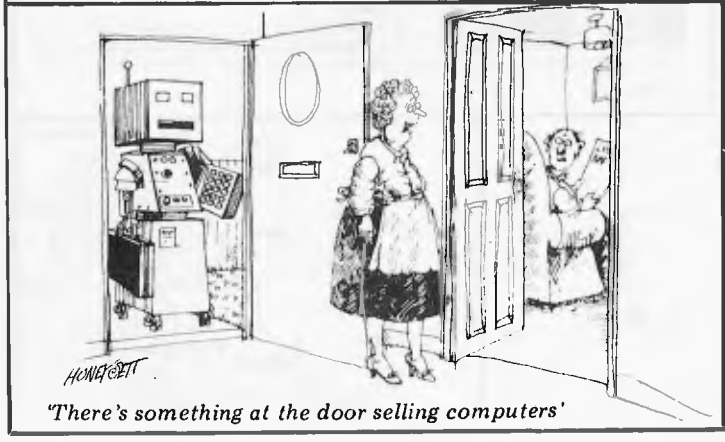
'No we can't tonight Gerald, it's not safe!'

We noticed about two months ago it started to subcontract half its programing'

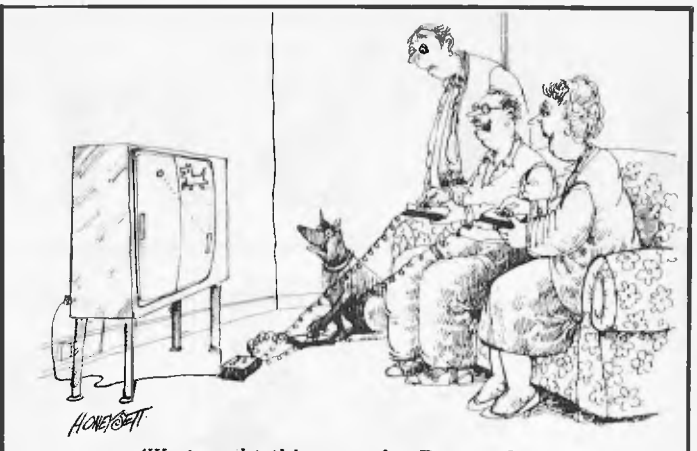


"It's amazing — with these microcomputers we only need one filing cabinet instead of five!"

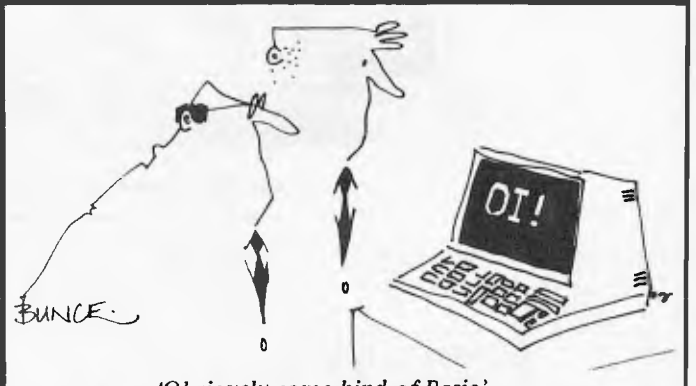




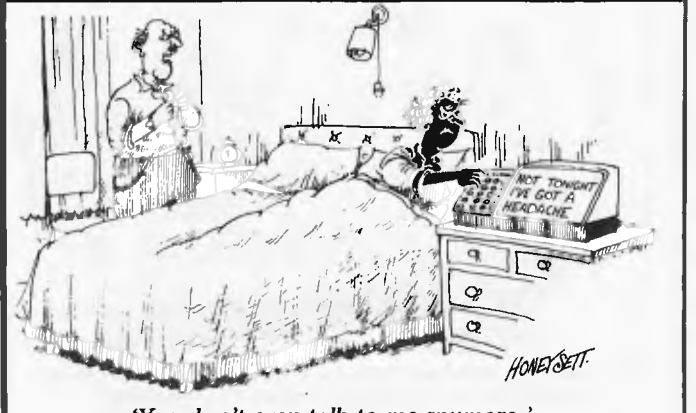
'There's something at the door selling computers'



'We bought this game for Rex, really. He just loves chasing balls.'



'Obviously some kind of Basic'



'You don't even talk to me anymore.'

I don't mind you collecting beer mats but I'm not having you collecting space invaders.'

'Dear Marge. . . . I've got a compatability problem you may not have come across.

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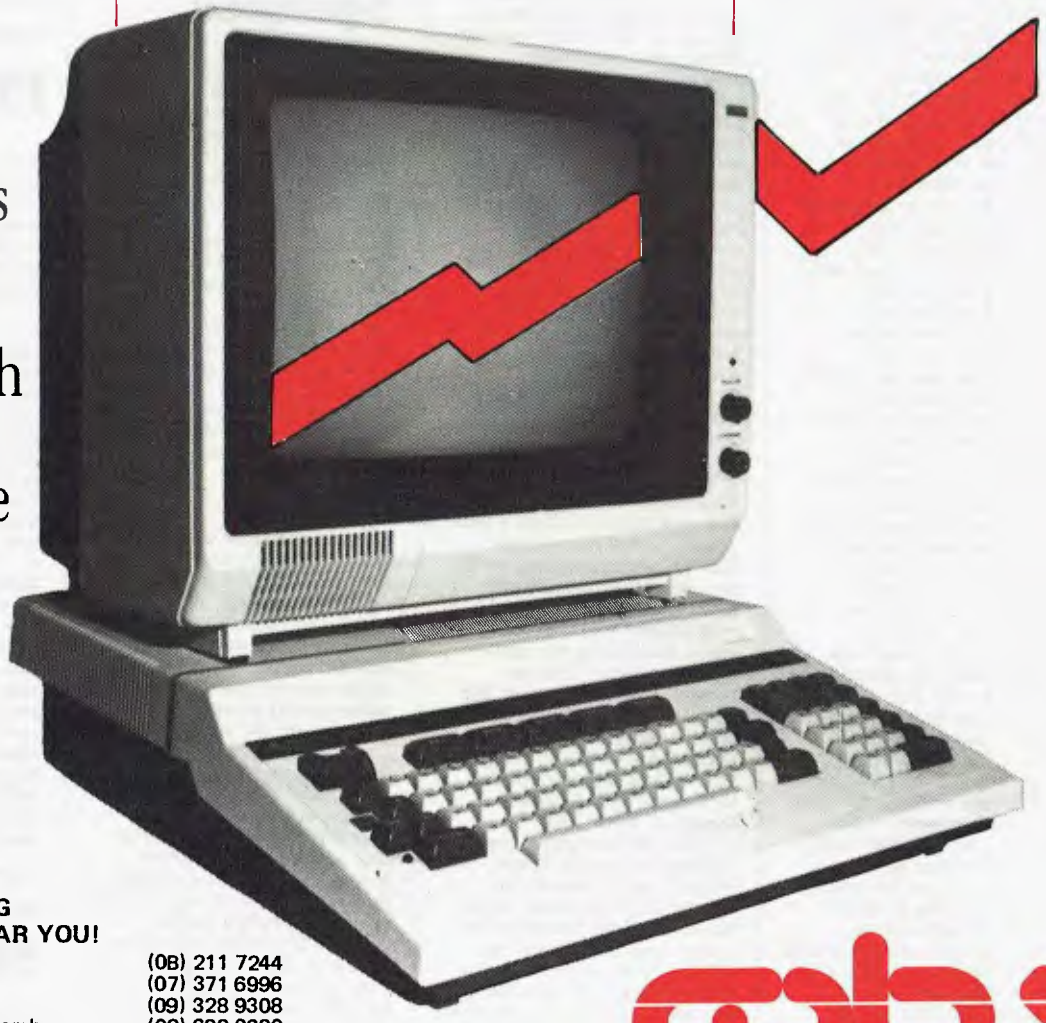

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COMMUNICATIONS

Where readers can be noticed more than streakers on Grand Final day.

Give me your answer, do...

Would you be willing to forecast whether the price of the least expensive daisywheel printers will go down much? I am sure that there is a mass market for 'letter quality' printers. Will developments in printer technology meet this need? How do I choose a printer? I await your august opinion with baited breath.
R Phillips

As you may have noticed I am not usually very outspoken, and also find it hard to make reliable predictions. However, I would say, yes, printers will come down in price markedly as the demand increases. But choosing a printer is a very difficult task – there are so many that a shortlist needs to be drawn up. In order to compile a shortlist you must first ascertain answers or ranges of answers in the following areas: price, speed, print quality, reliability, paper size/type, graphics capability, paper feed mechanism.

For everything except 'print quality' a matrix printer is best, but the familiar 'dotty' looking characters tend to put people off. There are several matrix printers around now that have an 'enhanced' print option. This reduces the dottiness by printing every column of dots twice, the second time with the dots shifted slightly to fill the gaps, The result is far more acceptable print quality but at half the printing speed. I would say that the quality is adequate for most letters. For the best in quality for letter-writing purposes, the daisywheel printer is hard to beat, though.

There are a couple of daisywheel printers on the market for around $900 and one of them even has a keyboard so it can be used as a typewriter, too. However, they are incredibly slow (around 10 cps) and would take about 6 minutes to print this answer. However, you can obtain for $2400 a 50 cps daisywheel that is maybe 10 times faster. It can manage that factor faster because the speed a printer operates is not determined just by how many characters per second it can print, but also by whether it prints bi-directionally, and has a logic seeking head. For example, try printing the alphabet down the centre of a page and see whether printers that all lay claim to being the same speed actually are. Bear in mind that matrix printers offer other advantages, such as enlarged and compressed print, or dot graphics, where a picture may be drawn using the individual pins of the matrix. Resolutions of over 1000 dots across the page can be obtained. Most matrix printers tend to slow down a lot when printing graphics because the matrix head gets extremely hot, and a delay is built in at the end of a certain amount of printing. The better daisywheels can also do limited dot graphics with 1/120th inch between dots.

Also coming on the market again (they have been around before) are the 'ink-jet' printers. These work on a similar principle to the matrix printer except that ink is sprayed out of a matrix of nozzles. The advantage here is twofold – the ink spreads slightly and thus fills the gap between the dots, and secondly the heads do not get hot and thus wear out as quickly as impact matrix printers. Siemens make an ink jet printer but at the time of writing I haven't seen it on sale in Australia. Acorn is also bringing out a printer for the Atom/BBC micro range.

Another favourite request from people is that the printer supports 'proportional spacing'

This means that letters like 'i' and 'l' take up less space than 'm' or 'w'. Remember that this probably needs a word processor that can use this feature, and that several word processing packages do not support proportional spacing.

Consider also the mechanism for feeding the paper into the printer. You may require single sheets to be fed in automatically. Does the printer have a single sheet (friction) feed. Does it have tractor feed for continuous stationery? Will it allow a variety of paper sizes?

Two printers that I would recommend are the Epson MX100 impact printer for around $1230 plus tax, which has most of the features listed above; and the Commodore 8300P for around $3000 plus tax, which is really the Diablo 630 daisywheel in Commodore clothing. The latter printer is really exceptional value for money in the Commodore guise. It supports all of the previously mentioned features and is the printer I use for the majority of my work now. You should also consider reliability and ruggedness, and it is in this area that money can be saved if you don't want a printer that can take being hammered for six hours a day, for example. There are certainly cheaper printers but they tend to be quite frail. So, all in all, printers are tending to hold their price at present, but are gaining in facilities and sophistication. I suspect that they will start to drop in price over the next few years, but remember that a $1000 printer that holds its price for a year is actually about $100 cheaper due to inflation! So don't expect too great a drop in price.

Sheridan Williams

Squashed

I have a dilemma and I am hoping that you can help. I have recently started a squash club. My membership lists are full. Several of my friends say that I should computerise my membership lists. There are several reasons why I think this would be a good idea: first and foremost because it is so time-consuming (and hence expensive) to do the mailing of renewals/circulars manually. However if I were to buy a computer it could be quite a large outlay, which is something that I can ill afford in the first year of the club's existence. Your advice would be most welcome.
J James

You are wise to be wary – many companies have bought computers and found out the expensive way that they are not always cost-effective. You could well find with further research that it is best to stick to the manual approach, perhaps using part-time labour to cope with the peak periods.

An alternative which should be investigated is to approach a computer 'Bureau'. Yellow Pages should list dozens, and your library should be able to help you locate some from their business index. Computer Bureaux exist to provide a wide variety of services, and can prove to be particularly cheap for some operations. From what I can gather from talking to people, few think of the 'Bureau' solution, although if you went to a proper computer consultant then a bureau should be offered as an alternative to buying or leasing a computer. Some of the reasons why companies should consider a bureau are: to gain data processing experience; to evaluate hardware and software; cost – you only pay for the service required; non-involvement; peak loads; advice; stand-by computer system.

The bureau could even install a terminal, so you could access the files yourself; this could prove rather expensive, though. Your application could almost certainly be processed in the 'batch' mode so a terminal is an unnecessary luxury.

I would consider the options that you have very carefully, as you would probably need to spend at least $5000 on the computer system. It would be possible to spend less, but you must take reliability, versatility and expandability into account.

Sheridan Williams.

PET upgrade

I am a PET 2001 'old ROM' owner and I would like to update my machine to either a 4000 series PET or a 'new ROM' PET. Which firm will do the update?
Richard Payton

It is certainly possible to upgrade your computer to version 2 Basic. However, only certain machines can be upgraded to Basic v4. The Basic language is contained in ROMs which can be removed and replaced with new ones. Usually the ROMs are not soldered in so it is a simple task to do this yourself.

You must determine which type of ROMs you have, as there are two kinds. The difference is the number of pins that the ROMs have. This can be either 40 or 24. If your machine has the latter, and dynamic RAMs (16 pin type 4018), then it can be upgraded to Basic v4. Any reputable Commodore dealer will be able to supply replacement chips, and advise on which to use.

Mark Wratten

Sharp talk

I wonder if you could give me some answers on the subject of interfaces. I have recently purchased a Sharp PC 1500 and CE 150 plotter. Sharp say that they will be soon bringing out an RS232 communications interface. But what does RS232 mean?
M Sargaison

Communications interfaces are used by computers to enable them to talk or listen to external devices. RS232 is one particular type of communication. Many printers, VDUs, etc, have an RS232 interface, which will enable your computer to send/receive information to/from them. Therefore in theory your machine will be able to 'talk' to any device which has an RS232 interface.

Described briefly, RS232 is a definition of a standard of communication. Information is passed along a single pair of wires, as a series of positive and negative pulses. Each pulse is known as a bit. Each byte is sent as a sequence of eight bits, preceded by one or two stop bits. The data is transmitted at a predefined rate (bits per second) to which both devices must be set.

Mark Wratten

Further Factor Facts

Permit me to continue the correspondence on factoring large integers. I have recently completed a study of efficiency of various factoring algorithms (for a first-degree course dissertation) and the following remarks are perhaps relevant.

A Bain takes a rather simplistic view with his division algorithm. With his 1,000 primes he can expect to factor numbers up to about 10^8. If it takes him 15 minutes to calculate these and probably as long to use his factoring algorithm and bearing in mind that the cost of the algorithm is $O(N^{1/2})$ then I calculate that it would take him about 10^{65} years to factor 150-digit numbers. Certainly 'not in a million years', Mr Bain. Your algorithm is suitable for factoring numbers up to say 10^{10}. I used a 32-bit machine (an IBM 370/165) and it was found practical to use this algorithm to factor numbers less than the word-size of the machine ($2^{32} \sim 4 \times 10^{10}$).

For larger numbers we use other algorithms. Knuth's 'Semi-numeric Algorithms, The Art of Computer Programming volume 2' (second edition, Addison-Wesley) has an excellent description of algorithms which beat the Exhaustive Search hands down. In particular I found the Monte Carlo algorithm most efficient in the range 10^8–10^{15} and the Continued Fraction method most efficient in the range 10^{15}–? However, not even these algorithms on our best computers would be capable of factoring 150-digit numbers if their factors are as large as 60 or 70 digits.

D A Faganchini is more cautious and closer to the truth. Sometime in the future we may be able to factor 150-digit numbers, just as today we can factor 40-digit numbers, and before electronic computers maybe 7 or 8 digit numbers. However, we can still use encryption algorithms if we use say 500-digit numbers which presumably we will not be able to factor. It is only when somebody can demonstrate a programmable algorithm which factors numbers of *any* size in a practical time that encyrption algorithms of this sort will become valueless. I for one doubt that such an algorithm exists.

R J MacMillan

No insult intended

I am disappointed by your article in *APC* Volume 3 No 8 1982, in Printout on page 7, headed "Personal insult to IBM?"

The article is in poor taste, insensitive, and contains inaccuracies.

First I must emphatically deny that any insult is intended by us to IBM, and request that you include a disclaimer to that effect in your next issue.

Second, the units are not imported from Hong Kong, rather they are supplied to us by an Australian importer who imports the units directly from the United States.

Third, the indication that the price of the units is "somewhat higher than IBM is likely to charge" is, I believe, misleading. Just what evidence do you have that this is the case? We are being most careful not to undercut IBMs final price. We do not wish to pre-empt their pricing policy.

You indicate that the people most likely to "jump the gun" are software developers. One of our main aims is to support development of Australian software. Many businesses and OEM distributors are also interested in evaluating the IBM PC.

Finally, John Hall is Cybernetics Research' Sales Manager not Retail Sales Manager.

Thank you for publishing the article, and bringing the IBM PC to your readers' attention. however the article's heading is really upsetting to a small firm trying to do the right thing by the Australian market and IBM. Our release of the PC is not an insult to IBM, but a compliment to their entry into the personal computer market.

John Skaller,
Cybernetics Research

The heading used in the article was intended as a humorous play on words, not as an insult to either Cybernetics Research or IBM. The source of the article was a well-placed source within IBM. APC has no reason to doubt the accuracy of the source, other than possibly the reference to the importation via Hong Kong. We apologise if this point is incorrect.

The incorrect caption on the photograph of Mr Hall was supplied by Cybernetics.
– Ed.

Thoroughly confusing

J Empson (May, 1982) can forget about his second letter to Sinclair. I also discovered that "X xx 2" greeted me with an error code. Replacing the -3 in line 110 with zero or a positive number, and "X xx 2" works. Why? Referring to the ZX81 manual (p. 196), we get an error code if the left operand of xx is negative, as in (-4) xx 2.

But what about -4 xx 2 = -16 then? The "-", a unary minus, has priority 9 and "xx" has priority 10. So the power is calculated first, then the urary minus. Not exactly what you would expect, but there you go. We all know (I hope) that raising a number (negative or positive) to a power always gives a positive number.

Now, VAL " "? There is nothing to eVALuate!

I hope this letter will be of some use to J Empson.

Andrew Dowling

Atari fake

I would like to convey my appreciation for the article on the ATARI 400/800 Home Computer in recent issues.

In TJ's Workshop in the April 1982 issue, N Brooks gave a very brief introduction to GRAPHICS 9, 10 and 11. Readers may be interested to know that these extra modes have been made possible by an extraordinary, custom-designed large scale integrated circuit known as GTIA. This is the Television Interface Adaptor which is installed in every PAL version of the computer (the version sold in Australia and Europe). The reason that it is not documented is that it was not initially installed in the NTSC version of the computer (as sold in U.S.A.) until January this year. Even so, the extra modes were always supported by the Operating System, hence the references quoted by N Brooks in the Operating System Users' Manual. Further details of the GTIA chip may be found in "De Re ATARI" and several recent articles from overseas magazines.

Several errors have crept into the article on 3-D graphics in the May 1982 issue. This has been brought about by not using an actual program listing and please don't try to deny it. Anyone familiar with the ATARI can see that it is definitely *not* an actual listing. The ATARI's immediate syntax checking would generate an error after entering line 420 due to the incorrect spelling of the SETCOLOR statement. The Basic interpreter automatically formats the program when listed and is distinctly different to the program printed in the magazine! If the following lines are substituted for those shown in the magazine, the program will run without any problems.

Gary Francis

```
160 X1=X1(1):X2=X1(2):Y1=Y1(1):Y2=Y1(2)
420 GRAPHICS 24:SETCOLOR 2,0,0:COLOR
    1:RESTORE 460
470 DATA 9,10,9,5,10,6,1,5,2,6,3,7,4,
    8,10,11,11,12,12,9
630 DATA -45,5,12.125,25,5,12.125,25,
    30,7.75,-45,30,7.75,30,5,12.125,40,
    5,12.125,40,30,7.75,30,30,7.75
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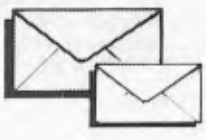
Contributions to Communications should be addressed to The Communications Editor, Australian Personal Computer, P.O. Box 280, Hawthorn, Vic. 3122.



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BEEB COLOUR HI-RES

The BBC Computer is a goldmine for micro explorers, with many of its features still undocumented or undiscovered. Jeff Aughton reports on a way to create multicoloured user defined graphics in Mode 2

The comprehensive graphics facilities of the BBC micro are currently the subject of much discussion. In particular, the use of the VDU23 command which enables the user to create her (or his) own graphics characters has been thoroughly documented. This command is simple to use, requiring only an elementary understanding of binary numbers, 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 graphics shapes requires some knowledge of the screen format. Most programmers will use Mode 2 for video games since it allows the maximum of 16 colours to be displayed. In this mode, each memory location allocated to the screen is responsible for lighting up two dots (the screen is arranged as 160x256 dots) as shown in Figure 1.

We see that the top left-hand corner of the screen is HIMEM and that the following seven locations are allocated to the seven dot-pairs below that on the screen. HIMEM+8 is the top dot-pair of the second character cell, and so on. This process is repeated across the screen.

The first dot-pair on the second text line will be HIMEM+640... and the final dot-pair, at the bottom right hand corner, will be (if my maths is correct) HIMEM+20479.

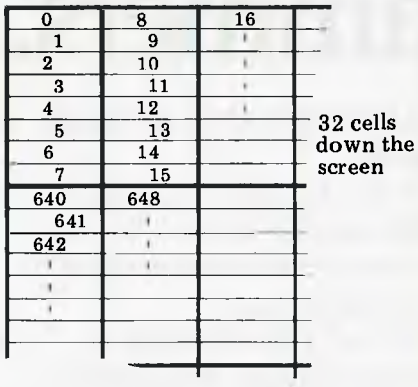
Writing numbers into these locations will light up one or both dots, although the relationship between the numbers and the colours is rather strange.

Suppose we wish to light up the two dots at memory location LOC with magenta and yellow (in that order). We proceed as in Table 1.

Thus ?(LOC)=39 will produce the desired effect.

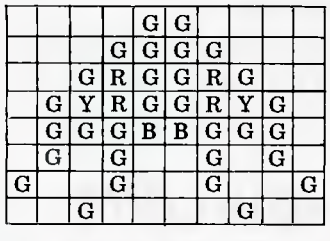
This merging process is very laborious and error-prone and so the utility program listed in Figure 2 has been written to assist with the calculations. It will generate the numbers required to

80 cells across the screen



locations are shown as displacements from HIMEM

Fig 1 Screen organisation in Mode 2



Key

G= Green B= Blue

R= Red Y= Yellow

Fig 3 Typical pattern

Colour number of magenta = 5 = 0101_2 → 0 1 0 1

Colour number of yellow = 3 = 0011_2 → 0 0 1 1

combining: $0\ 0\ 1\ 0\ 0\ 1\ 1\ 1_2 = 39_{10}$

Table 1

```
.ALIEN   LDX#40          ;NO OF BYTES TO MOVE
.LOOP    LDA BASE,X      ;GET A BYTE
         DEX
         STA LOC,X       ;STORE IT
         BNE LOOP        ;GET NEXT
         RTS             ;ALL DONE
```

Fig 4 Machine code program to draw alien on screen

```
 10 REM UTILITY FOR MODE 2 GRAPHICS
 20 MODE6:DIM A%(10,8),S%(20,8):W%=10
 30 PROCinfo
 40 PROCmenu
 50 ON M% GOSUB 70,90,140,340,410
 60 MODE6:GOTO40
 70 REM QUIT
 80 MODE7:END
 90 REM SET UP NEW PATTERN
100 FORI%=1TOW%:FORJ%=1TO8
110 S%(I%,J%)=0:NEXTJ%,I%
120 INPUT'"WIDTH (EVEN,2-20) "W%
130 IF(W%AND1)OR(W%<2)OR(W%>20)THEN120
140 REM EDIT OLD PATTERN
150 MODE3:PROCboard
160 ON ERROR GOTO 310
170 Y%=1:X%=1:*FX 4,1
180 @%=0:PRINTTAB(AC%+2*X%,8+Y%);"";
190 M%=GET:N%=M%+7*(M%>57)-48
200 IF M%>135 AND M%< 140 THEN 250
210 IFN%<0ORN%>15 THEN190
220 PRINTTAB(AC%+2*X%,8+Y%);CHR$(M%)
230 S%(X%,Y%)=N%
240 GOTO 180
250 M%=M%-135
260 IF M%>2 THEN 290 ELSE M%=M%*2-3
270 X%=X%+M%:IF X%<1 OR X%>W% THEN X%=X%-M%
280 GOTO 300
290 M%=M%*2-7:Y%=Y%-M%:IF Y%<1 OR Y%>8 THEN Y%=Y%+M%
300 GOTO 180
310 IF ERR<>17 THEN MODE7:PRINT"ERROR @ ";ERL:STOP
320 ON ERROR OFF:*FX4,0
330 GOTO60
340 REM VIEW SHAPE
350 MODE2:PROCmerge
360 PRINT"Here is your pattern"
370 FORI%=1TOW%/2:FORJ%=1TO8
380 ?(HIMEM+3479+8*I%+J%)=A%(I%,J%)
390 NEXTJ%,I%
400 PRINTTAB(0,10);:GOTO470
410 REM LIST DATA
420 MODE6:PRINT''"THE SEQUENCE OF NUMBERS YOU NEED IS:"''
430 @%=3:PROCmerge
440 FORI%=1TOW%/2:FORJ%=1TO8
450 PRINTA%(I%,J%);" ";:NEXTJ%
460 PRINT:NEXTI%
470 PRINT'"Press C to continue"
480 REPEATUNTILGET$="C"
490 RETURN
500 DEFPROCboard
510 PRINTTAB(22,4)"***  Press ESCAPE to recall menu ***"
520 AC%=(78-2*W%)DIV2
```

Now a Hewlett-Packard calculator specifically designed for programmers.

For a long while, ironically, computer analysts and programmers had to use the computer they were writing programs for, to write the programs themselves.

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Adelaide: 272 5911; Perth: 383 2188;
Brisbane: 369 8022; Canberra: 80 4244.

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```
530 PRINTTAB(AC%,8)" ";
540 FORI%=1TOW%:PRINT" ";CHR$(96+I%);:NEXT
550 FORJ%=1TO8:PRINT'TAB(AC%)CHR$(48+J%);
560 FORI%=1TOW%:M%=S%(I%,J%)
570 IFM%=0THENA$=" " ELSE A$=CHR$(48+M%-7*(M%>9))
580 PRINT" ";A$;
590 NEXTI%,J%
600 PRINTTAB(0,20)" 0=BLACK              4=BLUE";
610 PRINT"              8=BLACK/WHITE          C=BLUE/YELLOW"
620 PRINT" 1=RED                5=MAGENTA           ";
630 PRINT"9=RED/CYAN             D=MAGENTA/GREEN"
640 PRINT" 2=GREEN              6=CYAN              ";
650 PRINT"A=GREEN/MAGENTA        E=CYAN/RED"
660 PRINT" 3=YELLOW             7=WHITE             ";
670 PRINT"B=YELLOW/BLUE          F=WHITE/BLACK"
680 ENDPROC
690 DEFPROCmerge
700 FORI%=1TOW%-1STEP2:FORJ%=1TO8
710 M%=0:FORK%=0TO3
720 IFS%(I%,J%)AND2^K% THEN M%=M%+2^(2*K%+1)
730 IFS%(I%+1,J%)AND2^K% THEN M%=M%+2^(2*K%)
740 NEXTK%:A%((I%+1)DIV2,J%)=M%:NEXTJ%,I%
750 ENDPROC
760 DEFPROCinfo
770 PRINTTAB(14)"UTILITY 1.0"
780 PRINT'"This utility enables the creation of"
790 PRINT"high resolution colour graphics in MODE2"
800 PRINT"Facilities are available to set up,view"
810 PRINT"and edit the pattern which is formed in"
820 PRINT"an 8 x N matrix (where 2<=N<=20).Use the";
830 PRINT"selection menu to choose the required"'"facility."
840 ENDPROC
850 DEFPROCmenu
860 PRINT''" Options: 1) Quit program"
870 PRINT"           2) Set up new pattern"
880 PRINT"           3) Edit existing pattern"
890 PRINT"           4) View shape"
900 PRINT"           5) List numeric data"
910 INPUT'"Your choice "M%
920 IFM%<1ORM%>5THEN910
930 ENDPROC
```

create colour graphics patterns eight dots deep by up to 20 dots wide (the 20 limit is arbitrary and could be increased).

Obviously one major use of this program is to create SLABs (Sinister Looking Alien Beings) for space games and an example is given below.

To create the SLAB shown in Figure 3, run the program selecting width=10 and feed in the colour information shown in the figure. The program will generate the sequence of numbers:
0,0,0,4,4,4,8,0,0,4,9,11,12,4,4,8,12,
12,12,12,48,0,0,0,0,8,6,7,12,8,8,4,0,
0,0,0,8,8,8,4,0.

Writing these successively into HIMEM+8x,HIMEM+8x+1... HIMEM+8x+39 will draw the SLAB on the screen. For speed, this should be done in machine code and a simple program to do this is shown in Figure 4. Before calling the routine, the 40 numbers should be deposited in 40 safe consecutive memory locations, the first one being at BASE+1 and the last at BASE+40. LOC is assumed to contain a screen location which is divisible by eight. Notice that this program is not complete — it has to be assembled and both BASE and LOC need to be defined.

Obviously, this is a very simple example but it illustrates one possible approach to some sophisticated graphics effects.

Any shapes more than eight dots high would have to be produced by combining two or more such patterns but since they are being written to the screen in machine code speed problems are unlikely to arise. END

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CRAMMING IT IN

E40 is a new package which enables you to compress text files on disk to as little as 40 per cent of their original size. Because it's an interesting subject, we asked E40's author, Dennis Andrews, to introduce the subject, while Dick Pountain puts E40 through its paces.

We tend to think of computers as machines for complicated calculations, and when computers were new and expensive their primary function was indeed to compute. Today, the great bulk of computer use is for storage of data or text and the two simplest operations — fetch and store — occupy most of a computer's active life.

To meet this demand, cheap removable media becomes essential: the quantity of data is just too large for fixed disk or memory to hold. Current removable disks are fairly slow, not because they must be but because it is economic. The new bulk requirements of the computer are to view, to print, to transfer, to edit — these are mostly slow operations, and really fast response is not worth paying for.

These two factors provide the soil for a new development to grow: compression codes. It has long been realised that the eight-bits-per-character of ASCII is wasteful and that the English language contains redundancy which would permit a more compact representation of characters. Procedures which do this are called compression codes.

The theory

The principal difficulties in making an effective compression code are the time and space requirements. In theory, compression to 15 per cent is possible (or at least claimed; maybe the limit is nearer 25 per cent with real data files). However, the drawbacks are prohibitive: the existing techniques would need enormous word dictionaries — and an enormous amount of time to scan them — or else they would need to do a statistical analysis of the data before starting to code at all, which is *much* slower but not quite so bulky. By contrast, E40 codes in about the same time as it takes to PIP a file from one place to another, and the coding procedure occupies just 11k. Compression is to around 3.2 bits per character.

This seemingly impossible speed is *because* the file is compressed: the extra processing time is offset by the reduced time for disk I/O. The decode process is actually faster than a straight transfer of the equivalent ASCII file.

There is no net space loss, either. This is obvious for the disk itself but, surprisingly, it is also true of memory space requirement. For example, Wordstar in a typical 60k system administers a 30k buffer. Set aside 11k for E40 and the remaining 19k holds the equivalent of around 47k of ASCII.

Both of these results are relative: if the available buffer space is small, then E40 may intrude; if the media transfer is fast, then processing time does exceed the saved I/O time. However, coding is still rapid: using a winchester, one can compress a typical 300-page novel in about three minutes — a small price for doubling the apparent size of the winchester!

While the basic idea of E40 came in the proverbial flash, the specification emerged only gradually and some significant user features were added after the code itself had been standard for months.

The original aim was a compression of around 3 to 1. This is possible using the techniques of Keele Codes but the process would run slowly and the program would be bulky. The figure of 40 per cent or 2.5 to 1 does not sound very different but its time and space requirements are in a different ball-park. In the other direction, one could have a faster process which compresses to, say, 50 per cent; but that would be a poor bargain, quite apart from its lesser attractiveness. At the present state of the art, disk I/O defines the limiting speed, not the processing. If compression were 50 per cent instead of 40 per cent, then the extra I/O would more than offset the reduced processing time, with a floppy disk system. It gradually became apparent that the optimum compromise lay around 40 per cent and, surprisingly, this was true for both mainframe and micro. The ratio of processing time to I/O time is about the same in each case when removable media are used.

In practice

Having defined compression, one still has to strike a balance between memory requirement and speed. This is a property of the implementation, not of the code itself. The target set — and reached — was that E40 coding should take in all about the same time as a simple transfer. In particular, we had winchester-to-floppy backup in mind in choosing speed. For an all-floppy system, therefore, E40 coding is usually faster than straight transfer.

Robustness was an essential feature of the specification from the start. The compression ratio must present no risk to the user: his data must be as safe in E40 code as in ASCII. The code was therefore made self-correcting, so that noise in the communication line, or damage on the disk, has a localised effect only. E40 recovers almost immediately if the compressed file is deliberately corrupted.

This recovery feature was judged very important; one could achieve better compression if the requirement was relaxed but then no one would risk using the code. This recovery feature is unique to E40. Some compression codes are very vulnerable to errors — for example, with Huffmann codes an error in any bit means that the remainder of the file is unreadable. One can prove mathematically that Huffmann codes offer the best possible compression — but at what a price!

Two other features are incorporated for security:

a) There is a Verify option. (CP/M has no automatic readback verification when writing to disk.) This slows archiving by about 20 per cent.

b) The user may introduce checksums into the codestream, and can select their spacing over wide limits.

The latter feature was designed for noisy communication channels but can be used if desired for extra security in any application. In reality, E40 is as safe or as unsafe as ordinary ASCII and one should take the same precautions with both. Whatever level of backup is selected, it costs half as much using E40.

The current implementations of E40 are not the fastest possible; instead they represent the best compromise between space and speed for current hardware. It seems likely that in the future memory will become cheaper and media will run faster. If so, we can speed E40 by a factor of two just by writing a greedier implementation — which means that E40 can keep up with hardware developments and the code can remain standard in the long term while retaining its costless character.

All files compressed by E40 have a 32-byte leader. This idea developed from the perception that compression would be as important in communications as for static storage of files. The leader contains all the vital statistics of the compressed file and allows it to be treated as a message, with no other protocol required. The leader defines the code, the filename, the size, the size when expanded, the checksum and other options which affect coding. (Options such as Verify, which do not affect the form of coding, do not appear in the leader.)

This idea developed gradually, though the bare notion of E40 as a message format came at an early stage.

Portability

An E40 message is universal and it is independent of hardware/instruction set/operating system. Any two machines equipped with E40 can communicate. The package offered for CP/M includes a communication utility called XKC, which transmits or receives files through a serial port. CP/M communication devices do not transmit 8-bit data words and will not receive nulls. Therefore, XKC converts the file to a 7-bit format without nulls. The net time saving is a little better than two-to-one over direct ASCII transmission.

Some operating systems will be able to transmit E40 compressed files direct without this conversion, achieving 40 per cent of transmission time instead of 46 per cent. These systems do not strictly need XKC but it will be offered anyway, as many operating systems lack

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CRAMMING IT IN

a built-in computer/computer transfer utility.

Although XKC is profiled to CP/M, the E40 message which it carries is not. The code is guaranteed invariant, and is not shackled to any hardware, software or operating system. It is linked only to the English language and to ASCII (or an equivalent 8-bit character set). The code is also fully developed and is based on very extensive numerical research. We do not have plans for E38 or whatever, and are reasonably sure that no one else will better it by a fraction that is worth having. We know the drawbacks of each adjustment and have rejected far more than were finally incorporated.

This policy of invariance must be allied with a readiness to accommodate current practices; therefore E40 offers some tailored extensions, of which XKC is one example. Another variable is the end-of-file character — present in some operating systems but not in others. Therefore E40 excludes the end-of-file character from the message and the decode program EKC adds it back. Consequently, if a file is transmitted between systems it is correctly terminated in each host. (Nevertheless, the user does have an option to treat the end-of-file character as data. This is another tailored extension, largely to accommodate dBase II files; these sometimes include the CP/M end-of-file character CTRL-Z.)

E40 also has parameters which are geared to Wordstar. Most word processing systems use a 127-character set but Wordstar uses the eighth bit to distinguish fixed and reassignable formatting. We wondered whether to treat 'soft space' and 'soft return' as special characters but decided not to, because that would link E40 to one microcomputer product. Instead, the user has an option: code all 256 characters, or strip the eighth bit and fix the format. The latter gives much better compression. However, the second choice is not irreversible: there is a decoding option RESOFT which puts back the 'soft' spaces and returns.

This seems a long way round — but it achieves the intended aim: the compressed E40 file is completely standard and has optimal compression. One can pass it to another system which would baulk at Wordstar's character set; equally, one can receive a file written on another system and edit it using Wordstar, using all of Wordstar's formatting facilities. If one works exclusively with Wordstar, then both options can be preset in the program image. (All E40 options can be set as command parameters or in the program image, whichever the user prefers.)

Other extensions of E40 will be in the software interface, so that, for example, word processing software can read and write E40 files directly. Obviously, this can be achieved in short order by an overlay/chaining procedure, but it would be more efficient to build a software interface which is active throughout the word processing.

Compression utilities save money in the obvious way that disks take longer to fill up, or phone bills are halved. The less obvious savings are just as important.

Even experienced computer users find that disks can become very muddled and contain a mixture of finished and unfinished work, work of different kinds, and backup copies. This applies as much to winchesters as to floppy disks — perhaps even more so.

E40 offers a way to avoid this. The basic principle is to distinguish two roles for a disk: work-disks and completed work. Let us call these disks TEM and FIN. Work disks TEM are temporary and each relates to one enterprise or class of work. Completed work is copied onto FIN disks, using E40 instead of PIP. The completed work is thereby distinct in form as well as taking less space. FIN disks are classified, too, to form a compact library. Backup copies would be made anyway, so nothing is lost, but space is saved and the whole operation becomes methodical without any special effort.

Each TEM disk contains .TXT and .BAK copies of every file, which is the ideal arrangement when first editing a document. But FIN disks do not need to contain the last-version-but-one. In effect, then, FIN disks contain about five times as much material as the equivalent TEM disks; or the product of a working week rather than a working day.

Another saving occurs when the TEM disk becomes full. If one does not distinguish TEM and FIN, then DISK FULL usually results in the last file being copied to a new disk to continue work. There is considerable wastage on the first disk. Worse yet, the wasted space may be filled out of sequence because one can find no other disk handy. That work is as good as lost if it is set aside for any length of time.

These things do not happen when TEM and FIN are distinct. When TEM becomes full, the *earliest* work on it is transferred to its own FIN — if it is not already done — and is then deleted from TEM. Thus TEM is continually reassigned, and the current work is never taken out of it.

This work method requires two other classes of disk: system and archive. The latter is a straight copy of the FIN disk, made with suitable frequency; this provides far better security than two copies on one disk. Disks can be damaged, have corrupted directories, or just get lost. The system disk(s) contain editors, assemblers and the basic utilities.

In addition, TEM disks contain KC, and FIN disks contain EKC (and PIP for loading archive). That way, only one disk change is required at any stage of updating.

The four uses do not necessarily require four physical disks. With a winchester, all but archive can reside in it, and some floppy disks are large enough to contain both system and TEM files.

Are there any snags? Are the files less accessible? On the contrary, EKC can throw a file on the screen quicker than TYPE can do (though it takes 19.2 kbaud to demonstrate the benefit). Files can be transferred to new disks or via a line in less than half the time.
that you may not only fail to protect your idea but it becomes public can also be decoded direct to the printer.

The only delayed access is when another program needs the original ASCII — eg, when a word processor is used to print a file which is no longer in TEM. Then one must run EKC first, at the cost of a few seconds. This event is rare in practice: most printing is done at an early stage in the file's life. Similarly, it is rare to re-open editing of a

```
stat huge.txt

 Recs  Bytes  Ext Acc
  128    16k    1 R/W A:HUGE.TXT
Bytes Remaining On A: 134k

A>kc

Encode KCE40
07-Jan-82  Copyright 1982 (C) Keele Codes Ltd. Licence No.SH001008

*=huge.txt

FILE COMPRESSED

*

stat huge.*

 Recs  Bytes  Ext Acc
   57     8k    1 R/W A:HUGE.E40
  128    16k    1 R/W A:HUGE.TXT
Bytes Remaining On A: 126k

A>ekc

Decode KCE40
07-Jan-82  Copyright 1982 (C) Keele Codes Ltd. Licence No.SH001008

*=huge

.KCE40   HUGE.TXT          8k        16k       0000

Filename exists: Overwrite ? y

FILE EXPANDED
```

Fig 1

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CHECKOUT

Dick Pountain reports on E40 in use.

I checked out the E40 compression utility on the Sharp MZ80B under CP/M 2.2 without any communications hardware; I couldn't check the operation of XKC as a result. The version I tested was the original release which lacked the RESOFT option for expanding Wordstar files; this is included in all current releases of the software.

The package consisted of three CP/M COM files called KC, EKC and XKC. The first of these compresses files, the second expands them again; XKC is for serial communications with other machines.

Keele Codes has very cleverly designed the syntax of KC and EKC to be similar to that of PIP so that experienced CP/M users will have no trouble in adapting to its use. To compress a file HUGE.TXT you merely type 'KC', which loads the program and gives a sign-on message and the '*' prompt, as for PIP. Then 'B:SQUASH=A:HUGE.TXT' will compress the file into a file called SQUASH.E40 on drive B. The file type E40 is assigned automatically by the program. The shortest form allowed is '*=HUGE.TXT' which compresses into a file with the default name HUGE.E40 on the currently logged drive. A message FILE COMPRESSED signals successful completion.

To expand a file, type EKC, which loads the program and produces the '*' prompt. When you name the file for expansion a line of parameters is displayed which includes the original and final names and sizes and any options set. This line ends with the prompt GO? to which only the answer 'Y' will initiate expansion; any other answer returns the * prompt. FILE EXPANDED signifies success. Again the shortest form of the command is '*=SQUASH' which assumes the file extension E40 on the current drive and expands the file under its original name which is always saved in the header of the compressed file. Since this may involve overwriting the original version of HUGE.TXT, EKC asks you if you wish this to happen and gives you a chance to change the file name. Figure 1 shows the printout from one of the test sessions using KC followed by EKC.

Since KC and EKC are 10 and 12k long (ie, 22k total), it is feasible on a machine like the Sharp with 340k per drive to have them resident on all your work disks (I already do this with CP/M system, PIP, STAT and BACKUP).

The programs come with an 18-page manual which explains their use clearly and concisely for the experienced CP/M programmer. The less technical user will only require the one page summary of syntax in order to use KC and EKC.

So how well does it work? I tried it out on a 16k ASCII file generated with a text editor and achieved a reduction to 44.5 percent, a little short of the theoretical minimum. Transferring this file to another drive using PIP took 14 seconds. Using KC the transfer took 17 seconds and using EKC took 9 seconds. So decoding a compressed file onto another drive is significantly faster than using PIP while compressing is slightly slower.

I next tried E40 on a Lisp source file of 12k and here only achieved a reduction to 66 per cent, in line with what Keele Codes claims for program text (the reduction is less because program code is not plain English and contains a high percentage of unusual words).

Various other flavours of ASCII file produced compressions between 42 and 60 per cent, with the average being around 44 per cent for English text (most of it technical with a high unusual word count).

Using E40 on a Wordstar text file initially *increased* its size slightly; this is because I didn't use the [z] option which strips off the eighth bit for its 'soft' carriage returns which results in very inefficient coding by E40 as these constitute 'abnormal' characters. Running E40 again with [z] appended to the command produced a reduction to 45 per cent. Expanding this file restores the original text exactly but certain Wordstar options for re-editing, such as changing the margin width or reformatting, are lost. The current release of E40 has RESOFT, an optional parameter [r] to the EKC command, which restores the parity bit in appropriate places when expanding the file and so retains all of Wordstar's features.

I was unfortunately unable to get hold of a database file to try E40 on; with some DBM systems these contain much wasted spaced and so really large compressions to below 40 per cent are said to be achievable.

In summary, E40 did all it was claimed to do on the material I tried it on; it is no harder to use than PIP and can be used as a regular CP/M utility. It can provide a useful increase in disk space (Osborne and Apple owners would benefit substantially) as well as saving time when archiving large numbers of files. It is not really worth using it on program source but on text files it performed well and in line with its author's claims.

For further information you'll have to phone Keele Codes (in England! – this quite revolutionary product is not yet available in Australia) on (0742) 686040.

file that has left TEM.

The benefits are frequent, however: the operations which are speeded by E40 are the common ones, transfer and viewing. One must put in this pan too the savings made in general housekeeping. When E40 is used routinely, files are more easily located, there are fewer false moves and there are fewer transfers needed to keep the system up to date. Best of all, you do not have that drawer full of old disks saved in case they contain the only copy of something!

Database back-up

Compression can be as great as 5:1 with database files, mainly because they contain reserved but unfilled space. (Where this is not the case, compression of a database is much like any other text.)

The use of E40 doubles the maximum size of the database which can be backed up from winchester to floppy. It postpones the day — which comes all too soon — when segmentation becomes necessary for backup. When a database has reached this size, there is a temptation to risk fewer backups because it has become tedious. One may even have no room on the source disk for the segments.

Secrecy and patents

I must disappoint your curiosity as to how E40 works. Keele Codes Ltd has maybe a nine-month lead in which to establish E40 as a standard. By all means compare input and output and try to figure it out — but we won't help you!

The basic ideas of E40 are the subject of a patent application — but the peculiarities of patent law may cause the application to be withdrawn. Copyright remains, of course, and the code E40 is protected by copyright — not just the particular way of executing it.

The company Keele Codes Ltd is legally quite independent of the university. However, there are close links: all the members of the company are also members of the university and the company pays the university for the goods and services it uses. This symbiosis works very well. The university gains money at an opportune time, and can sell offpeak computer time to a convenient customer. (All really heavy computing is reserved for the summer.)

It is an interesting thought that 10 years ago E40 would almost certainly have become a scientific paper rather than a commercial product. . .

END

'Goodbye Harold, I've left you for good. For dinner see program one. . . clean shirts see program two. . .'

BENCHMARKS

We have received a large number of requests for details of the Benchmark programs used in our Benchtests so we're reprinting them here. You'll also find the timings for machines Benchtested since May last year, including those in this issue.

The Benchmark programs, originally published in *Kilobaud*, are fairly self-explanatory and provide a rough rule-of-thumb guide to the efficiency of the machines' Basic interpreters and, to a lesser extent, to the efficiency of certain aspects of hardware design. They should be interpreted as such, and not used as absolute guides to which machine is 'better' than another; this is a decision which involves a great many factors and which can only be arrived at by studying the full Benchtests and by forming a clear idea of which machine is best suited to the purpose to which you intend to put it.

The disk Benchmark timings which were introduced earlier this year have not been listed, and neither have the disk timings been reproduced here as they do not apply to all machines. As different dialects of Basic have such widely different disk I/O formats, we cannot provide listings of a specific suite of programs which can run unaltered on any machine. Here, however, is a summary of what the disk tests do:

Test 1 OPEN a new file, then immediately CLOSE it.

Test 2 Using a FOR . . . NEXT loop, fill two strings, A$ and B$ with 128 As each; OPEN an existing file; using a FOR . . . NEXT loop, fill each of the 100 records, each of which contains two fields of 128 characters, with A$ and B$ in ascending order; CLOSE the file.

Test 3 Identical to Test 2 except that the records are written in reverse order.

Test 4 OPEN the file; read records 1 to 100 into A$ and B$; CLOSE the file.

Test 5 Identical to Test 4 except that the records are read in reverse order.

Timings in seconds of some machines Benchtested to-date:

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8
TI99/4A	3.0	9.0	24.0	24.8	26.2	61.9	84.6	38.4
Micro Bee	2.7	10.0	18.1	17.9	20.9	39.4	67.3	–
Sharp MZ80B	0.6	4.5	8.5	11.5	13.0	19.0	27.5	5.0
Atari 400	2.35	7.41	18.89	23.16	26.78	40.75	61.51	43.08
IBM Personal Computer	1.5	5.2	12.1	12.6	13.6	23.5	37.4	3.5
Apple III	1.7	7.2	13.5	14.5	16.0	27.0	42.5	7.5
Hitachi Peach	2.0	11.0	16.0	26.0	27.0	46.0	78.0	10.0
The following machines have not been reviewed by APC but are included for interest.								
TRS-80 Model I	2.5	18.0	34.5	39.0	45.0	67.0	109.0	–
PET	1.7	9.9	18.4	20.4	21.0	32.5	50.9	12.3
Apple II	1.3	8.5	16.0	17.8	19.1	28.6	44.8	10.7
Sorcerer	1.8	10.0	20.7	22.2	24.3	37.6	53.7	9.6

S/prec = Single precision
D/prec = Double precision

```
BM1   300 PRINT "S"
      400 FOR K=1 TO 1000
      500 NEXT K
      700 PRINT "E"
      800 END

BM2   300 PRINT "S"
      400 K=0
      500 K=K+1
      600 IF K<1000 THEN 500
      700 PRINT "E"
      800 END

BM3   300 PRINT "S"
      400 K=0
      500 K=K+1
      510 A=K/K*K+K-K
      600 IF K<1000 THEN 500
      700 PRINT "E"
      800 END

BM4   300 PRINT "S"
      400 K=0
      500 K=K+1
      510 A=K/2*3+4-5
      600 IF K<1000 THEN 500
      700 PRINT "E"
      800 END

BM5   300 PRINT "S"
      400 K=0
      500 K=K+1
      510 A=K/2*3+4-5
      520 GOSUB 820
      600 IF K<1000 THEN 500
      700 PRINT "E"
      800 END
      820 RETURN

BM6   300 PRINT "S"
      400 K=0
      430 DIM M(5)
      500 K=K+1
      510 A=K/2*3+4-5
      520 GOSUB 820
      530 FOR L=1 TO 5
      540 NEXT L
      600 IF K<1000 THEN 500
      700 PRINT "E"
      800 END
      820 RETURN

BM7   300 PRINT "S"
      400 K=0
      430 DIM M(5)
      500 K=K+1
      510 A=K/2*3+4-5
      520 GOSUB 820
      530 FOR L=1 TO 5
      535 M(L)=A
      540 NEXT L
      600 IF K<1000 THEN 500
      700 PRINT "E"
      800 END
      820 RETURN

BM8   300 PRINT "S"
      400 K=0
      500 K=K+1
      530 A=K↑2
      540 B=LOG(K)
      550 C=SIN(K)
      600 IF K<100 THEN 500
      700 PRINT "E"
      800 END
```

What do IBM Tandy and Osborne have in common?

They will be at The1st Australian Personal Computer Show in March 1983. They and their competitors will be promoting the latest personal computer developments. The exhibition will be a forum for manufacturers, importers, distributors and retailers of microcomputer technology.

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For further visitor and exhibitor information about The 1st Australian Personal Computer Show, please contact Rachel Tetley Australian Exhibition Services Pty Ltd 1250 Malvern Road Malvern Victoria 3144 Telephone (03) 20 1208 Telex AA39329.

The 1st Australian Personal Computer Show

Centrepoint Sydney 10-12 March 1983

DIY LOGO

Mike Parr presents 'Pogo' — a 16k implementation of Logo in Microsoft Basic

In the May 1982 *APC*, Harvey Mellar looked at the Logo language in general terms, and indicated the educational possibilities of an easy-to-use procedure-defining facility coupled with turtle graphics.

Logo is now becoming available on some micros (Apple, TI) but is not yet widespread. No problem! In Figure 3 there's a listing of a Logo system written in Microsoft Basic which runs in 16k. Some 'uncommon' features of Basic have been avoided (eg, the ELSE), thus the program, though written on a TRS-80 Model I, will run on most systems without major alterations. Later, I'll describe how to carry out any modifications.

Pogo?

Though Logo is not rigidly defined, the version in this article has one major omission — list processing — hence I call it 'Pico Logo', or 'Pogo'. What it does have, however, is simple procedure defining with local variables (which allow recursion) plus turtle graphics and IF, REPEAT, WHILE and assignment statements. In short, most 'standard' Logo turtle graphics programs will work in Pogo.

To any Logo distributors who are concerned that my free system will put them out of business, don't worry! Pogo is slow, being an interpreter written in an interpreted language. Typically, a ten line procedure definition takes at least 30 seconds to be translated into an internal machine code, which is then interpreted. Editing and input of procedures is reasonably fast, though.

The language

In this section I'll describe in detail the Logo subset features, referring to Pogo where a major difference exists.

When you load and run the Pogo system, it prompts you with C?, meaning that a command is required. You may choose to do a calculation — PRINT SUM 3 7 will display the result '10'. SUM is a built-in procedure which needs two 'arguments', and which produces a result. PRINT is a procedure which takes one value and displays it on the screen. Note that an argument can be a procedure call, as in PRINT SUM 3 PROD 4 6. Here, Logo first evaluates 4 times 6, then adds 3, then finally prints 27. For subtraction, multiplication and division we have DIFF, PROD and QUOT respectively.

To 'teach' Logo the meaning of a new word, use the TO command, as in

```
TO SHOWTWICE 'NUMBER
10 PRINT ; NUMBER
20 PRINT ; NUMBER
END
```

When you embark on typing a definition, you will be prompted by NE?, which means 'type a numbered line or END'. The rules for inserting and deleting lines are the same as in Basic. This definition also introduces two new symbols — the quote and the semicolon — which Pogo uses to distinguish variables from procedure names. More precisely, a semicolon indicates the value of a variable, and the quote indicates the name of a variable. (Logo uses a colon, but this confounds most Basic INPUT statements.)

Anyway, back to SHOWTWICE. The purpose is to print a number twice, but we require that it works for any number. In Logo, this is simple — we make the procedure accept a value to work on, and (arbitrarily) we have called this value NUMBER. In Pogo all variables are local to the procedure in which they occur, thus the programmer has an unrestricted choice of names. To test the procedure, we may type

```
SHOWTWICE 6
```

causing

```
6
6
```

to be printed. This procedure has a printing effect, but no result. To return a value we use the RESULT statement, as in

```
TO DOUBLE 'N
10 RESULT SUM ; N ; N
END
```

and might test it with

```
DOUBLE 8
DOUBLE DOUBLE 3
```

which print 16 and 12 respectively.

As well as TO, we have EDIT, which allows one to alter an existing procedure; LIST, to display a definition; and ERASE, to remove a definition from memory.

To compare values, we have the six procedures EQ, NE, GT, LT, GE, LE. 'True' and 'false' are represented in Pogo as 1 and 0, thus

```
PRINT EQ 10 PROD 2 5
```

causes 1 to be displayed, as 10 is equal to 2 times 5.

To illustrate the IF...THEN...ELSE statement, here are two simple procedures:

```
TO MAX 'A 'B
10 IF GE ; A ; B
20     THEN RESULT ; A
30     ELSE RESULT ; B
END
```

which could be tested by

```
PRINT MAX 6 9  (9 is printed)
```

and

```
TO SHOWPOSITIVE 'N
10 IF GE ; N 0 THEN
20                PRINT ; N
END
```

which displays a value only if it is positive. In Logo the layout of a program is up to you, except that spaces are used to separate items.

When one of the options of an IF is composed of more than one statement, we can either define them as a new procedure, or 'connect' them using AND, as in

```
IF EQ 'A 'B
      THEN PRINT ; A
      AND PRINT ; B
```

Repetition

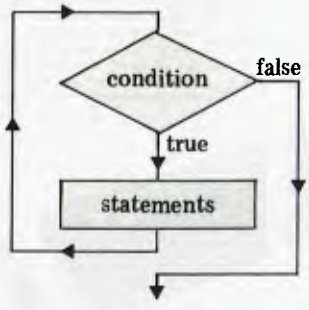
We have two choices — REPEAT and WHILE; eg,

```
REPEAT 3 PRINT ; A
      AND PRINT ; B
```

which causes six items to be printed. Note that where '3' was used, we could have used any item that produces a value. When the number of repetitions is unpredictable, WHILE is used, as in —

```
WHILE GE ; A ; B  DO
                  statement
AND               statement
AND               statement    etc.
```

The logic of a WHILE as a flowchart is



Presumably, the repeated statements will affect the terminating condition otherwise the program will loop for ever. Note that, to maintain compatibility with Logo, a WHILE may use either DO or THEN.

The problem is that, where an IF is contained within a WHILE, an AND could be linked to either statement. Full Logo allows us to use square brackets to overcome ambiguities, but the Pogo rule is that an AND is connected with the nearest IF or WHILE. Where this rule is unsuitable for your program logic, consider using an extra procedure definition to get round the problem.

Assignment

Whereas in Basic we write A=B + C, in Logo we write

```
MAKE 'A SUM ; B ; C
```

Again, any new variables that we invent are automatically made local to the current procedure, and will be re-created every time the procedure is entered — this allows recursion.

Graphics

Turtle graphics are a major feature of Logo, and enable procedures to be

STOP

(Read this now!)

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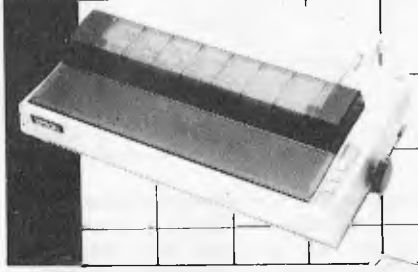

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defined which draw shapes. We have FORWARD, RIGHT, PENUP, PENDOWN. To draw an 'L' shape on the screen we could enter

```
FORWARD 6 AND RIGHT 90 AND
   FORWARD 6
```

Here are three useful procedures:

```
TO LEFT 'DEGREES (turn left)
10 RIGHT DIFF 360 ; DEGREES
END
TO FD 'N (allow FD as short for
FORWARD)
10 FORWARD ; N
END
```

Finally, to backtrack N steps without drawing a line:

```
TO BACK 'N
10 RIGHT 180
20 PENUP
30 FORWARD ; N
40 PENDOWN
50 RIGHT 180
END
```

We can now define a procedure to draw a shape with N equal sides of length L (called a polygon in geometry).

```
TO POLYGON 'N 'L
10 REPEAT ; N
20    FD ; L
30    AND RIGHT QUOT 360 ; N
END
```

If your program frequently draws squares, it might be worth having a special definition:

```
TO SQUARE 'N
10 POLYGON 4 ; N
END
```

Other built-in procedures

These are peculiar to Pogo. Firstly, to read in a number while the program is running, use INPUT:

```
PRINT SUM  INPUT  INPUT
```

which asks you for two numbers, then prints their sum.

To produce random numbers in range 0 to 9, use RND, eg,

```
REPEAT 100 PRINT RND
```

Finally, a 'quick and dirty' patch. In full Logo, we may use global variables and lists. In Pogo, PEEK and POKE can be used to provide global variables and arrays, while still keeping the overall size of the system small. Unlike similar Basic statements, full-length integers can be stored and recalled from an area of memory, as in

```
POKE 1234 6 (put 1234 in 6th
location)
PRINT PEEK 8 (print contents of 8th
location)
```

By suitable choice of procedure names, the effect of global arrays and variables can be obtained. Note that you cannot 'crash' your underlying Basic interpreter with Pogo PEEK/POKE.

Other statements

The two remaining statements — STOP and QUIT — are simple, but might be confused with similarly named Basic statements. STOP causes a return from the current procedure to the calling procedure, whereas QUIT stops the program completely, allowing the user to type fresh commands.

Setting up Logo

Firstly, a brief guide to the overall operation of the system. Typed-in procedure definitions are stored in a linked list. When a procedure call is typed, the appropriate procedures (because the call may itself involve other calls) are translated into an internal machine code, similar in nature to the stack-based p-code of many Pascal translators. Finally, this code (held in an integer array) is interpreted.

I adopted this approach mainly because I had a suitable interpreter subroutine, and didn't want to re-invent wheels — especially my own. A further benefit arises from the splitting of a relatively complicated program into two simpler separate routines which can be written and tested independently.

Now to details. The system is portable but not intelligible, due to Basic's primitive control structures, short variable names, and lack of named subroutines. It is a tight fit in 16k, so there are few comments, and those that do exist employ a shortand:

a. 'C' means 'subroutine to compile and check an item'. Each language item has its own compilation subroutine, which may need to call other similar subroutines (or even itself) if nested items exist. This method of compilation is known as 'recursive descent'.

b. The 'WH' comment indicates the start of a 'WHILE' loop. The program was planned (on paper) using Pascal-style loops, and then converted to Basic. Thus

```
WHILE condition DO
   BEGIN
        statements
   END
```

becomes in Basic —

```
1999 IF NOT condition THEN 3000'WH
        statements
2999 GOTO 1999
3000 etc.
```

The listing

As listed, the program runs on a TRS-80 Model I Level II machine in 16k, but alteration to other Microsoft Basic systems is no problem. Refer to these lines:

Line 20 — if your Basic doesn't need a CLEAR, remove it.

Lines 10050 and 10060 — if you have more than 16k, you can usefully increase some of the K variables, as indicated in figure 1.

Line 20005 — clear the screen.

Lines 23400 to 23460 — their purpose is to draw a line (usually an approximation in characters or pixels) from an initial position X,Y that is A units long at an angle of AN degrees. Afterwards, X and Y are updated to the new position. If you need to resort to POKE, alter line 23440 to plot a suitable character (eg,*) at the closest position to X and Y — ie, at INT (X+0.5) and INT (Y+0.5). To be on the safe side, include a check that X and Y do in fact correspond to a legal screen position. Finally, if you have the luxury of high-definition graphics (meaning that lines will be shorter), you may choose to multiply X and Y by a scale factor.

Line 29115 — read a line from cassette to L9$.

Line 29420 — transmit L9$ (including its trailing space) to cassette.

Filing procedures

The listed program has two filing commands. FETCH will load the next procedure from cassette, and FILE, followed by a procedure name, will write a procedure onto cassette. To run the system with named files (either on

Vital Variables

K9	number of Logo lines in total (16k, 100. 24k, 200)
K8	number of reserved words
K7	size of c() code array (16k, 200. 24k, 300).
K6	size of compiler stack (16k, 20. 24k, 40)
NU()	number of line
TE$()	text of line
LK()	link (ie, pointer) to next line
CS()	compiler stack
C()	holds internal machine code, and also interpreter run-time stack
SY$	current symbol being compiled
TY$	— and its type.
L9$	I/O line
ID$	input device — K M F — keyboard, memory, or file.
EL$	end-of-line flag
0D$	output device — S F — screen or file.
E0	error occurred
PU	Penup/pendown
P	interpreter program counter (also misc. compiler pointer)
PK()	PEEK/POKE array (16k, 10. 24k, 100)

Error codes

Number	Meaning
1	missing ; before variable
2	illegal item after ;
3	missing THEN in IF statement
4	missing THEN or DO in WHILE statement
5	missing ' after MAKE
6	illegal item after ' in MAKE
7	procedure name after '
8	reserved word after '
11	not enough room to hold the internal machine code.
20	attempt to define a procedure twice
21	illegal item after TO
22	missing ' in TO
23	missing variable in TO
24	procedure does not exist

tape or disk) would require the addition of OPEN and CLOSE statements using (for example) the procedure name as a file name.

Recent developments

In that essential book *Turtle Geometry*, forms of 'pursuit' games are described — to program these, it is useful to be able to run a 'hunter' and 'evader' procedure simultaneously. Though details are not included in the current listing, I have extended the language to allow this 'concurrent' or 'parallel' running, and also to allow procedures to interact using the technique of semaphores.

Reference

'Logo Learning' Mellar. *APC* May 1982.

Turtle Geometry. Abelson and diSessa. MIT Press 1981.


```
10 PRINT"LOGO MK1"'MIKE PARR
20 CLEAR 1000:GOSUB 10000:GOSUB 40100:ID$="K"
100 'FOREVER,DO:
205 EO=0:PRINT"C";:GOSUB 29100:C$=" ":GOSUB 28000
210 IF SY$="TO" THEN GOSUB 800:GOTO 350
220 IF SY$="EDIT"THEN GOSUB 700:GOTO 350
230 IF SY$="LIST" THEN GOSUB 1200:GOTO 350
240 IF SY$="FILE" THEN GOSUB 1300:GOTO 350
250 IF SY$="ERASE"THEN GOSUB 1500:GOTO 350
260 IF SY$="FETCH"THEN ID$="F":GOTO 350
290 S3=0:S4=0:S1=0:EO=0:GOSUB 5100:I=0:GOSUB 9010
294 GOSUB 7000:ID$="K":IF EO=1 THEN 350
296 PRINT"ABOUT TO RUN:-":GOSUB 20000
350 GOTO 100'END LOOP
700 'EDIT SY$
720 GOSUB 28000:GOSUB 1000:IF P1=0 THEN E=24:GOSUB 9990:RETURN
725 XP=OP:X1=P1:X2=P2:XN=LK(P2)'TEMP
730 PRINT"NE";:GOSUB 29100:GOSUB 28000:GOSUB 900
740 IF(P1=X1)AND(P2=X2)THEN RETURN
750 IF X1=P5 THEN P5=P1:GOTO 770'ELSE
760 LK(XP)=P1
770 IF X2=P6 THEN P6=P1:RETURN
780 LK(P2)=XN:RETURN
800 'TO
810 GOSUB 9400:IF EO=1 THEN RETURN
820 GOSUB 40400:TE$(X)=L9$:NU(X)=-1:P1=X
825 GOSUB 40400:LK(P1)=X:TE$(X)="END ":NU(X)=-1:P2=X:PRINT"NE";:
    GOSUB 2910C
830 GOSUB 28000:GOSUB 900
850 IF P5=0 THEN P5=P1:P6=P2:ID$="K":RETURN
860 LK(P6)=P1:P6=P2:ID$="K":RETURN
900 'EDIT A DEF
910 IF NOT(SY$<>"END") THEN 960'WH
920 IF TY$<>"NUM" THEN PRINT"NUMBERED LINE OR END PLEASE!":
    GOTO 950
925 NL=VAL(SY$)
930 IF EL$="Y" THEN GOSUB 40500:GOTO 950'DEL
940 TL$=RIGHT$(L9$,LEN(L9$)-P9+1):GOSUB 40500
950 PRINT"NE";:GOSUB 29100:GOSUB 28000:GOTO 910
960 RETURN
1000 'SEARCH FOR DEF
1010 F=0:P=P5:OP=0
1020 IF NOT((P<>P6)AND(F=0)) THEN 1070'WH
1030 IF NU(P)<>-1 THEN OP=P:P=LK(P):GOTO 1060
1040 IF TE$(P)="END " THEN OP=P:P=LK(P):GOTO 1060
1050 N$=RIGHT$(TE$(P),LEN(TE$(P))-3):N2=1:X$=""
1052 IF NOT(MID$(N$,N2,1)<>" ") THEN 1054'WH
1053 X$=X$+MID$(N$,N2,1):N2=N2+1:GOTO 1052
1054 IF X$=SY$ THEN F=1
1055 IF F=0 THEN OP=P:P=LK(P)
1060 GOTO 1020
1070 IF F=0 THEN P1=0:P2=0:RETURN'NOT THERE
1080 P1=P:P=LK(P)
1090 IF NOT(NU(P)<>-1) THEN 1110 'WH
1100 P=LK(P):GOTO 1090
1110 P2=P:RETURN
1200 'LIST
1210 OD$="S":GOSUB 1400:RETURN
1300 'FILE
1310 OD$="F":GOSUB 1400:OD$="S":RETURN
1400 'PROC OUT TO OD$
1410 GOSUB 28000:GOSUB 1000:IF P1=0 THEN E=24:GOSUB 9990:RETURN
1430 L9$=TE$(P1):GOSUB 29400:P=LK(P1)
1440 IFNOT(NU(P)<>-1)THEN 1490'W
1450 L9$=STR$(NU(P))+"  "+TE$(P)
1480 GOSUB 29400:P=LK(P):GOTO 1440
1490 L9$="END ":GOSUB 29400:RETURN
1500 'ERASE
1510 GOSUB 28000:GOSUB 1000:IF P1=0 THEN E=24:GOSUB 9990:RETURN
1517 P=P1
1520 IF(P1=P5)AND(P2=P6)THEN P5=0:P6=0:GOTO 1535'ONLY1
1523 IF OP=0 THEN P5=LK(P2):GOTO 1535'FIRST
1527 IF P2=P6 THEN P6=OP:GOTO 1535'LAST
1530 LK(OP)=LK(P2)'MIDL
1535 X=LK(P):GOSUB 40450:P=X
1540 IFNOT(NU(P)<>-1)THEN 1560'W
1550 X=LK(P):GOSUB 40450:P=X:GOTO 1540
1560 GOSUB 40450:RETURN
2000 'EVAL 1 PROC CALL
2010 GOSUB 4300:IF W<>0 THEN GOSUB 4000:
    GOTO 2300'WAS BUILT IN ONE
2020 T1=P1:T2=P2:GOSUB 1000:IF P1=0 THEN E=24:GOSUB 9990:GOTO 2300
2025 PRINT SY$;" ";
2030 GOSUB 9700:IF W=0 THEN GOSUB 9300:GOSUB 9100:W=S1
2035 P1=T1:P2=T2
2040 S3=S3+2:NA(S3-1)=W:NA(S3)=N:GOSUB 28000
2050 IF NOT(NA(S3)>0) THEN 2080'W
2060  GOSUB 3000:NA(S3)=NA(S3)-1'EVAL ARGS,RECURSE
2070 GOTO 2050
2080 S3=S3-2:I=4:A=-NA(S3+1):GOSUB 9020:GOTO 2300
2300 RETURN'EVAL PROC END
```

```
3000 'EVAL 1 ARG
3010 IF TY$="NUM" THEN I=18:A=VAL(SY$):GOSUB 9020:GOSUB 28000:
    GOTO 3300
3020 IF TY$="WORD" THEN GOSUB 2000:GOTO 3300'IS A FUN CALL
3030 ' IT MUST BE A ;VAR
3040 IF SY$<>";" THEN E=1:GOSUB 9990:RETURN
3042 GOSUB 28000:IF TY$<>"WORD"THEN E=2:GOSUB 9990:RETURN
3044 GOSUB 9500
3050 I=5:A=W:GOSUB 9020:GOSUB 28000:GOTO 3300
3300 RETURN'EVAL ARG END
4000 'C. 1 BUILT-IN PROC
4010 IF SY$="PRINT" THEN GOSUB 4500:GOTO 4200
4020 IF SY$="IF"THEN GOSUB 4600:GOTO 4200
4030 IF SY$="WHILE"THEN GOSUB 4800:GOTO 4200
4040 IF SY$="MAKE"THEN GOSUB 4900:GOTO 4200
4050 IF SY$="RESULT"THEN GOSUB 28000:GOSUB 3000:I=19:
    GOSUB 9010:GOTO 4200
4055 IF SY$="FORWARD" THEN GOSUB 28000:GOSUB 3000:I=24:
    GOSUB 9010:GOTO 4200
4060 IF SY$="RIGHT" THEN GOSUB 28000:GOSUB 3000:
    I=25:GOSUB 9010:GOTO 4200
4065 IF SY$="REPEAT"THEN GOSUB 5000:GOTO 4200
4070 IF SY$="STOP"THEN I=3:GOSUB 9010:GOSUB 28000:GOTO 4200
4075 IF SY$="PENUP"THEN I=16:GOSUB 9010:GOSUB 28000:GOTO 4200
4080 IF SY$="PENDOWN"THEN I=17:GOSUB 9010:GOSUB 28000:GOTO 4200
4081 IF SY$="RND"THEN I=32:GOSUB 9010:GOSUB 28000:GOTO 4200
4083 IF SY$="INPUT" THEN I=29:GOSUB 9010:GOSUB 28000:GOTO 4200
4085 IF SY$="PEEK" THEN I=30:GOSUB 9010:GOSUB 28000:GOTO 4200
4087 IF SY$="POKE"THEN GOSUB 28000:GOSUB 3000:GOSUB 3000:I=31:
    GOSUB 9010:GOTO 4200
4100 IF(W<6)OR(W>15) THEN 4120
4110 X=W:GOSUB 10600:GOSUB 28000:GOSUB 3000:GOSUB 3000:
    GOSUB 10700: I=X:GOSUB 9010:GOTO 42C .
4120 REM
4200 RETURN'C. BUILT-IN END
4300 'SEARCH RES WORDS
4310 W=K8
4320 IF W=0 THEN RETURN
4330 IF SY$=R$(W) THEN RETURN
4340 W=W-1:GOTO 4320
4500 'C.PRINT
4510 GOSUB 28000:GOSUB 3000:I=1:GOSUB 9010:RETURN
4600 'C.IF
4610 GOSUB 28000:GOSUB 2000:I=20:A=0:GOSUB 9020:X=S4:GOSUB 10600
4620 IF SY$<>"THEN"THEN E=3:GOSUB 9990:RETURN
4630 GOSUB 28000:GOSUB 5100:IF SY$="ELSE" THEN GOSUB 28000:
    GOTO 4650
4640 GOSUB 10700:C(X)=S4+1:RETURN'ND ELSE
4650 I=22:A=0:GOSUB 9020:GOSUB 10700:C(X)=S4+1
4660 X=S4:GOSUB 10600:GOSUB 5100:GOSUB 10700:C(X)=S4+1:RETURN
4800 'C.WHILE
4810 X=S4+1:GOSUB 10600:GOSUB 28000:GOSUB 2000
4820 IF(SY$<>"THEN")AND(SY$<>"DO")THEN E=4:GOSUB 9990:RETURN
4830 I=20:A=0:GOSUB 9020:X=S4:GOSUB 10600:GOSUB 28000:GOSUB 5100
4840 I=22:A=0:GOSUB 9020:GOSUB 10700:C(X)=S4+1
4850 GOSUB 10700:C(S4)=X:RETURN
4900 'C.MAKE
4910 GOSUB 28000:IF SY$<>"""" THEN E=5:GOSUB 9990:RETURN
4920 GOSUB 28000:IF TY$<>"WORD"THEN E=6:GOSUB 9990:RETURN
4930 T1=P1:T2=P2:GOSUB 1000:IF P1<>0 THEN E=7:GOSUB 9990:RETURN
4940 P1=T1:P2=T2:GOSUB 4300:IF W<>0 THEN E=8:GOSUB 9990:RETURN
4950 GOSUB 9500:X=W:GOSUB 10600:GOSUB 28000:GOSUB 3000
4960 GOSUB 10700:A=X:I=23:GOSUB 9020:RETURN
5000 'C.REPEAT
5010 GOSUB 28000:GOSUB 3000:X=S4+1:GOSUB 10600
5020 I=21:A=0:GOSUB 9020:GOSUB 5100:I=22:A=0:GOSUB 9020
5030 GOSUB 10700:C(S4)=X:C(X+1)=S4+1:RETURN
5100 'C.BLOCK
5110 GOSUB 2000
5120 IF NOT(SY$="AND") THEN 5140'WH
5130 GOSUB 28000:GOSUB 2000:GOTO 5120
5140 RETURN
6000 'C. 1 DEF
6005 ID$="M":SY$="":GOSUB 29100
6010 PA(N1)=S4+1
6020 GOSUB 28000:GOSUB 28000:GOSUB 28000:S2=-1
6030 IF NOT(SY$="""") THEN 6050'WH
6040 GOSUB 28000:GOSUB 9500:GOSUB 28000:GOTO 6030
6050 I=2:A=S2+1:GOSUB 9020
6060 S2=S2+2:VN$(S2)="":VN$(S2-1)=""
6070 IF NOT((SY$<>"END")AND(EO=0))THEN 6090'WH
6080 GOSUB 2000:GOTO 6070
6090 I=3:GOSUB 9010:RETURN
7000 'C. ALL NEEDED FUNC DEFS
7010 CA$="N"
7020 IF NOT(CA$="N") THEN 7100'WH
7030 CA$="Y":N1=1
7040 IF NOT(N1<=S1) THEN 7090'WH
7050 IF PA(N1)<>0 THEN 7080
7060 SY$=PN$(N1):GOSUB 1000
```

```
7070 GOSUB 6000:CA$="N"
7080 N1=N1+1:GOTO 7040'EW
7090 GOTO 7020
7100 GOSUB 7200:RETURN
7200 'FIX UP CALL ADDRS
7210 FOR N=1 TO S4-1
7220  IF(C(N)=4)AND(C(N+1)<0)THEN C(N+1)=PA(-C(N+1))
7230 NEXT N:RETURN
9010 'GEN CODE I
9012 IF S4+1=K7 THEN E=11:GOSUB 9990:RETURN
9014 S4=S4+1:C(S4)=I:RETURN
9020 'GEN CODE I,A
9022 IF S4+3>K7 THEN E=11:GOSUB 9990:RETURN
9024 C(S4+1)=I:C(S4+2)=A:S4=S4+2:RETURN
9100 'NOTE CALLED PROC NAME,AND N ARGS
9110 S1=S1+1:PN$(S1)=SY$:CP(S1)=N:PA(S1)=0:RETURN
9300 'COUNT N ARGS OF A PROC
9305 N=0
9310 FOR X=1 TO LEN(TE$(P1))
9320 IF MID$(TE$(P1),X,1)="'" THEN N=N+1
9330 NEXT X
9340 RETURN
9400 'CHECK 'TO' LINE
9410 GOSUB 28000:IF TY$<>"WORD" THEN E=21:GOSUB 9990:RETURN
9415 GOSUB 1000:IF P1<>0 THEN E=20:GOSUB 9990:RETURN
9416 GOSUB 4300:IF W<>0 THEN E=20:GOSUB 9990:RETURN
9418 PRINT SY$
9420 IF NOT(EL$="N") THEN 9460'WH
9430 GOSUB 28000:IF SY$<>"'" THEN E=22:GOSUB 9990:RETURN
9440 GOSUB 28000:IF TY$<>"WORD"THEN E=23:GOSUB 9990:RETURN
9450 GOTO 9420
9460 RETURN
9500 'GET/MAKE VAR NUMB
9510 GOSUB 9800:IF W>=0 THEN RETURN
9520 S2=S2+1:VN$(S2)=SY$:W=S2:RETURN
9700 'SEARCH PROC TABLE
9710 W=S1
9720 IF W=0 THEN RETURN
9730 IF SY$=PN$(W) THEN RETURN
9740 W=W-1:GOTO 9720
9800 'SEARCH FOR A VAR
9810 W=S2
9820 IF W=-1 THEN RETURN
9830 IF SY$=VN$(W) THEN RETURN
9840 W=W-1:GOTO 9820
9990 'ERROR
9991 IF EO=1 THEN GOSUB 28000:RETURN
9992 EO=1:PRINT"ERROR NUMBER "E;" NEAR ITEM ";SY$
9993 PRINT"IN LINE:":PRINT L9$:GOSUB 28000:RETURN
10000 'INIT
10010 S2=-1:S5=1
10040 P1=0:P2=0:P5=0:P6=0
10050 K8=33:DIM R$(K8):K9=100:DIM NU(K9),TE$(K9),LK(K9)
10060 K7=200:DIM C(K7):K6=20:DIM CS(K6),PK(10)
10090 R$(1)="PRINT":R$(2)="IF":R$(3)="THEN":R$(4)="ELSE"
10100 R$(5)="WHILE":R$(6)="SUM":R$(7)="DIFF":R$(8)="PROD"
10110 R$(9)="QUOT":R$(10)="GE":R$(11)="LE":R$(12)="GT"
10120 R$(13)="LT":R$(14)="EQ":R$(15)="NE"
10130 R$(16)="RESULT":R$(17)="AND":R$(17)="REPEAT":R$(18)="END"
10140 R$(19)="MAKE":R$(20)="FORWARD":R$(21)="RIGHT":R$(22)="STOP"
10150 R$(23)="PENUP":R$(24)="PENDOWN":R$(25)="INPUT":
      R$(26)="PEEK":R$(27)="POKE"
10160 R$(28)="TO":R$(29)="LIST":R$(30)="ERASE":R$(31)="FILE":
      R$(32)="FETCH"
10165 R$(33)="RND"
10200 RETURN
10600 'PUSH X
10610 IF S5>K6 THEN STOP
10620 CS(S5)=X:S5=S5+1:RETURN
10700 'POP X
10710 IF S5<=1 THEN STOP
10720 S5=S5-1:X=CS(S5):RETURN
20000 '*** INTERPRET ***
20005 CLS
20010 P=-1:S=S4+1:A=0:B=0:L=0:AN=0:X=30:Y=30:DR=3.142/180:PU=0
20020 P=P+1
20030 P=P+1
20040 I=C(P):A=C(P+1):IF I=0 THEN RETURN
20045 IF S+2>K7 THEN PRINT"TOO MANY PROC. CALLS!":RETURN
20050 IF I>6 THEN 20070
20060 ON I GOTO 21100,21200,21300,21400,21500,21600
20070 IF I>12 THEN 20090
20080 ON I-6 GOTO 21700,21800,21900,22000,22100,22200
20090 IF I>18 GOTO 20110
20100 ON I-12 GOTO 22300,22400,22500,22600,22700,22800
20110 IF I>24 THEN 20130
20120 ON I-18 GOTO 22900,23000,23100,23200,23300,23400
20130 ON I-24 GOTO 23500,23600,23700,23800,23900,24000,24100,24200
21099 '** INTERPRET INSTRUCS **
21100 PRINT C(S):S=S-1:GOTO 20030'PRN
21200 S=S+1:C(S)=L:L=S-1:S=S+1:C(S)=B:
      B=S-A-2:GOTO 20020'FUN HEADER
21300 S=B-1:B=C(L+2):P=C(L):L=C(L+1):GOTO 20040'RET
21400 S=S+1:C(S)=P+2:P=A:GOTO 20040'CALL
21500 S=S+1:C(S)=C(A+B):GOTO 20020'LLV
21600 S=S-1:C(S)=C(S)+C(S+1):GOTO 20030'SUM
21700 S=S-1:C(S)=C(S)-C(S+1):GOTO 20030'SUB
21800 S=S-1:C(S)=C(S)*C(S+1):GOTO 20030'MUL
21900 IF C(S)=0 THEN PRINT"ZERO DIVIDE !":RETURN
21910 S=S-1:C(S)=INT(C(S)/C(S+1)):GOTO 20030'DIV
22000 S=S-1:IF C(S)>=C(S+1) THEN C(S)=1:GOTO 20030'LE
22010 C(S)=0:GOTO 20030
22100 S=S-1:IF C(S)<=C(S+1) THEN C(S)=1:GOTO 20030'LE
22110 C(S)=0:GOTO 20030
22200 S=S-1:IF C(S)>C(S+1) THEN C(S)=1:GOTO 20030'GT
22210 C(S)=0:GOTO 20030
22300 S=S-1:IF C(S)<C(S+1) THEN C(S)=1:GOTO 20030'LT
22310 C(S)=0:GOTO 20030
22400 S=S-1:IF C(S)=C(S+1) THEN C(S)=1:GOTO 20030'EQ
22410 C(S)=0:GOTO 20030
22500 S=S-1:IF C(S)<>C(S+1) THEN C(S)=1:GOTO 20030'NE
22510 C(S)=0:GOTO 20030
22600 PU=1:GOTO 20030'PUP
22700 PU=0:GOTO 20030'PDOWN
22800 S=S+1:C(S)=A:GOTO 20020'LCN
22900 C(B)=C(S):S=B:B=C(L+2):P=C(L):L=C(L+1):GOTO 20040'RES
23000 S=S-1:IF C(S+1)=0 THEN P=A:GOTO 20040'JIF
23010 GOTO 20020
23100 C(S)=C(S)-1:IF C(S)<0 THEN S=S-1:P=A:GOTO 20040'TESTREP
23110 GOTO 20020
23200 P=A:GOTO 20040'JUN
23300 C(A+B)=C(S):S=S-1:GOTO 20020'STORE
23400 A=C(S):S=S-1:T1=COS(DR*AN):T2=SIN(DR*AN):N=1'FWARD
23410 IF NOT(N<=A)THEN 23460'W
23420 X=X+T1:Y=Y+T2
23430 IF PU=1 THEN 23450
23440 SET(INT(X+0.5),INT(Y+0.5))
23450 N=N+1:GOTO 23410
23460 X=INT(X+0.5):Y=INT(Y+0.5):GOTO 20030
23500 AN=AN-C(S):S=S-1'RIGHT
23510 IF NOT(AN<0) THEN 23530'WH
23520 AN=AN+360:GOTO 23510
23530 GOTO 20030
23900 INPUT"NUMBER ";N:S=S+1:C(S)=N:GOTO 20030
24000 C(S)=PK(C(S)):GOTO 20030'PEEK
24100 S=S-2:PK(C(S+2))=C(S+1):GOTO 20030'POKE
24200 S=S+1:C(S)=INT(10*RND(0)):GOTO 20030
28000 'GET SYM,TYPE
28005 IF(EL$="Y")AND(ID$="K")THEN SY$="":TY$="X":RETURN
28007 IF(SY$="END")AND(ID$="M")THEN RETURN
28010 SY$="":GOSUB 29300
28020 IF CC$<>"D" THEN 28060
28030 SY$=SY$+C$:GOSUB 29200
28040 IF CC$="D" THEN 28030
28050 TY$="NUM":RETURN
28060 IF CC$<>"L" THEN 28100
28070 SY$=SY$+C$:GOSUB 29200
28080 IF(CC$="L")OR(CC$="D")THEN 28070
28081 TY$="WORD":RETURN
28100 SY$=C$:TY$="X":GOSUB 29200:RETURN
29000 'READCHAR
29005 EL$="N"
29035 IF P9>LEN(L9$)THEN GOSUB 29100
29037 IF P9=LEN(L9$) THEN EL$="Y"
29040 C$=MID$(L9$,P9,1):P9=P9+1:RETURN
29100 'READLINE
29105 P9=1:EL$="N"
29110 IF ID$="K" THEN INPUT L9$:L9$=L9$+" ":RETURN
29115 IF ID$="F" THEN INPUT#-1,L9$:RETURN
29120 IF ID$="M" THEN L9$=TE$(P1):P1=LK(P1):RETURN
29130 RETURN
29200 'GETCHAR
29210 GOSUB 29000
29220 IF(C$>="0")AND(C$<="9")THEN CC$="D":RETURN
29230 IF(C$>="A")AND(C$<="Z")THEN CC$="L":RETURN
29240 CC$="X":RETURN
29300 'GET NON-SPACE
29310 IF C$<>" " THEN RETURN
29320 GOSUB 29200:GOTO 29310
29400 ' OUT L9$
29410 IF OD$="S"THEN PRINT L9$:RETURN
29420 IF OD$="F"THEN PRINT#-1,L9$:RETURN
40000 'LINE EDITOR
40100 'INIT FREE LIST
40120 FOR X=1 TO K9-1
40130  TE$(X)="":NU(X)=0:LK(X)=X+1
40140 NEXT X
40150 P3F=1:LK(K9)=0:RETURN
40200 'SEARCH FOR NL IN NU(),RESULT P
40210 OP=0
40235 P=P1H
40240 IF NOT(NL>NU(P)) THEN 40280'WH
40245 IF P=P2 THEN 40280
40250  OP=P:P=LK(P)
40270 GOTO 40240
40280 RETURN
40400 'GETFREE X
40410 IF P3F=0 THEN PRINT"OUT OF SPACE !!":STOP
40420 X=P3F:P3F=LK(P3F):LK(X)=0:RETURN
40450 'RETURN P TO FREE.
40460 TE$(P)="":NU(P)=0:LK(P)=P3F:P3F=P:RETURN
40500 'DO EDIT
40510 GOSUB 40200
40520 IF EL$="Y" THEN GOSUB 40800:RETURN 'DEL
40530 IF P=0 THEN GOSUB 41000:RETURN'MUST BE INSERT
40540 IF NU(P)=NL THEN GOSUB 40700:RETURN'REPL
40550 GOSUB 41000:RETURN'INSERT
40700 'REPL
40710 TE$(P)=TL$:RETURN
40800 'DEL
40810 IF P=0 THEN RETURN
40820 IF NU(P)<>NL THEN RETURN
40840 'FIRST,LAST,MIDDLE?
40850 IF P=P1H THEN P1H=LK(P1H):X=P:GOSUB 40450:RETURN
40860 IF P=P2T THEN P2T=OP:X=P:GOSUB 40450:RETURN
40870 LK(OP)=LK(P):GOSUB 40450:RETURN
41000 'INSERT
41030 GOSUB 40400:NU(X)=NL:TE$(X)=TL$:LK(X)=LK(OP):LK(OP)=X:RETURN
60000 CSAVE"1":CSAVE"2":CSAVE"3"
```

END

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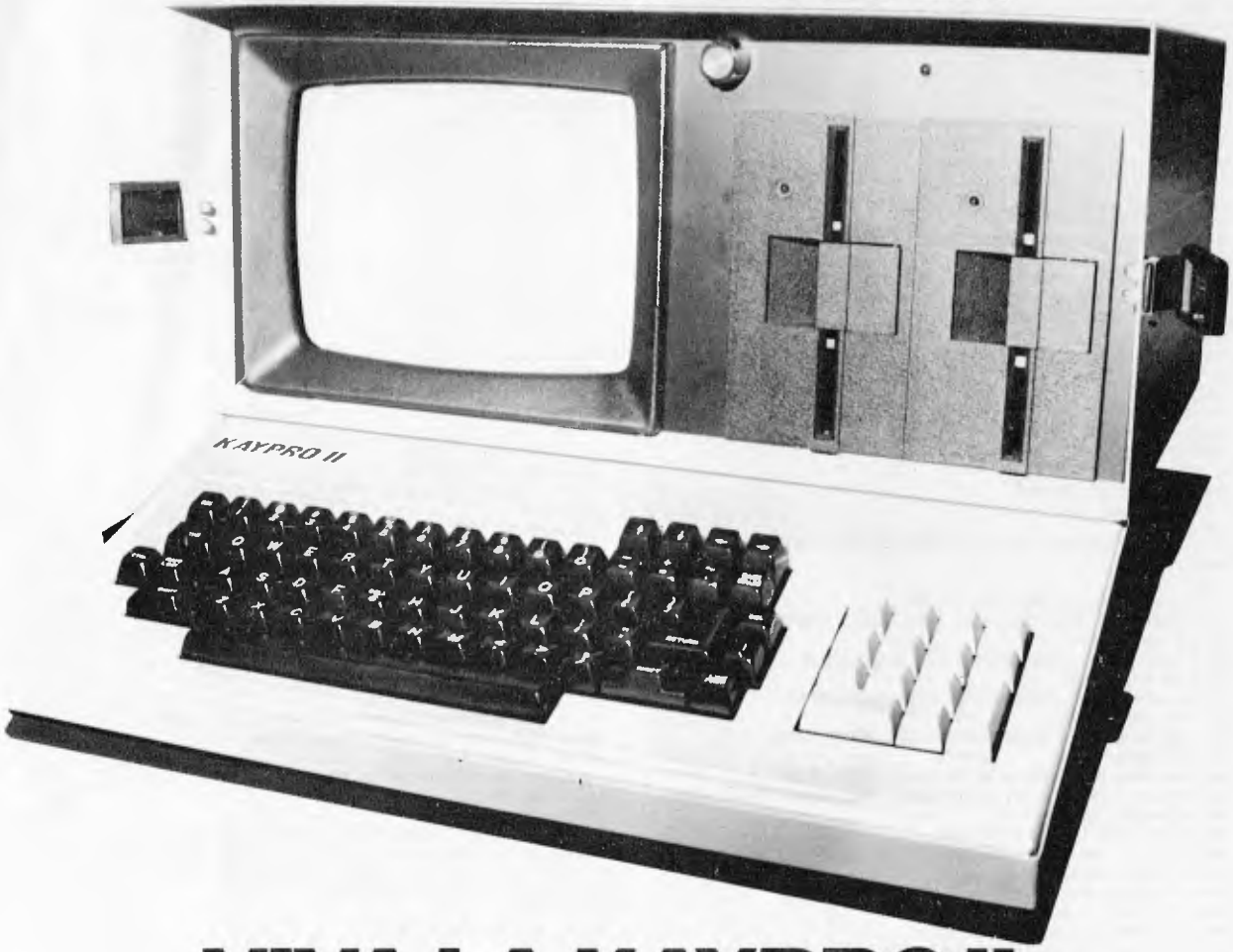

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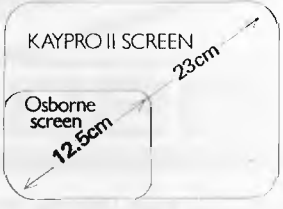

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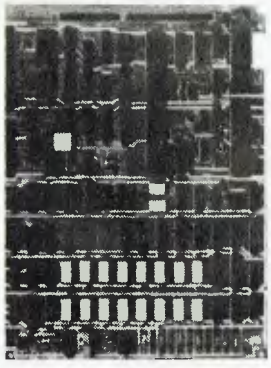

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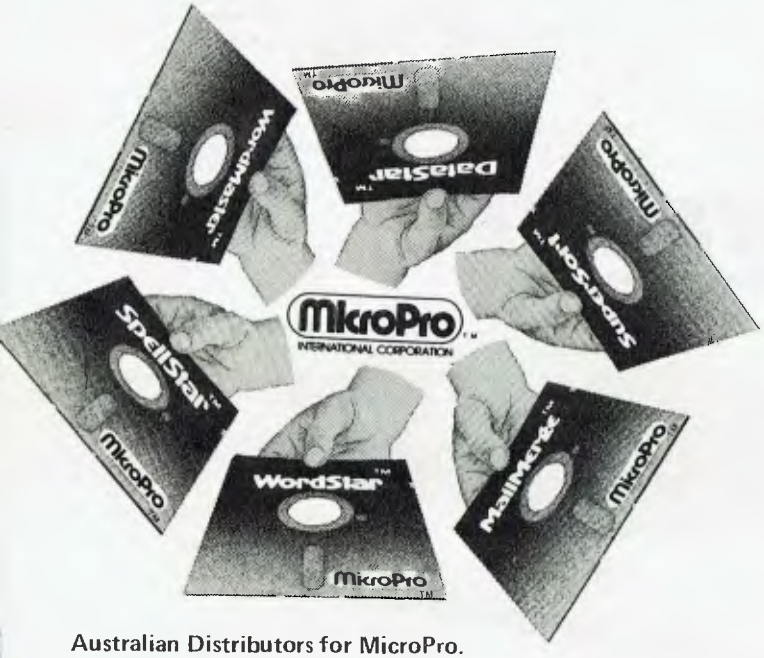

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FRACTALS

Alan Sutcliffe concludes his series with a look at generating textures.

Misunderstanding is among the mothers of invention. As a for instance, I recently read a fascinating article in *Computer Graphics and Image Processing* about programs to analyse and then synthesise textures. Reading it again later and more carefully, I found that I had not followed it at all — but in the meantime I had written my own program based on what I thought was proposed. And it worked: at least it is capable of producing many kinds of texture. I have not used it for analysis but that seems straightforward once a texture has been digitised and stored in the computer.

For the purpose of explanation, I present a more limited program and before that a few words on the use of the textures that can be produced.

Suppose you want to simulate flying over an area of the moon. If it is possible to characterise the appearance of the surface using just a few numbers, then suitable-looking fine detail of the terrain can be invented. This will cost a little more in processor power than keeping precise data on a vast area but there will be a great saving in the storage needed and, probably more important, in the time needed to enter the data. Major known features could be imposed on such statistically correct texture.

At the level of personal computing, there are many games and simulations that would be much improved by the addition of appropriate textures to otherwise bald and unconvincing superfices.

The method (this much I did get right at the first reading) can be applied to any kind of display that uses a cellular array of picture elements or pixels. It is easily adapted for whatever number of colours or grey levels the system has, from simple black and white upwards.

Here is the simplest possible version of the method. Each pixel is black or white and its colour is controlled by the one immediately to the left of it and the one immediately below it. Thus there are four cases, as shown in Figure 1. The value of N, representing the colour of the current pixel, is not fully determined by its two neighbours. What *is* fixed is the probability of its being black or white in each case. This requires just one number between 0 and 1 in each case, the probability of being black, say. The difference between this number and 1 is then the probability of being white, since a probability of 1 represents certainty; in this case, the certaintly of being black or white. Figure 1 shows some possible values.

The implementation of this version is given in Program A. The probabilities are stored in the array T. There is clearly a problem in getting the process started, since the pixel at the bottom left of the display does not have the neighbours it needs to determine which probability applies, so these extra cells must be provided. X(XMAX) is a row of cells, not displayed on the screen, to provide neighbours below for the bottom row proper. XMAX is the width of the display. Similarly, Y(YMAX) is an extra column of cells to the left of the main array. These are first of all filled with values 0 or 1 for black or white at random.

It may be thought preferable to fill these two starter arrays with values distributed like the values in the resulting display — but we do not know yet what will be. I have found that this edge effect from starting with a row and column not typical of the main texture is small and when some effect can be seen it affects only the bottom few rows and a few columns at the left. Each texture seems to settle down quickly to a more or less characteristic pattern,

Pixel to the left		Pixel below	
	1	T(1,0)=0.2	T(1,1)=0.7
	0	T(0,0)=0.7	T(0,1)=0.5
		0	1

Fig 1 Probabilities for this pixel based on two neighbours.

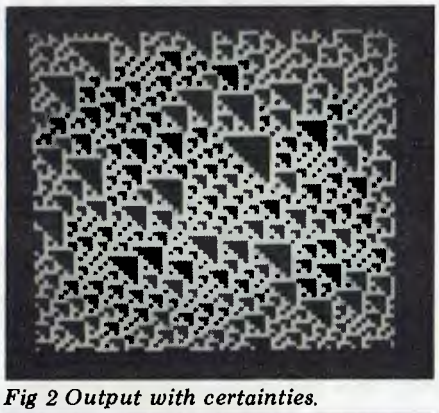

Fig 2 Output with certainties.

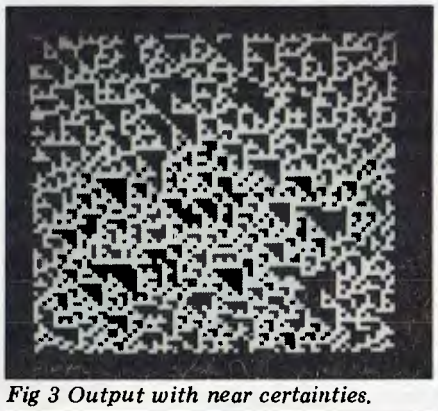

Fig 3 Output with near certainties.

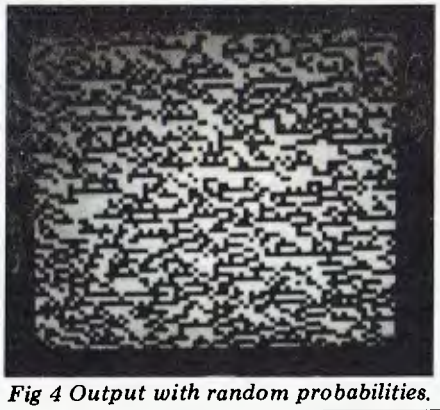

Fig 4 Output with random probabilities.

```
IMP INT                         Variables are integer
IMP FPT P-T                     except those starting P to T
CLEAR 1000
100 MODE 2                      Low resolution
110 COLORG 0 1 2 3              Set colours - only 1 is used
120 DIM X(XMAX),Y(YMAX)         Boundary values
130 DIM T(1,1)                  Probabilities
140 T(0,0)=1.0                  Set probabilities
150 T(0,1)=0.0
160 T(1,0)=0.0
170 T(1,1)=1.0
180 FOR I=1 TO XMAX             Set up X boundary
190 X(I)=RND(2)                 50/50 0 or 1
200 NEXT I
210 FOR J=0 TO YMAX             Set up Y boundary
220 Y(J)=RND(2)                 50/50 0 or 1
230 NEXT J
240 FOR J=0 TO YMAX             Main loop for each line
250 C=Y(J)                      Set left cell effect
260 FOR I=0 TO XMAX             For each cell on a line
270 D=X(I)                      set effect of cell below
280 S=RND(1.0)                  Random selector
290 N=0                         If S>T(D,C)
300 IF S<T(D,C) THEN 330        select case
310 N=1
320 DOT I,J N                   Draw dot
330 X(I)=N                      Save value for next line
340 C=N                         Set effect for next cell
350 NEXT I
360 NEXT J
370 COLORG 0 15 00              Set col to black & white
380 GOTO 380                    Keep display on screen
```

Program A Simple Basic program for textures

which remains stable across the display.

Figure 2 shows the result when the probabilities have been turned into the certainties of 0 and 1, as in lines 140 to 170 of Program A. In this case, the value of each pixel is fully determined by its two neighbours. Looking at the pattern you can see that each pixel that has black pixels below and to the left of it is white, with a probability of 1 = certainty. The whole pattern depends entirely on the values in the two random starter arrays, X and Y.

Figure 3 shows what happens when the probabilities are changed slightly to 0.9, 0.1, 0.1, 0.9. This is very like Figure 2, but with 10 percent noise added. But if the probabilities are changed completely then quite different textures result: Figure 4 shows an example with probabilities set at random.

This simple system is not complex enough to produce a very rich variety of textures. There are at least two ways to think of this intuitively. First, four variables, the four probabilities, are not enough to represent or characterise the many different dimensions of texture. Second, working at the level of single pixels is too low: there is in most textures a lowest level of detail that is more or less random and the texture itself is somehow operating at a slightly less microscopic level.

A move that copes with both these points is to use small groups of pixels. In the example presented here a simple array, two pixels by two pixels, is used, and I call this unit a cell. With just black and white there are now five possible values for a cell, ranging from all four pixels black, three black and one white, to all white. When, say, one pixel in a cell is black, it is not considered important which one it is. In Program B the setting of pixels within a cell is fixed, and is set in the array A. For a little more computer time the one to be set could be chosen at random.

Program B implements this scheme in Pascal and Figure 5 shows five textures produced by this program, where the probabilities stored in T are themselves set by calls to the random function. The function RAND takes an integer in the range −32768 to +32767, which is what the system function Random produces, and converts it to a floating point value in the range 0.0 to RANGE. Most of the variables have the same uses as in the Basic program. It is necessary to have U and V as the coordinates for plotting pixels as twice X and Y which are coordinates of the cells. The array of probabilities T now has three dimensions, there are 5 x 5 = 25 different cases for the values of the two neighbours, and for each case there are now four probabilities. The multiple calls to RAND in setting the values in T ensure more variety in these settings.

Reference: Monne, Schmitt and Massaloux, 'Bidemensional texture synthesis by Markov chains', *Computer Graphics and Image Processing*, September 1981. (Academic Press).

END

```
Program TEXTURE;                                  Prog to plot textures
Const
 XM=100;                                          Screen width
 YM=100;                                          Screen height
Var
 C,D:Integer;                                     Val of cells left & below
 I,J:Integer;                                     Loop ctrl, cell co-ords
 N:Integer;                                       Current cell value
 U,V:Integer;                                     Pixel co-ords
 S:Real;                                          Random selector value
 X:Array[0..XM] of Integer;                       Start values along X
 Y:Array[0..YM] of Integer;                       Start values along Y
 A:Array[0..4,0..3] of Boolean;                   Cell definitions
 T:Array[0..3,0..4,0..4] of Real;                 Main table of probabilities

Function RAND(RANGE:Real):Real;                   Random function 0 to RANGE
Begin
 RAND:=RANGE*(Float(Random)+32770.0/65540.0;      Scale Random to range
End;

Begin                                             Main program
 InitRandom;                                      Initialise Random
 Readln(I);                                       Read in seed
 For J=1 to I do                                  Ignore 1st I random values
  N:=Random;
 For I=0 to 4 do                                  Set up array for cell values
  Begin                                           0 to 4 pixels set
   For J:=0 to 3 do
    Begin                                         1 3 4 pixels
     A[I,J]:=false;                               0 2 in each cell
     If I>J then A[I,J]:=true
    End;
  End;
 For I:=0 to 4 do                                  Set up main array of
  Begin                                             probabilities
   For J:=0 to 4 do                               5 values at left
    Begin                                          by 5 values below
     T[0,I,J]:=RAND(RAND(RAND(3.0)));             Ist case quite likely
     T[1,I,J]:=RAND(RAND(RAND(1.0)))+T[0,I,J];    2nd 3rd & 4th no so
     T[2,I,J]:=RAND(RAND(RAND(1.0)))+T[1,I,J];    likely
     T[3,I,J]:=RAND(RAND(RAND(1.0)))+T[2,I,J];    Rest is 5th case
    End;
  End;
 For I:=0 to XM do                                Set up X boundary
  X[I]:=Trunc(RAND(5.0));                         Random integer 0 to 4
 For J:=0 to YM do                                Set up Y boundary
  Y[J]:=Trunc(RAND(5.0));                         Random integer 0 to 4

 For J:=0 to YM do                                Main loop for each line
  Begin
   C:=Y[J];                                       Effect of cell to left
   V:=J+J;                                        Double the Y co-ord
   For I:=0 to XM do                              For each cell on a line
    Begin
     D:=X[X];                                     Effect of cell below
     U:=I+I;                                      Double the X co-ord
     S:=RAND(1.0);                                Random selector
     N:=4;                                        If S>T[3,C,D]
     If S<T[3,C,D] then N:=3;                     Select case according to S
     If S<T[2,C,D] then N:=2;
      If S<T[1,C,D] then N:=1;
      If S<T[0,C,D] then N:=0;
     If A[N,0]=true then Dot(U,V,U,V);            Plot points
     If A[N,1]=true then Dot(U+1,V,U+1,V);
     If A[N,2]=true then Dot(U,V+1,U,V+1);
      If A[N,3]=true then Dot(U+1,V+1,U+1,V+1);
     X[I]:=N;                                      Save value for next line
     C:=N;                                         Set effect for next cell
    End;
  End;
End.
```

Program B Pascal program for 2 x 2 cells in black and white.

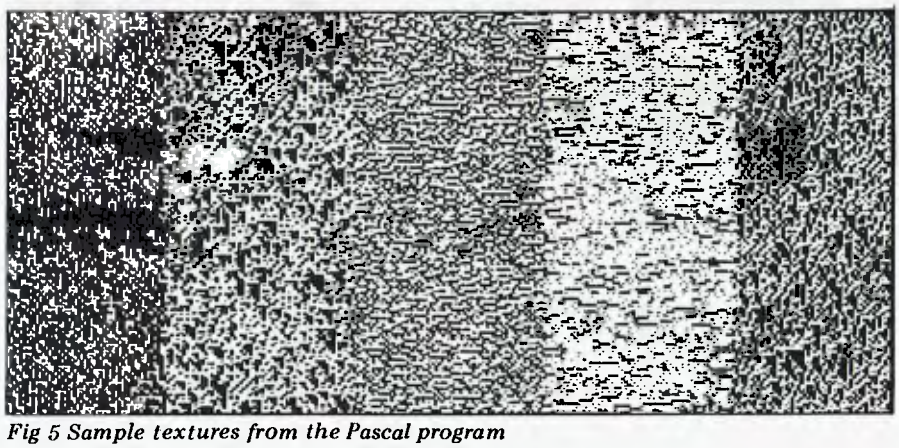

Fig 5 Sample textures from the Pascal program

ONE BIT AT A TIME

M Gonzales and D A Sinclair conclude their examination of the RS232 interface.

PART 2: SIMPLE INTERFACING WITH RS232

One possible reason for buying a microcomputer system is for use as a terminal to another computer such as a mainframe. The simplest requirement is for use as a cheap alternative to a VDU or teletype without any extra local intelligence — ie, a dumb terminal. A dumb terminal program (DTP) is quite simple to write. Figure 1 gives a flowchart for a DTP which operates in the full duplex mode. For half-duplex operation the flowchart should be modified to display the keyboard character on the screen after it is output to the UART.

This looks straightforward enough, but there are some pitfalls. For example, a mainframe which runs an on-line literature searching service sends two control characters which turn the teletype motor off and on between lines of print. One of us had the job of writing a program to enable a Sorcerer micro to be used as a terminal to this computer. These control characters meant 'cursor home' and 'clear screen' to the Sorcerer, so it was impossible to read the mainframe's output on the screen. However, the problem was easily solved by a subroutine to filter out any awkward control codes from the received data.

A more sophisticated solution is to have a conversion table to convert received control codes to their local equivalent. So, if the mainframe thinks that 'clear screen' is 0H (ie, ASCII VT) whereas on the micro it is 13H (ASCII DC3), the table should have an entry saying that received 0BH should be echoed to the VDU as 13H. Of course the inverse process should not be carried out — ie, 13H should not be transmitted as 0BH.

Ideally no conversion or other processing should be done on characters typed at the keyboard, since in full duplex mode they can have no unpleasant local effect (such as accidentally clearing the screen). Problems may occur, however, if you use the routines provided in the monitor to read the keyboard, since these routines often look for and act upon certain control characters. For example, on one microcomputer, depressing Control–F on the keyboard causes the machine to enter the software front panel mode. This can be avoided only by writing an alternative keyboard input routine.

The flowchart in Figure 1 assumes that output to the VDU is much faster than I/O to the RS232 port. Surprisingly enough, this is not always the case. This particular micro has a flicker-free display, achieved by scrolling only during the TV frame blanking, which occurs just 50 times a second. So writing a line feed to the VDU can take up to 20ms! Therefore characters will be lost at the beginning of each line for data rates over 50cps (550 baud). To solve this, a flickering display routine must be written — a difficult task as the screen memory is not one contiguous block. In our application (described below) we took the easy way out: we connected a spare VDU to the second serial output port. The main RS232 port was being

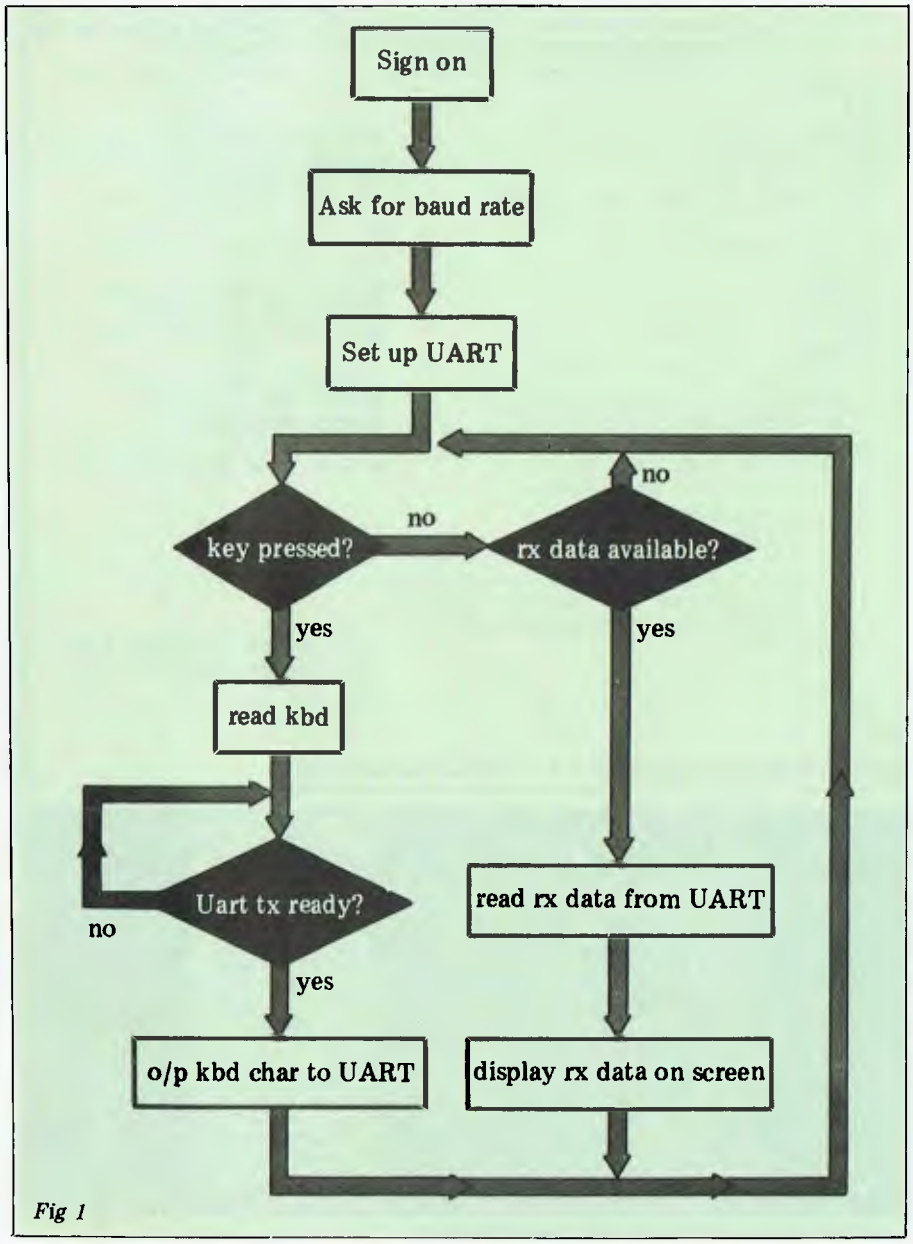

Fig 1

Signal name		Pin number
Protective ground		1
Signal ground		7
Transmitted data	TXD	2
Received data	RXD	3
Request to send	RTS	4
Clear to send	CTS	5
Data set ready	DSR	6
Data terminal ready	DTR	27
Carrier detect		8
Ring indicator		22

Table 2a Main RS232 signals

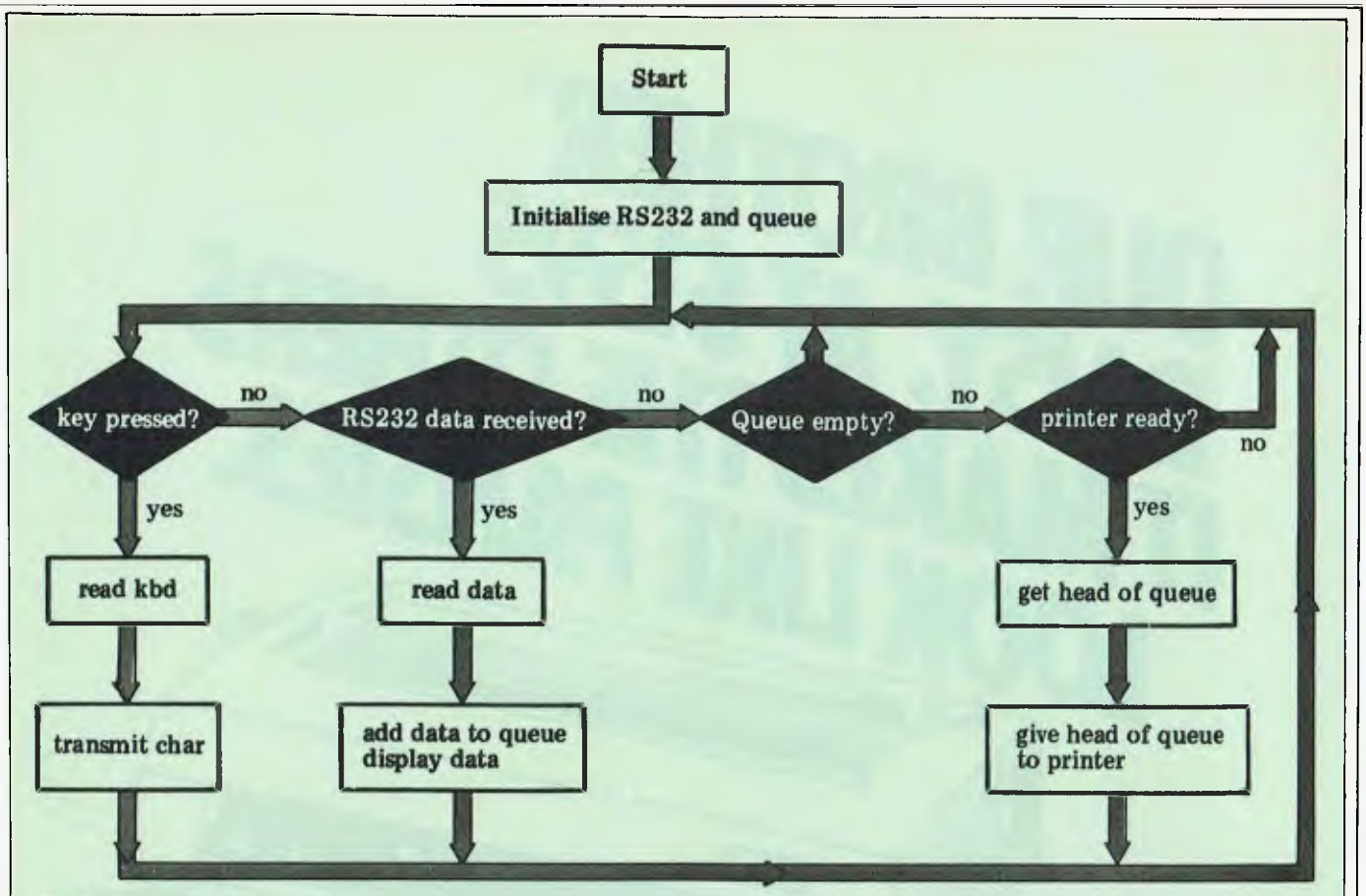

Fig 2

used at 1200 baud so we set the VDU port to 2400 baud; we found that output to the VDU was then sufficiently fast for us not to miss any incoming characters on the main RS232 port. This arrangement worked perfectly as long as one remembered to type on the keyboard while watching the VDU screen (the second serial port is not bidirectional).

It is possible to copy the dialogue between a mainframe and a microprocessor system to a printer even if the printer is much slower than the RS232 data rate between the microprocessor and the mainframe, always assuming that the printer status ('ready to print' or not) can be tested. To do this the full duplex system in Figure 1 is modified as in Figure 2. All characters received from the RS232 port are queued, and whenever the keyboard, RS232 and printer are not busy a character is taken from the front of the queue and printed. As characters are added and removed the queue will move up the memory buffer allocated to it. If the buffer length is a power of two then the buffer can very easily be made circular (by logically ANDing the 'position in the queue pointer' with 2^{n-1} for a buffer of length 2^n). This prevents the queue growing without limit and perhaps overwriting the program.

Intelligent terminals

We can now make a cheap VDU-cum-teletype from a micro, but we are still far from realising the full power of the micro as an intelligent terminal. In our application we wished to use the micro as an intelligent terminal that gathered data from various experimental sensors, buffered the results on disk, and at convenient intervals sent the data to a number-crunching mainframe for subsequent processing. We also needed to retrieve the results of the processing from the mainframe and store then on the intelligent terminal's disk for examination, plotting and analysis. This meant we wanted to be able to transmit and receive ASCII files over an RS232 line without making any changes in the software in the mainframe at the far end of

Information Transfer	Computer Industry	Telecommunications Industry
Both ways at the same time	Duplex	Duplex
Both ways but not at the same time	Half Duplex	Simplex
One way only	Simplex	Channel

Table 1. Nomenclature for various types of information exchange

Protective ground	is tied to the instrument power grounds and if connected to both the DTE and the DCE they should both have the same power line ground reference.
Signal ground	is the ground reference for interface signals.
Transmitted Data	is used to send serial data from the DTE to the DCE.
Received Data	is used to send serial data from the DCE to the DTE.
Clear to send	is a control signal that indicates that the DCE is ready to receive data on the TXD line.
Data Set Ready	is a control signal that indicates the DCE is connected and prepared to receive/transmit data.
Data Terminal Ready	is a control signal that indicates the DTE is connected and prepared to receive/transmit data.
Request to send	is a control signal sent from the DTE to the DCE that indicates the DTE wishes to send something to the DEC.
Carrier Detect	is a control signal in a modem system that indicates to the DTE that a data carrier is being received from the distant modem.
Ring Indicator	is a control signal in a modem system that indicates to the DTE that a ringing signal has been received by the modem.

Table 2b Major RS232 signals — signal definition

the line. Such a system has the additional advantages that source programs and data can then be readily exchanged with other similarly equipped microprocessor systems, and that local pre- and post-processing of the results could significantly reduce the amount of mainframe computing time required.

Transmitting a file from the microprocessor system to the mainframe is straightforward. The file is read off the disk a block at a time and sent down the line and, provided the mainframe can buffer up characters as fast as they are received, no problems are encountered. If the mainframe buffer tends to fill up too soon (or it is non-existent) then the intelligent terminal program (ITP) should, after transmitting the carriage return at the end of each line, wait for receipt of the corresponding line feed (supplied by the mainframe). After the arrival of the line feed the ITP can safely assume the mainframe is ready and able to receive the next line.

Receiving a file is much more complicated because writing a block of data (say, 128 characters) to the microprocessor disk takes much more time (2-3 seconds approx) than is needed to transmit a single character from the mainframe. So, unless the mainframe can be persuaded to stop talking at the right moments, data will be lost every time a block is written to disk. To get a mainframe to pause after exactly 128 characters requires non-trivial software to be written for it; this precludes file reception on an ad hoc basis by non-programmers. Also, if a character in a block is transmitted but not received the micro will wait for ever for the 128th character of the block.

The average end user wants to be able to say 'that looks interesting — I'll take a copy of that' and then do so without needing to write fancy programs for his mainframe. Therefore the ITP must be able to buffer up more than a 128-character disk block and must be able to write to the disk only when the mainframe is not transmitting.

It is obviously asking too much for a program to decide when a mainframe is going to pause for enough time to write several kbytes of buffered dialogue to disk and to be able to make this decision independent of which mainframe it is connected to. The ITP could transmit a character meaning 'pause terminal output' to the mainframe whenever the receiving buffer is almost full and then restart the printout when the buffer is written to disk. Unfortunately the 'pause' and 'restart terminal output' control characters are likely to be different for different mainframes. Also 'pause terminal output' may not be noticed immediately, so some characters will be received after it has been transmitted; this again leaves us with the problem of deciding when the mainframe has finally finished transmitting.

To avoid these problems we decided to let the mainframe send a variable number of characters. The user examines the output from the mainframe as it is displayed on the micro-screen and decides when the mainframe has finished transmitting. The user then tells the ITP (by pressing a control key unused by the mainframe) that it is safe to write the buffer to the disk. The ITP then does so and replies with a message to the user that it is now safe to restart mainframe output. There will be an upper limit to the number of characters that the mainframe can transmit in one block, since there will only be a finite amount of space for buffer storage in the microprocessor memory.

Ideally we should give an error message when the ITP buffer is almost full. It is difficult to give a decent message such as 'The buffer is almost full' without either data loss or intermingling of received data and error message. A simpler solution is to carry on storing data in the buffer but to echo all received characters as 'bells' or '?'s.

To reduce development time we loosely based our program on a program in volume 25 of the CP/M user group library. Called '88-MODEM', this was written by Tim Pugh. It is intended for sophisticated American modems that include facilities such as auto-dialling, but it can be adapted to our conditions without too much rewriting. Communications programs such as those described above are not recommended for the novice programmer! It is often tricky to debug such programs, since if the program fails to work it may be difficult to decide what caused the fault — this is due to the complex interaction between the communications equipment and the computers at each end of the line. For this sort of program development it is often best to use a terminal or another microprocessor system in the same room to simulate the modem connection to the mainframe. This enables both sides of the dialogue to be seen simultaneously — so, for example, you can verify that characters transmitted at one end of the line are actually being received at the other end.

RS232 for fun and profit

After reading this far you should have enough information to write a user-friendly dumb or intelligent terminal program, based on the RS232 standard, for your microcomputer. In this section we suggest some answers to the questions of whether the RS232 is a good standard for inter-computer communications, and how useful an intelligent terminal program can be.

The standard has some drawbacks — chiefly because it is not being used for its intended purpose, so it cannot be followed to the letter. The use of DTR/DSR for handshaking is a good example of a necessary breach of the standard. More control lines are provided than are needed for computer serial I/O; this has the effect that manufacturers tend to select any six lines from 25.

However, RS232 is very widely used so it shouldn't take much more than a specially wired cable to connect two devices from different sources. Problems start to occur if handshaking is attempted — eg, DTR or DSR may be held permanently high even when the device is not ready to receive.

Another advantage of the RS232 interface is that it is cheap to implement, using widely available special purpose ICs such as the 8251 UART for the Z80, and it is usual for microprocessor systems to come ready equipped with one or two RS232 ports.

With an RS232 port and an inexpensive modem, programs and data can be very cheaply transferred from a micro to other micros or mainframes. In a three-minute phone call costing 12c at a speed of 1200 baud, almost 20,000 characters (about 3500 words of English) can be transferred. To send 3500 words by mail would cost at least 27c and the Post will do its best to deliver within a day or so!

One possible concern of a user of a terminal-modem-computer link might be related to the security of the transmission system. He would be worried not only about the possibility of criminal interception and modification of his data, but also about possible corruption of his data by a noisy or faulty line. For instance, say, if data terminals between various branches of a bank and the head office computer were connected using RS232 modem-like links over the public telephone network there would be at least some potential doubt about the security of the data thus transferred. A solution to this problem might involve the use of secure, dedicated land lines. In addition, sophisticated error-checking and correction codes would (hopefully) be used to ensure that only valid transactions were performed.

In this article we have tried to describe the basic elements of the serial RS232 interface. In the computer world ideas and equipment often change radically in a few years. The RS232 interface and the concept of a serial interface are embedded in the basic techniques of the computer designer. Transplanted from its original role of modem-terminal interconnection the RS232 interface now appears on almost every computer and microprocessor back panel. It is frequently the method of communication between processors and printers, plotters and other slow and medium-speed peripherals. Its popularity is based on the availability of cheap custom chips like the UART that provide most of the hardware necessary for the interface, the simple nature of the software needed to drive the interface and the small number of wires (and hence the small expenditure on cabling) needed to interconnnect interfaces.

In the future we can expect to see many more interconnection standards appear (like the Ethernet and the RS432 standards, to mention a couple). It is difficult to see how the basic effectiveness and simplicity of the RS232 interface can be improved upon for most routine applications. We expect to be typing our programs in via an RS232 port for quite a few years to come.

END

Who holds all the aces in

HiSo

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

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

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

HiSoft's opening hand

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

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

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

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

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

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St. Kilda 3182.
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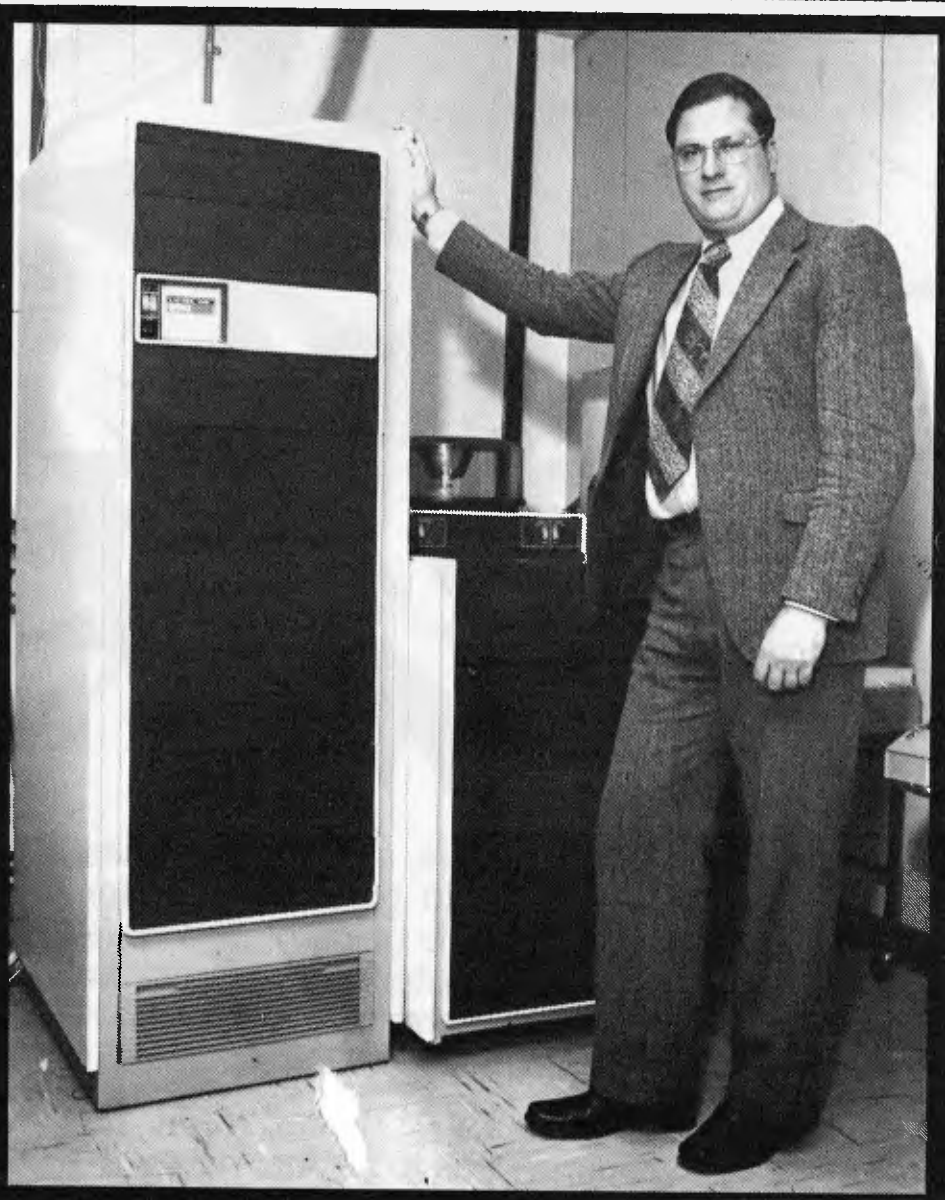
or any Authorised HiSoft dealer.

Life will never be the same
The Australian Beginning has begun!



The Australian Beginning
Computer Country Group
always on the
move forward

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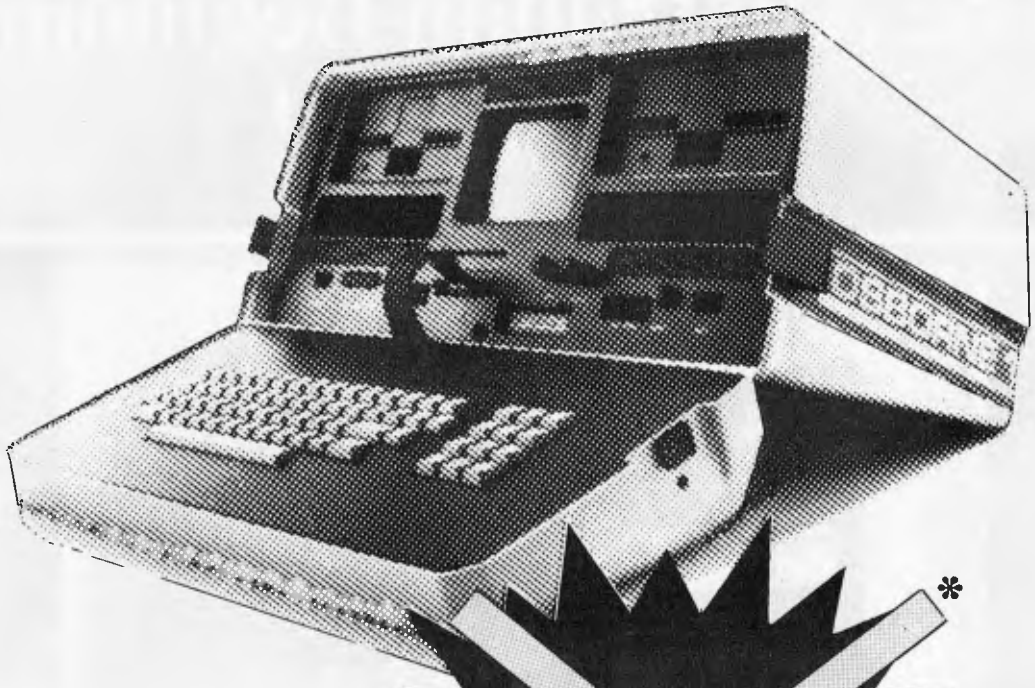

*

Your low-cost entry to computers.

The computer office is here, and those business people who are quick to grasp this modern technology are the people going places faster. And now, you can computerise **your** business with a compact high-performance machine - the Osborne 1. The computer itself offers top value.

With 5 software packages i**ncluded in that price,** the Osborne 1 has to be Australia's best value.

* SPECIAL TO APC READERS
CALL US FOR PROBABLY THE LOWEST PRICE IN AUSTRALIA

COMPUTER COUNTRY

NATIONWIDE PTY. LTD.

338 QUEEN ST
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(03) 329-7533

AUSTRALIAN BEGINNING EXPANDS THE SERVICES OF EXISTING MICROCOMPUTER AND WORD PROCESSOR OWNERS

The Australian Beginning is able to give existing owners of microcomputers and word processors a number of services at an extremely small cost. Individuals or businesses with their own computer equipment or word processor can join the Australian Beginning for a once-off cost of $100 and thereafter pay an hourly use charge of $10.00 an hour . . . 8am – 6pm during the week and $4.50 an hour . . . 6pm – 8am during the week and all day during the weekend.

The Managing Director of The Australian Beginning, Mr Gary Wayne Alpert said:

"The service we are offering is one of the most revolutionary packages available on the Australian market today. To microcomputer users and word processor users who have already invested in a system or are about to invest in a system, this represents a great opportunity.

For only a few dollars extra, computer users can substantially enlarge the capabilities of their own systems. The capability to receive hundreds and in certain cases thousands of free programs over a system is worth thousands to system owners who would otherwise have to spend substantial sums to find and buy these programs individually.

Through the Australian Beginning system, microcomputer and word processor system owners and owners of dumb terminals are able to:

1. have access to a wide variety of information sources and data banks which include such things as the news, the weather, both domestic and international airline schedules, a wide range of investment advisory services, sports and government information.

2. members have the ability to use the electronic mail function of the system to send and receive messages with hard copy if they desire, across the street, around the country or across the world.

3. have the capability to make use of the systems computer's huge storage capacity to use our many on-line application programs and put their programs on our system for disaster back up.

4. have access to a myriad of computer programs that include entertainment, educational aids, programming and diagnostic tools, and a wide range and variety of financial and business applications.

5. to take advantage of our shopping by computer system to get the best price on many consumer and business needs.

6. another interesting feature is that you can send *telex* messages through our system to any telex user and at the same time receive telex messages from other telex users.

This network is the start of the computer revolution which is giving computers to people at a price they can afford. Thus for the first time, the concept of the "home computer era" really can become a reality."

INDUSTRY TRADE BODY SUPPORTS THE AUSTRALIAN BEGINNING

Nationwide Computer Retailers and Resellers of Australia has reaffirmed its support for the Australian Beginning.

Chairman Gary Wayne Alpert said: "The feedback we have received from our computer retailers and resellers has been overwhelming in support for the concept of the Australian Beginning. It has become quite clear to the retail industry that the Australian Beginning will mean further growth for the industry as a whole as now there will be a substantial number of new computer services available to any microcomputer owner.

The Nationwide Computer Retailers and Resellers of Australia is a trade group formed for computer retailers and resellers.

The main aims and functions of this group are:

1. to act as a forum for computer retailers and their problems.

2. to act as a lobbying group with government departments to protect the interest of this segment of the Computer Industry.

3. act as arbitrators in disputes between members as well as disputes between members and non-members.

4. act as clearinghouse for overseas suppliers and local distributors looking for sales outlets.

5. act as a "certifying" body for those stores and resellers able to meet set standards. Thus enabling these outlets to present themselves to the public as companies who have met

certain business standards of a recognised trade group.

The Chairman of this group is Gary Wayne Alpert, Managing Director of Computer Country, one of Australia's largest microcomputer retailers.

For membership information, contact:

NCRRA
C/O COMPUTER COUNTRY,
338 QUEEN STREET,
MELBOURNE VIC 3000
TELEPHONE: (03) 329 7533.

AUSTRALIAN BEGINNING — NEW LOCAL ACCESS NUMBER IN SYDNEY

Managing Director, Gary Wayne Alpert, has announced that a local access number is now available to Australian Beginning users.

Now for the cost of a local phone call Sydney users are able to gain access to the Melbourne computer.

He further stated — "We plan to have similar access numbers in Brisbane, Perth and Adelaide within 60 to 90 daya. It should also be noted that when the new Telecom Auspac communications system comes on stream in the next six months all Australian Beginning members will be able to access The Australian Beginning through this new Telecom service. These steps are in keeping with our desire to keep our costs as low as possible so as many people as possible can make The Australian Beginning a part of their life."

NEW LOW COST COMPUTER PACKAGE

The Australian Beginning Pty Ltd and Sigma Data Corporation Pty Ltd have combined to offer a new cost computer package from as little as only $20 a week to enable users to avail themselves of the services of the Australian Beginning computer network.

This computer package will include:

1. an inexpensive easy to operate desk top terminal
2. an acoustic coupler
3. an Australian Beginning lifetime membership, together with a block of 60 computer hours
4. this package will be available for $20 a week over 5 years.

The Australian Beginning is Australia's first computer information service directly aimed at giving the average microcomputer and word processor user access to the computer data banks and massive storage of mainframe installations.

This system, which is being run on Data General computers is the first of its kind in Australia and will be available at a remarkably low cost.

The launching of the Australian Beginning computer in Australia is probably the most singularly important event yet to take place in this country. As for the first time, the world of huge data banks and massive computer capacity previously only available to large corporations and government departments can now be put in any home or office for less than the cost of a few dollars a day.

The Australian Beginning Pty Ltd is an associated company of the well-known Melbourne-based microcomputer importing and retailing group Computer Country.

Through the Australian Beginning system, microcomputer and word processor system owners and owners of "dumb" terminals will be able to:

1. have access to a wide variety of information sources and data banks which will include such things as the news, the weather, both domestic and international airline schedules, a wide range of investment advisory services, sports and government information.

2. members have the ability to use the electronic mail function of the system to send and receive messages with hard copy if they desire, across the street, around the country or across the world.

3. have the capability to make use of the systems computer's huge storage capacity to use our large on-line application programs and put their programs on our system for disaster back-up.

4. have access to a myriad of computer programs that include entertainment, educational aids, programming and diagnostic tools, and a wide range and variety of financial and business applications.

5. to also be able to take advantage of our shopping by computer system to get the best price on many consumer and business needs.

6. another interesting feature is that you can send *telex* messages through our system to any telex user and at the same time receive telex messages from other telex users.

An inexpensive high quality printer which can give the user "hard" copies of all messages and data is available for only another $5 a week. After sales service is provided by the national engineering team of Sigma Data Corporation in all Australian capital cities.

Mr Alpert stated:

"The availability of this new low cost equipment package is to enable the public to take advantage of the amazing services of the Australian Beginning. Without doubt this represents one of the most revolutionary events that has taken place over the last few years in this country. We believe it will make a number of fundamental changes in the fabric of Australian society.

"This network is the start of a computer revolution which is giving computers to people at a price they can afford. Thus, for the first time, the concept of the 'personal computer era' really can become a reality.

THE COMPUTER COUNTRY GROUP

One of the most powerful new microcomputers on the market which uses the 6809 microprocessor. Comes with excellent super high resolution graphics — 640 x 200 dots and has a 40/80 character x 25 lines user programmable screen configuration.

HITACHI PEACH PROFESSIONALS

STANDARD FEATURES:
ADVANCED 8/16 BIT MICROCOMPUTER TECHNOLOGY (WILL ADDRESS 1 MEGABYTE) NUMERIC KEY PAD, 10 (5 WITH SHIFT) PROGRAMMABLE FUNCTION KEYS, PROTECTED BREAK KEY, TYPEWRITER STYLE KEYBOARD, CLOCK, SPEAKER WITH VOLUME CONTROL, RF SHIELDING THROUGHOUT, 24K ROM (READ ONLY MEMORY), 32K RAM (RANDOM ACCESS MEMORY), TERMINAL CAPABILITIES, SIX EXPANSION SLOTS FOR PERIPHERALS, AND TWO FOR MEMORY (ALL WITH CLIP-IN PLASTIC DUST PROTECTORS), "MAIN FRAME" QUALITY CONSTRUCTION, SPECIAL CHARACTER GENERATION, 40 and 80 COLUMN SCREEN x 25 HORIZONTAL LINES OF TEXT, 8 BRILLIANT COLOURS, UPPER AND LOWER CASE, 640 x 200 DOT HIGH RESOLUTION GRAPHICS (ALL PIXELS BYTE-ADDRESSABLE FOR TOTAL CONTROL), TEXT AND GRAPHICS ON SAME SCREEN, **MICROSOFT COLOUR BASIC,** MACHINE LANGUAGE, FULL DOCUMENTATION, AVAILABILITY TO **THE AUSTRALIAN BEGINNING** DEMONSTRATION SOFTWARE PACKAGE (ON CASSETTE OR DISKETTE) WITH GAMES, GRAPHICS, PHONE/MAIL SYSTEM, ETC, CONNECTIONS FOR RS232, "CENTRONICS", LIGHT PEN, AUDIO, MONOCHROME VIDEO, COLOUR VIDEO, CABLES FOR CASSETTE DECK AND VIDEO, CP/M, FLEX, AND OS-9 SOFTWARE AVAILABILITY, AND MORE . . .

COME TO
COMPUTER COUNTRY (NATIONWIDE) PTY LTD

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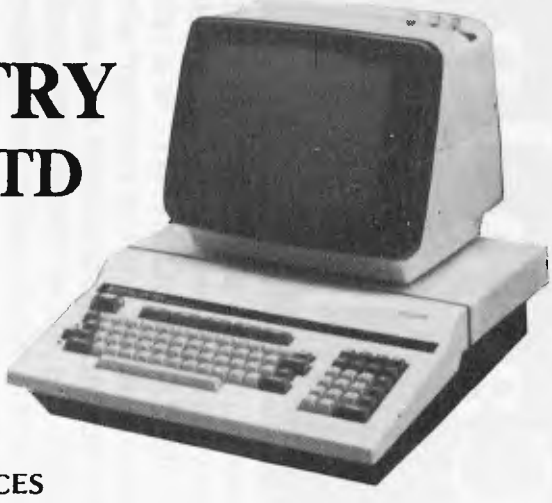

*** CONTACT US FOR PROBABLY THE LOWEST PRICES ON HITACHI COMPUTERS IN AUSTRALIA**

Cash In On Explosive Growth. Join Computer Country.

Now you have a chance to get your share of the explosive growth of the microcomputer industry.
"COMPUTER COUNTRY" is a retail microcomputer showroom marketing concept which offers a wide range of microcomputer products and accessories designed to satisfy the requirements for small business management, personal use as well as educational and scientific applications.

Already one of the fastest growing companies in its field in Victoria.
COMPUTER COUNTRY is now ready to expand further via the area franchise method. Exclusive area franchises are now available for many parts of Australia.

FRANCHISE HOLDERS WILL RECEIVE:

(1) A broad, full line inventory of small business and personal computer products.
(2) National and local advertising support.
(3) Complete technical and management back-up.
(4) Assistance with finance.
(5) Aid on site selection, staff training and store management.
(6) The right to market exclusively made-for-Australia software packages.
(7) Exclusive area franchises.

To qualify you do not need an in-depth knowledge of computers, just a strong desire to succeed in the business world.

A COMPUTER COUNTRY area franchise is a unique and rewarding venture in a highly dynamic and rapidly expanding field. It is more than a business, it represents an innovative approach to conventional problem solving.

Of the people you know today, probably very few can operate a computer right now. Yet, in the not too distant future, computer operation will become a basic element in day-to-day functions for anyone who works, plays or studies. As a COMPUTER COUNTRY area franchise, you can participate in the huge growth that is only around the corner for the microcomputer industry.

You can create for yourself more than just a successful business but a very valuable asset that will grow as you, the microcomputer industry and Australia grows in the 1980s.

CALL THE MANAGING DIRECTOR NOW BEFORE YOUR AREA IS TAKEN

Apply to Computer Country (Nationwide) Pty. Ltd.

Come to
COMPUTER COUNTRY

338 QUEEN STREET, MELBOURNE, VIC., 3000
Tel. (03) 329 7533

CMS 9615 H

"It is no longer a question of a businessman or individual owners asking should he go on a system like this. It is a matter of he cannot afford not to."

COMPUTER SPECTRUM OPENS IN WOLLONGONG

Now Computer Spectrum offers Wollongong and surrounding areas one of the largest ranges of computers in Australia.

Through its affiliations with Computer Country and The Australian Beginning, Computer Spectrum can now offer its customers brand names like Hitachi, Commodore, Osborne, Atari, CEC, Casio, NEC, CED and many more.

Brian and Val Walters the proprietors of Computer Spectrum are now able to offer bright, friendly and comprehensive advice and after sales support, as well as probably the lowest prices in the area on most of the items they offer.

Whether you are just a beginner and are confused with what computer to buy, or you are an experienced computer buff who wants the professionalism you deserve, you will find Computer Spectrum is the only place you will ever need for all your computer needs.

The Managing Director of Computer Country and The Australian Beginning says, "We are extremely pleased to have Computer Spectrum as part of the Computer Country family. Brian and Val Walters have the enthusiasm and professionalism that we demand of anyone associated with us. We fully support Computer Spectrum."

For further information call
Brian and Val Walters.
Computer Spectrum.
14 IMB Arcade,
110-116 Crown Street,
Wollongong, NSW 2500.
Telephone (042) 27 1666

COMPUTER DEALERS IMPROVE YOUR BOTTOM LINE, ADD AUSTRALIAN BEGINNING MEMBERSHIPS TO YOUR STORE

The addition of The Australian Beginning memberships can nicely round out the sale of a system.

The Australian Beginning will make your customer happy and help insure repeat business and referral of other prospective customers.

The addition of any communications package (acoustic coupler, etc.) will enlarge your gross profit as well.

A very handsome remuneration and many extra benefits are available by joining The Australian Beginning team.

Don't be the only computer store in your area not selling The Australian Beginning.

Full audio visual and point of sale material (video tapes, etc.) are available.

Join The Australian Beginning team now.
Call the Managing Director.
The Australian Beginning,
364 Latrobe Street,
Melbourne, Vic 3000
Telephone: (03) 329 7533

COMPUTER COUNTRY

Computer Country was started by Gary Wayne Alpert in Victoria almost three years ago when the microcomputer was just in its infancy.

Computer Country has now grown to be one of the dominant forces in what has become one of the fastest growing industries in Australia.

The Computer Country group distribute one of the largest ranges of microcomputers in Australia. We are either distributors of or dealers for one of the largest range of products including Apple, Hitachi, Osborne, NEC, Casio, CEC, Texas Instruments, CED, Soroc, OKI, Adds, Dataproducts, Epson, Micro Sci, Electro Med, Star, 3M and many more.

Gary Wayne Alpert stated, "The Computer Country group of companies are considered by many as one of the few professional companies in the computer retail industry.

In the past it has been very fragmented, and full of small companies with very little capital and no indepth broad-based management.

Computer Country not only offers users probably the lowest cost price but just as important also offers them complete after sales service and advice and support which we believe to be the best in the industry."

TELEX THROUGH THE AUSTRALIAN BEGINNING

The Australian Beginning has now announced that it will be providing to its members a service whereby they can send out Telex messages to Telex owners by going through the Australian Beginning. They can also receive Telex messages through the Australian Beginning network system.

Mr Gary Wayne Alpert stated: "This represents another breakthrough for the Australian Beginning. We believe that a large number of our members will now make substantially more use out of the telex network now available in Australia. Many small businesses and individuals cannot justify the cost of installing and renting a telex machine when they are only sending and receiving a few telex messages a month. We believe the inclusion of this new telex feature through our service will mean our members will send and receive many more telexes than ever before. Now a member of the Australian Beginning network will only need to type in his messages on a microcomputer like an Apple or his own word processor or even a terminal such as provided under our special '$20 a week' package and he will be able to send a telex. It should be noted that we do not make any additional charge for this service (other than normal Telecom charges). It is all included in our normal service charge.

"This is just another example of the Australian Beginning giving its members a range of services to give them more value for less money."

AUSTRALIAN BEGINNING ANNOUNCES NEW STOLEN PROPERTY REGISTER

As of 1st October The Australian Beginning will be instituting its new stolen computer property register for its members.

Australian Beginning members will be able to list any items they have had stolen and their serial numbers on our stolen property data base.

We will be working closely with computer distributors, computer retailers, computer service centres, insurance companies and police departments to insure the widest possible circulation of this list of stolen items.

As most computer items require servicing of one type or another at some time and because there are only a limited number of service centres in Australia, we feel that a data base like this will make it easier to be on the look out for these items and thus a thief may think twice before stealing a microcomputer.

Managing Director, Gary Wayne Alpert, noted, "I know what a traumatic experience it can be to have a microcomputer stolen — if we can deter only one theft it will be worth it."

COMPUTER COUNTRY BUSINESS OPPORTUNITY

Computer Country now announces an all new expanded Franchise program.

It is now possible for you to have your own local computer showroom open and running within six weeks.

If you are tired of your job or the business you are currently in and want to become part of Australia's most exciting and fastest growing industry — microcomputers — then Computer Country's area Franchise is probably the answer.

Through our Franchise program, you are able to take advantage of Computer Country's experience, contacts and product sourcing abilities to help you get into the microcomputer industry virtually overnight.

Through our program, Franchise holders receive:

1. A broad, full line inventory of small business and personal computer products.
2. National and local advertising support.
3. Complete technical and management back-up.
4. Assistance with finance.
5. Aid on site selection, staff training and store management.
6. The right to market exclusively made-for-Australia software packages.
7. Exclusive area franchises.

It should be noted that while computer knowledge is helpful, indepth knowledge of computers is certainly not necessary to qualify; what is necessary is a strong desire to succeed in the business world and to create a valuable asset for you and your family.

Franchises are now available in virtually every area of Australia. This could be the opportunity you have always dreamed of — to make a change in your life and to become the winner you have always wanted to be.

CASH IN ON EXPLOSIVE GROWTH.

JOIN COMPUTER COUNTRY.

Australian Beginning 'SPOTLIGHTS' these fine products

PEACH MICROCOMPUTERS

The Peach has come a long way since it was first launched almost 12 months ago.

The Peach encountered difficulties with disk drives and software not becoming available as fast as the distributors would have liked. However, the wait has been worth it, as now Delta have really got their act together.

The Peach represents an excellent piece of hardware now that Hitachi has an excellent pair of disk drives to match its CPU and now that substantial software is becoming available.

The Peach Microcomputer system is now extremely good value for the money.

THIS PRODUCT IS AVAILABLE FROM COMPUTER COUNTRY

EAGLE COMPUTERS

The Eagle range of computers represent an exciting new entry into the microcomputer arena in this country.

The Eagle range includes five computers of varying storage capacity, matched with a comprehensive range of business software.

The range starts with the Eagle I ($5,995 including sales tax) which has 64K internal memory with single sided double density drives (390K) standard. With the hardware comes C-Basic, CP/M and Spellbinder word processing.

The top of the range Eagle V ($11,995 including sales tax) has 15 megabytes of hard disk and has Spellbinder word processing and Accounting Plus, a very comprehensive accounting package.

The exceptional design of these systems, coupled with their competitive pricing and backing by the extremely professional SCOMO Pty. Ltd. group of Sydney, ensure these systems represent extremely good value.

THESE PRODUCTS ARE AVAILABLE FROM COMPUTER COUNTRY

CASIO FX 9000P

Now a true low cost desk top microcomputer is available — the FX 9000P made by the world famous Casio group.

A completely integrated unit which includes a 5 inch CRT, built in Alpha-numeric keyboard and numeric key pad. A 16K ROM pack is also available as well as Add-on disk drives.

A great low cost microcomputer for a beginner who wants expandability later on.

This wonderful machine comes with virtually everything built in for only $999 plus sales tax.

THIS PRODUCT IS AVAILABLE FROM COMPUTER COUNTRY

DEALER ENQUIRIES INVITED

HI-SOFT PEACH SOFTWARE

Now a great combination — sophisticated business and commercial software which takes advantage of the Peach's excellent colour graphics.

The Hi-Soft Group is quickly becoming well known throughout Australia as true software professionals.

If you liked the Peach and were waiting for software good enough to match the excellent hardware of the Peach — your wait is over.

Hi-Soft now offers Hi Finance, a fully comprehensive business package designed for Australia; Hi Writer — a professional word processing package incorporating full mail merge capabilities; Pro-Calc — a sophisticated spread sheet utilising all the Peach's best features and Data Base an easy to use package offering sophisticated report generators.

And big new things are coming from Hi-Soft. An extensive real estate package and very professional medical package are expected to be released in October.

ALL THESE PROGRAMS ARE AVAILABLE FROM COMPUTER COUNTRY

AY SYSTEMS — PLANFIN AND PROFIN FOR THE APPLE

If you have been waiting for an easy to use "spread sheet" software package for your "what if" calculations — Planfin and Profin are for you.

Planfin is designed to enable managers to produce forecast and budgets for their businesses without any prior knowledge of computers.

The authors — AY systems — say you can actually use the software and print out reports within five to ten minutes after reading the manuals — it is so simple to use.

We have tried it and AY is right — Planfin is very simple to use and does the job.

Profin, its brother package, is designed for feasibility evaluation of capital projects and while it is a bit more expensive ($495) versus ($299) for Planfin, it really represents good value.

Both software programs are supplied by AY systems — an associated company of the international accounting firm, Arthur Young and Associates.

THESE PROGRAMS ARE AVAILABLE FROM COMPUTER COUNTRY

MOUNTAIN VALLEY SOFTWARE — TRS-80 SOFTWARE

Mountain Valley software is one of Australia's newest and most dynamic software companies, specialising in software for the TRS-80 and System 80. Their range includes adventure games, superterm — a dumb terminal program and a test and grading program for schools.

Mountain Valley Software programs are available through the Electronic Shopping facility of The Australian Beginning and from Computer Country stores.

ALL THESE PROGRAMS ARE AVAILABLE FROM COMPUTER COUNTRY

NORTHSTAR ADVANTAGE

The Northstar Advantage is an interactive integrated computer system which can supply a business with business data, word processing or scientific data with processing capabilities, and both character and graphics output.

Advantage is fully supported by Northstar's wide range of system and application software.

Two exciting new products are now being added to the Northstar Advantage which will substantially increase its attractiveness. First, a board which will make a Northstar Advantage a 16 Bit machine, as well as 8 bit machine which allows the user to have a complete upgrade path as required. And second, "Northnet" a local area in network system that can interconnect 64 work systems.

It is products like these that show the Northstar — which on one hand is one of the oldest veterans of the microcomputer industry — will continue to remain in the forefront of technologcial advance because of Northstar's continuing committment to research and development.

ALL THESE PRODUCTS ARE AVAILABLE FROM COMPUTER COUNTRY

3M WHISPERWRITER

An interesting new product from the 3M group is the new Whisperwriter.

A low cost tele printer that has full portability with its own carrying case and comes complete with its own acoustic coupler.

Perfect for checking for Electronic Mail messages on The Australian Beginning or sending reports direct to head office.

Naturally, the Whisperwriter is supported by the national 3M group Australia wide.

THESE PRODUCTS ARE AVAILABLE FROM COMPUTER COUNTRY

SERIAL COMMUNICATION CARD FOR THE APPLE MICRO-COMPUTER

The Australian Beginning now has a perfect new inexpensive ($189 excluding tax) Serial Communication Card for the Apple microcomputer.

Perfect for use with The Australian Beginning and other networks.

Your chance to save dollars and still get a first class product.

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DEALER ENQUIRIES INVITED

OTRONA

Portable computer power is what Otrana is all about.

It comes with 64K internal memory, a CRT and 2 disk drives all in a very handsome package.

Standard software, includes CPM, Wordstar plus (word processing software), Basic 80 (a sophisticated version of Basic) and Charton (a graphic package).

The Otrona package is not cheap at a price of $4,500 plus, but as professional quality is worth paying for — you should look at the Otrona.

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MICRO SCI DISK DRIVES FOR THE APPLE

Quality disk drives are available for the Apple that give you value for your money.

There are three models of Micro Sci drives.

A2 — These drives are 143K and are fully compatible. As they are less expensive than their Apple equivalent they represent great value for their money.

A40 — These drives are 160K versus 143K for the standard Apple drives and are slightly less expensive than their Apple equivalent.

A70 — These drives are 286K per drive and while they are somewhat more expensive than standard Apple drives they still give you good value for your dollar as only two A70 drives give you over half a megabyte of floppy power.

THESE PRODUCTS ARE AVAILABLE FROM COMPUTER COUNTRY

DEALER ENQUIRIES INVITED

NEC PC 8000

The NEC PC 8000 is distributed by Hanimex in Australia.

The CPU comes standard with 32K internal memory, five full function keys, in built calendar clock, in built parallel and serial ports, numeric key pad and RGB colour capability and starts at a price of $1,395 excluding sales tax.

This represents good value on a comparative basis.

Also available are two disk drives (160K each), an expansion chassis with 32K and seven additional ports, and an excellent dot matrix printer, the PC 8023. The PC 8000 runs on NEC DOS and also CP/M. Accordingly, most of the standard CP/M library software is available.

A colour monitor for the PC 8000 is also available and shows up the colour capabilities of the PC 8000 quite nicely.

THIS PRODUCT IS AVAILABLE FROM COMPUTER COUNTRY

3M MEDIA PRODUCTS

3M Scotch brand products are for those who know that their data is too important to lose.

We use it for our work in The Australian Beginning because we know it is better to pay a bit more than to lose your data.

3M has a large range of Media products which go from diskettes and hard disk packages to personal computer tapes, head cleaning kits and anti-static mats.

Quality is what 3M is famous for and we unreservedly recommend 3M Scotch brand products as good value for your money.

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A big powerful machine at an affordable price.

A very attractive sexy looking business machine that is built to work hard.

The CEC has 64K internal memory, expandable to 256K and 2½ megabytes floppy disk storage.

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MACLAGAN AND WRIGHT

MacLagan and Wright are well known to Apple owners as one of Australia's most innovative board design teams.

Under their brand name "Digicard" the MacLagan and Wright team have released a number of cards for the Apple which include a Pal Colour Card, a 16K RAM board and the latest, an 80 Column Card.

Pal Colour Card — A cost effective card with a number of interesting features which include an on-board video modulator which removes the need for a separate video modulator or a special colour monitor.

16K RAM Card — A low cost 16K board which because it draws only 75 MA from the 5 volt Apple power supply, allows it to run cooler.

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IS THE AUSTRALIAN BEGINNING DEVELOPING A "CULT" FOLLOWING OVERSEAS?

A number of enquiries from outside Australia including the U.S. have arrived at Australian Beginning headquarters.

Following these enquiries, The Australian Beginning sales team has learned that being a member of The Australian Beginning is now becoming something of a status symbol for overseas computer owners.

Managing Director, Gary Wayne Alpert, reports that, "I already knew our Australian members believed in The Australian Beginning with almost something of a religious passion and that belonging to our network is becoming an important part of their lives. However, I did not realise our message had reached overseas to the extent it has so far. I have now learned from my contacts overseas that in certain parts of the U.S., a number of people consider the membership of The Australian Beginning as an "in" thing as these people feel that while "anybody" can be a member of certain "other" computer data banks very few of their friends would actually be a member of The Australian Beginning network."

THE AUSTRALIAN BEGINNING GOES OVERSEAS

The Australian Beginning is now in the process of becoming the central network in a network of networks all over the Pacific Basin.

A New Zealand "Beginning" complete with New Zealand data banks and an Auckland access phone number is scheduled to be up and running before Christmas this year.

Talks are presently being conducted with groups in Hong Kong, Philippines, California, (U.S.A.) and Thailand. In each case, local marketing and administration will be conducted by a local group of residents in the area with a local access number and a resident computer installation.

Managing Director, Gary Wayne Alpert, reports, "It is quite clear that the microcomputer revolution is now expanding outside the U.S. at an explosive rate. We aim, as always, to be in the forefront both technologically and marketing-wise. The Australian Beginning will become the lynchpin of a network of networks outside the States."

SALES REPS WANTED

The Australian Beginning is looking for full or part time sales reps to assist in marketing its special "$20 a week" terminal package for both business and home users.

Positions are available in every capital city for individuals to join an aggressive sales team.

You will receive complete training on our system. No technical knowledge on computers is necessary as the instructions are in every day English and meant for non-computer experts. Generous commission schedules, full backup support and a healthy supply of leads should ensure a very high level of remuneration for all those concerned.

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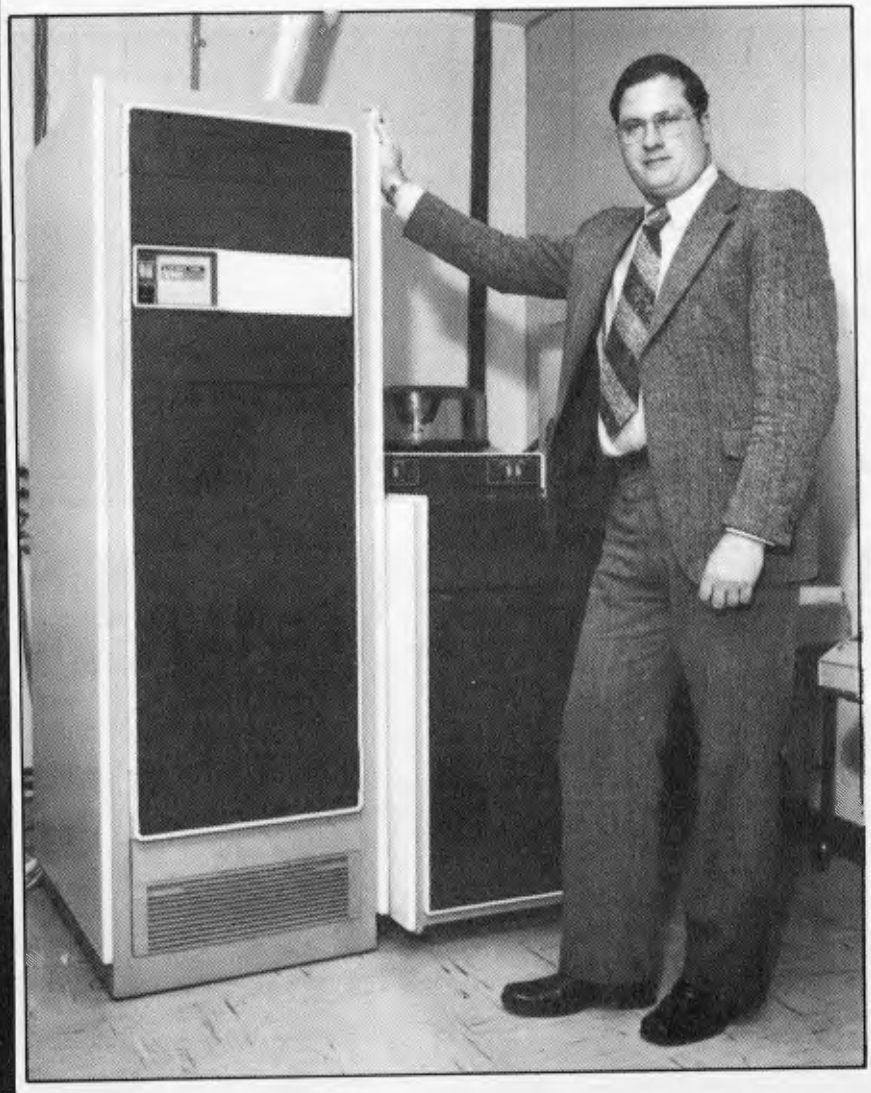

Gary Alpert
Managing Director
Australian Beginning.

Scotch Diskettes are the diskettes you can depend upon with the information your business depends upon.

Each one is tested and certified error-free before it leaves our factory. Because we know nothing less than perfection is acceptable for your vital business data.

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ELECTRONIC MAIL

The Australian Beginning now offers full electronic mail features to its members to communicate with each other.
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Electronic mail can be useful in a multitude of situations whether it be for communication between branches of the same company or allowing customers of a wholesaler to place orders.

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Enquiries are invited from existing information providers as well as those interested in becoming information providers for computer data banks.
Contact Mr Gary Wayne Alpert

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1 Electro-Med Sendata 700 0/0 Acoustic Coupler 1 Serial communication card
1 Communication software package for the "Apple"
(Allows you not only access to The Australian Beginning, but also to upload and download files and programs.)
1 AUSTRALIAN BEGINNING MEMBERSHIP

ONLY $480.00 PLUS 20% SALES TAX APPLICABLE
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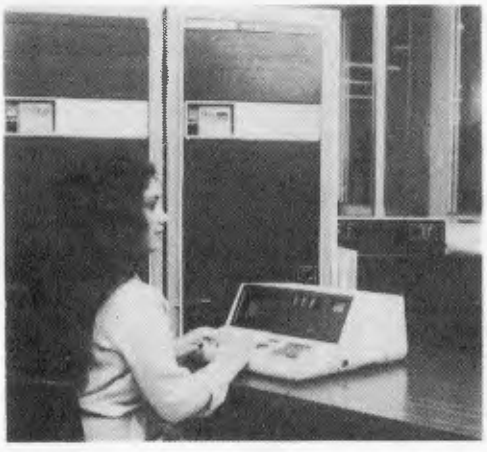

THE AUSTRALIAN BEGINNING PTY. LTD.

The Australian Beginning Pty. Ltd. is an Australian company, with Australian based computer facilities, using the Australian Telecommunications network to offer Australian clients Australian information services and software.

WE ARE PROUD TO ANNOUNCE THE LAUNCHING OF AUSTRALIA'S FIRST MICROCOMPUTER INFORMATION UTILITY

The AUSTRALIAN BEGINNING is Australia's first microcomputer information utility, aimed at giving the average microcomputer user access to the computer data banks and also massive storage space previously only available to large Mainframe installations. The era of home computers has now officially begun in Australia now that the AUSTRALIAN BEGINNING is here; as now, any small businessman or student can have on his desk for an extremely small cost, a system that has the level of storage power and access to data banks for which only a few years ago, government departments and large private users were paying millions of dollars.

The AUSTRALIAN BEGINNING can be accessed through a number of 'approved' personal computers, and terminals, by use of an acoustic coupler or modem.

Users receive a number of benefits which include:

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Members have access to a number of information sources which will include the latest news, sports results, financial reports, and farm information.

ELECTRONIC MAIL

Members are able also, to communicate nationwide with other AUSTRALIAN BEGINNING members through our system.

THE AUSTRALIAN BEGINNING RECOMMENDS 3M DISKETTES

SOFTWARE BANK

Users have access to a myriad of computer programs that will include entertainment, education aids, programming and diagnostic tools, and financial applications.

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Users have the capability to make use of the Mainframe's huge storage capacity by using any of our large programs on our system.

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You can take advantage of our 'shopping by computer' system to get the best prices on a number of popular consumer items.

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You do not have to be a computer programmer to make use of the AUSTRALIAN BEGINNING. All of the instructions are in everyday English, so that even the younger members of your family will be able to operate the,system.

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While services like these used to cost tens of thousands of dollars to the government departments and large corporations who used them, they are now available to you for less than the cost of a packet of cigarettes a day for the 'average' user.

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☐ *I am interested, but I need more information.*

DEALER INQUIRIES INVITED

P FOR PERFECT?

Sue Eisenbach and Chris Sadler continue their look at the UCSD p-System.

Part 2 The p-System

Programmers and others could be forgiven, after reading last month's article on the UCSD p-System, for believing that there was more to an operating system than the fact that it could run on almost every disk-based microcomputer system commercially available and that it offered a reasonably comprehensive catalogue of applications packages. They would be concerned with the quality (and scope) of the 'program development environment' offered by the system, and it is this which we hope to cover in this article.

On the p-machine, access to the processor and the memory is achieved by submitting p-code programs to the run-time system. A program development environment, however, must provide a means of producing these p-code programs and this is normally done through a language translator which produces the p-code program from a source program written in a high level language. In turn, an editor is required in order to produce the source program.

The elementary building blocks of the p-System program development environment comprise:
SYSTEM.EDITOR — to create source program;
SYSTEM.COMPILER — to create p-code program;
SYSTEM.LINKER — to include any code required from the library;
SYSTEM.INTERPRETER — to execute program.

In addition, a command interpreter (called SYSTEM.PASCAL) is needed to accept the user's commands and initiate the necessary action (as well as providing run-time support). The basic program development sequence is illustrated in Figure 1.

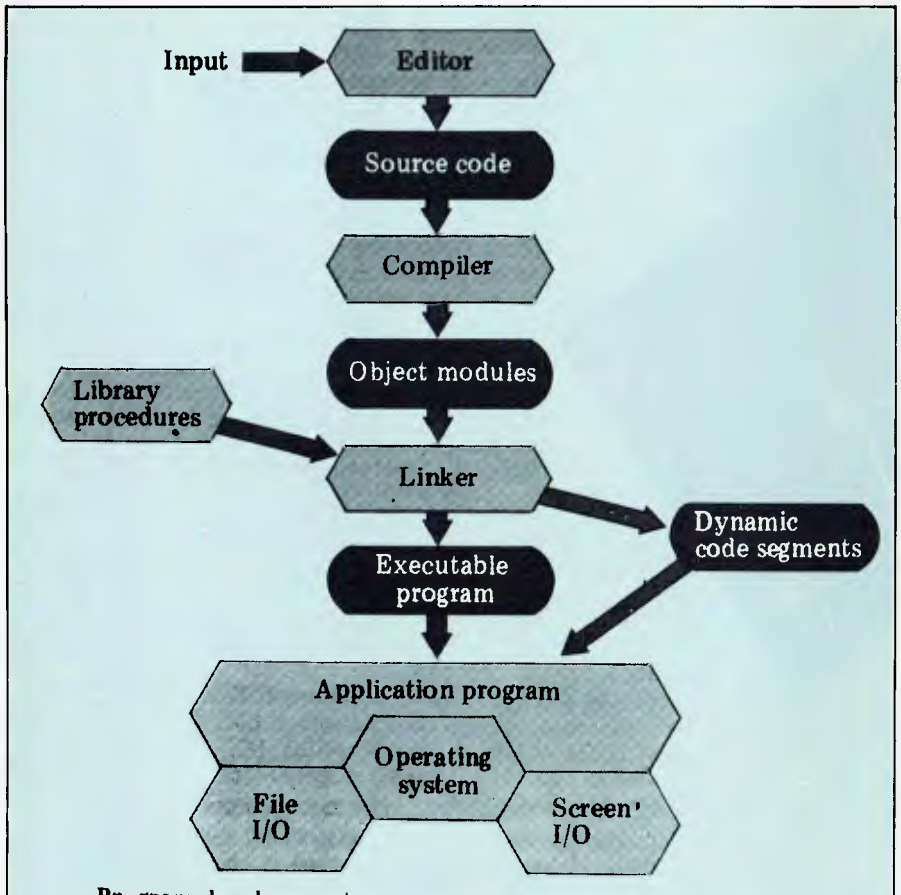
None of this can occur without accessing the backing store (disk subsystem) on which the system programs and the source and code files are stored. In order to make things easy for the user, the concept of a system workfile has been adopted for the p-System. The user nominates a particular source file as the system workfile and thereafter any requirement for access to a file uses the default name SYSTEM.WRK. This minimises the amount of typing required during program development. In fact once the program is entered, the compile-link-execute process is so automatic that an additional command R(un is provided which performs all three in sequence if required and whatever is necessary if not (see Figure 2). When a syntax error is encountered by the compiler the user is offered the option of transferring directly back into the editor, continuing with the compilation or returning to the main command line.

The administration of files on the disks, of the disks themselves and the interchange of files between peripherals, are all handled by a utility called SYSTEM.FILER. Other tools include a native code assembler and a p-code debugging program. Also available at the highest command level are functions which reboot the system, reinitiate the previous program (without having to reload from disk), or halt the processor. The promptline looks like:
Command: E(dit, R(un, F(ile, C(ompile, L(ink, X(ecute, A(ssem, D(ebug ? while typing "?" brings up:
Command: H(alt, I(nitialize, U(ser Restart, M(onitor.

Where necessary, utilities (notably the FILER and EDITOR) have their own promptlines which work in the same way and facilities exist for users to incorporate promptline and command interpretation features into their own application programs.

The Xecute program provides a few shortcuts around the system allowing last-minute changes to the environment before a program is executed. Following the prompt 'Execute what file?' the system will accept a series of different commands in addition to the name of the program to be executed. This is as close as the p-System gets to 'command-line' arguments which are employed in other operating systems. The command P=⟨volumename⟩ allows the prefixed (default) volume name to be set or altered, while L=⟨filename⟩ causes the default library text-file name to be changed. The most powerful commands at this level, however, are those which give control over program and system I/O. Thus PI=⟨filename⟩ directs the program to expect its input from the named file while PO=⟨filename⟩ sends program output to the named file. This is a fairly ordinary facility but the p-System goes further.

Firstly, the command PI=⟨string⟩ will cause the given string to be passed to a scratch buffer from where it will be passed to the program at the appropriate moment. Furthermore the command I=⟨filename⟩ or ⟨string⟩ will cause the string or the contents of the file to be passed direct to the operating system for processing before program execution begins; while O=⟨filename⟩ sends system output (eg, error messages) to the named file. The I=⟨string⟩ command is particularly powerful since it grants access to all the system commands to set up the program's run-time environment. In conjunction with the main-line M(onitor command, however, the I=⟨filename⟩ command is the most useful, since a sequence of commands entered



Program development sequence

Fig 1

under the control of the Monitor will automatically be stored in a filename which can be used subsequently to ensure that the program's environment is consistently set up. This is the p-System equivalent of using SUBMIT under CP/M.

Since the p-System is not tied to any hardware it can be run on almost any disk-based system. This machine independence is achieved by means of three devices: first, there is the p-code interpreter which dynamically translates each p-code instruction into its actual machine equivalent. This program is loaded into the system at bootup time and runs the whole time the system is up except during the execution of machine code segments. Second, there is the Basic Input Output System (BIOS) which connects the p-System's logical devices (the console, disk volumes, printer, modem line) to the corresponding physical devices on the actual system. Finally, there is a file called SYSTEM.MISCINFO which the system refers to when communicating with the user's terminal. The information which it contains is specific to the particular terminal and this file had to be created by executing a program called SETUP. By using this information together with a user-supplied procedure called GOTOXY the editor can offer full screen editing facilities on any cursor-addressable terminal and is thus also device independent.

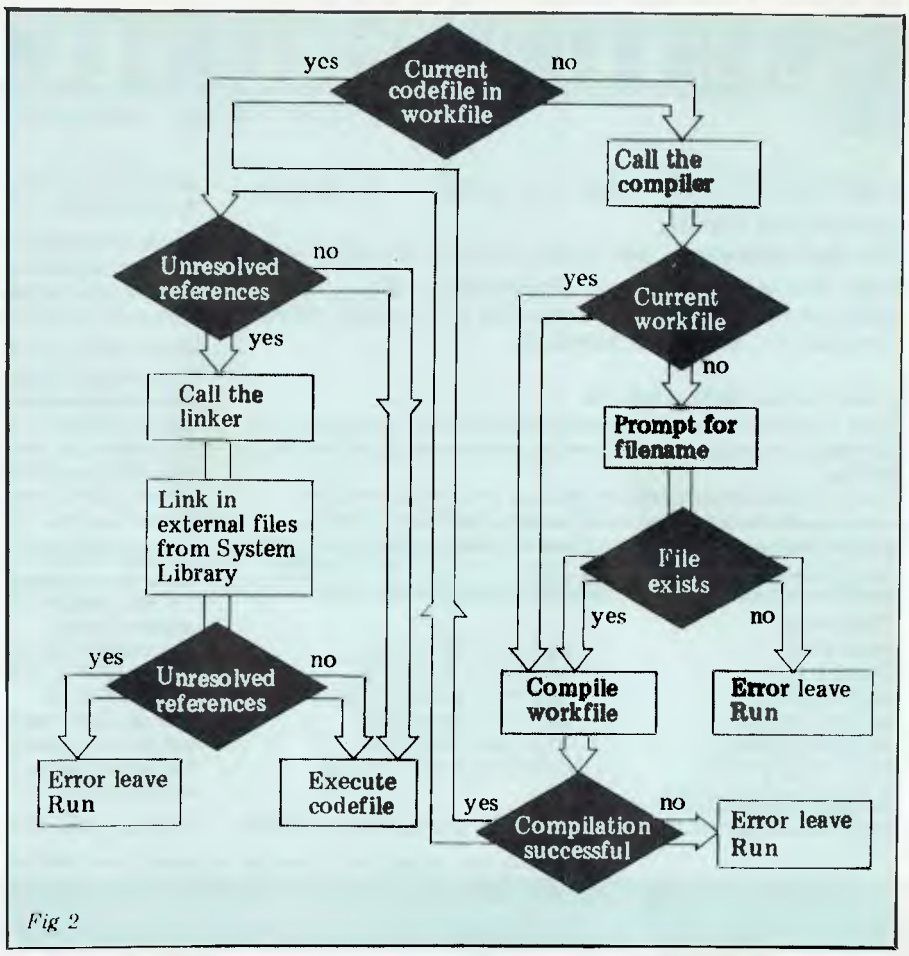


Fig 2

The editor

Typing E to the top level command line invokes the program called SYSTEM.EDITOR. The p-System comes with a choice of two candidates for this position — YALOE (yet another line oriented editor) and the screen editor. Either editor automatically reads in the current work file when entered and will either update the current workfile or any named file upon exiting.

YALOE is a line-oriented editor based on Digital's RT11 editor (ESC ESC is required to get a command accepted). It contains a reasonable number of features (including a macro facility) but is not particularly easy to use (it's similar to CP/M's ED). YALOE was the editor for the first UCSD system and is currently only used when the p-System has not been set up for a specific VDU.

Far more widely used is the screen editor. It is equally easy to use for either program or text files, responding to commands from a prompt line as well as the cursor keys. Unfortunately not all the commands are on the prompt line. (Any file to be edited contains a file header with easily alterable information about the file's environment).

For program files there is an auto-indent mode which, upon pressing carriage return, will put the cursor immediately below the first character on the line above — so that the user has to indent just once while typing in a block (and then backspace when the block is completed) rather than on every line. To aid good layout further there is an Adjust command which allows the user to move whole blocks of text a few spaces left or right very easily.

An impressive feature of the screen editor as an aid to program development must be the tie-in with the compilers. The typical programmer will want to move rapidly between the compiler and the editor while the syntax errors are being ironed out of the source code. On detection of a syntax error, the p-System compiler offers the option of returning directly to the editor, which, if taken, delivers the source code back on the screen with the cursor at the point where the error was detected and the particular error message on the top of the screen.

For text files auto-indent can be turned off and line filling on. Margins can be set as well as tab stops and paragraph margins. K(olumn will shift columns left or right while M(argin will reformat a paragraph between new margins. A text formatter is still required if justification or pagination is required.

Most commands (including I(nsert, d(elete and eX(change) can be completed with 'accept' (usually CTRL-C) or 'ignore' (usually ESC). Whether a command is accepted or ignored it fills up a buffer which can be copied out anywhere in the file. Some commands can be undone with Z(ap.

It is easy to move around the file by using the cursor keys (20↑ will move the cursor 20 lines up). Alternatively, one can jump to the beginning of the file, the end of the file or user pre-set markers, or one can page forwards or backwards one screenful at a time.

We have used the screen editor extensively and have found it a major aid in both program and text development. Of course there are some features we would like included that aren't there. One major gripe is that it can only work on files small enough to fit into main memory (about 15k on our LSI II) — which is an irritation for people who regularly produce 4000 (about 25k) word articles. Version II had a version of the screen editor for large files called L2, but this was full of bugs and has been dropped in Version IV. Another company, Volition Systems, sells a large screen editor (the Advanced System Editor) which is upward compatible with the p-System editor. This can cope with large files and also features facilities for macros, nested edits and some extra editing commands.

The filer

The filer is a collection of utilities which deals exclusively with disk housekeeping. Some deal with the disk as a whole, ie, as a volume or peripheral device, while others treat the disks at file level. File names can be up to 15 characters in length including an optional extension separated from the rest of the filename by a '.'. Some standard extensions are:

.TEXT — for a file produced by the editor.
.CODE — for a file produced by a compiler or assembler
.DATA— for a datafile produced by a user's program or by the system
.FOTO — for a disk image of the graphics screen (if available)
.BAD — for a file generated by the disk-scanning utility Examine.

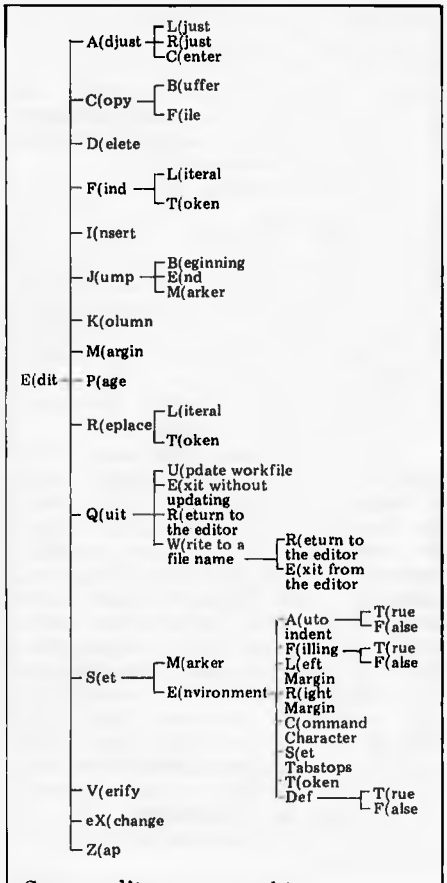
System files are all prefixed by 'SYSTEM'. Filenames should not contain the characters '=', '?', ':', or ',' as these have special meanings during file-handling operations. Unfortunately the rest of the system (eg, the editor and translator) allow the user to create file names containing special characters which are quite difficult for the filer to manipulate.

Although the filename extensions are

optional for the user, when generated by the system, as described above, they tend to denote different file attributes. For example TEXT files are equipped with a header which contains information used by the editor. Other utilities cope with this header while manipulating the file — eg, it will be copied from disk to disk but not listed on the lineprinter. Text files generated by user programs on the other hand (ie, DATA files) will be improperly accessed by the editor, although the header can be forced on the file from within the user program by explicitly naming it with the .TEXT extension.

Disk drives have device numbers while the disks themselves have volumes (up to seven characters). This brings disk volumes into line with the other 'volumes' on the system which have both device numbers and symbolic names as shown in Table 1.

The system disk can be referred to by its user name, by its device number (4:) or by the shorthand symbol '*'. Similarly, on bootup, the System disk is also the default disk although it is possible to change this to the other drive. The symbol '=' is used as a wildcard to represent 'all' instances, so = .TEXT means all text files.D = will refer to all files beginning with 'D' and '=' simply means 'all files'. The symbol '?' has the same meaning as '=' except that the system will stop and confirm each operation on each file. It is possible, for example, to pass through a disk directory selectively deleting files. The symbol '$' is a repeater which stands for the current disk or the previously defined file identifier — provided it appears within the same command. Finally the ',' serves to separate a series of named



Screen editor command tree

files on which the given function should act.

The filer promptline takes up three lines on the screen (although only one is shown at any time) as follows:
Filer: G(et, S(ave, W(hat, L(dir, R(em, C(hng, T(rans, D(ate?
Filer: Q(uit, B(ad-blks, E(xt-dir, K(runch, M(ake, P(refix, V(ols?
Filer: X(amine, Z(ero

In general the filer expects the user to select one of these options and will then prompt for file names and other information not already given, double-checking before doing anything destructive (like deleting a disk directory). For this reason, the type-ahead buffer is frequently suspended so that the user cannot get too far ahead of the action. This scheme of prompting is doubtless a bit slow for expert users, especially when used on small implementations of the p-System, but it has the great advantage that it is very easy for the beginner or infrequent user and it is almost never necessary to consult a manual to find out how to do something unfamiliar. The versatility of the filer is something of a mixed blessing — because it is so large it cannot fit into memory in its entirety and has to swap parts of itself off the disk. This is a big nuisance especially during disk-to-disk operations when both drives are needed and the system disk must constantly be replaced.

The commands can be divided into four categories — disk operations; file operations: workfile operations and others. Disk operations include: Zero, which initialises a disk, giving it a volume name and allocating space for a directory; Bad-blocks which searches a disk for physically corrupt areas, while eXamine attempts to recover bad blocks or else marks them as .BAD; Prefix which nominates one volume or another as the default disk; and Krunch which moves files across the disk to concentrate all the free space at the end (files are held in consecutive blocks). Finally Ldir will list the directory of a disk while Extdir gives a fuller listing displaying the physical layout of files (and unused areas) on the disk.

General file operations include Change (the name of a file or directory), Make (a file of a certain size), Remove (a file entry from a directory) and Transfer (a file from one volume to another). The Workfile can be manipulated by Get (a named file and nominate it as the workfile); Save (the current workfile under another name); What (file is the current workfile?); and New, which clears the workfile. Finally, Volumes produces a listing of all the devices recognised by the system and Date allows the current date to be set — this is recorded as an attribute in the file directory when a file is saved or created. The last command is Quit which exits from the filer.

Other utilities

The p-System comes with a collection of useful programs which can be executed. These vary slightly from system to system as some are machine dependent. This section describes many of these utilities but does not pretend to be comprehensive.

The Debugger offers full debugging facilities at the p-code level including single-step, breakpoints, the display of memory information in a variety of different formats (global, local, intermediate or procedure) and markstack traversal. The user is expected to possess a fairly sophisticated view of the p-machine, and is offered no promptline as this would, in the words of the User Manual, 'detract from the information displayed by the debugger'. Lines can be altered either in ASCII or hex and symbolic debugging information can be accessed by inserting a compilation option into the source code at compile time. Variables and procedures can then be referenced by name rather than by segment and offset number. Unfortunately, SofTech does not seem to have any plans for providing a source language debugger.

The Compressor was designed to prepare assembler language programs for applications outside of the p-System environment. The code it produces has all the p-System information stripped out and the result is optionally an absolute or a relocatable object module. System specific Adaptable Assembler directives must be omitted if the Compressor is going to be used.

Patch is a Screen-oriented utility which allows the program developer to edit files at the byte level or to extract listings of files (typically p-code files) in a variety of formats. Edit mode allows the user to access named files or numbered blocks within a file. Type mode allows the user to modify characters as displayed on the screen. (This is done simply by positioning the cursor and overtyping). Finally, there is Dump mode which outputs the code file, as stored on disk or as a range of memory addresses in a variety of formats including ASCII, hexadecimal, word-or-byte-octal or word-or-byte-decimal (BCD).

The Decoder is a utility which provides access to information in code files, either in the form of a p-code disassembly or as a series of tables giving segment, unit and linker information.

The Cross-referencer (XREF) is the only avowed 'software tool' among the utilities offered by SofTech and is adapted from a program produced by Professor A Sale (of Tasmania) who, in turn, based his program on another by A J Currie of Southampton University. Once again, the input for this program is a simple working codefile while the output includes: a lexical structure table; a call structure table; a procedure call table; a variable reference table; a variable call table.

Finally, a WARNINGS file can be produced, predicting possible problems. Unfortunately SofTech did not fully customise XREF for UCSD Pascal. All characters in an identifier are taken as significant in XREF whereas UCSD

Device No	Volume Name	
1	CONSOLE:	Standard terminal
2	SYSTEM:	Non-echoing terminal
3	GRAPHIC:	Graphics terminal
4	(username):	System disk
5	(username):	Another disk
6	PRINTER:	Serial or parallel printer
7	REMIN:	Remote serial line (in)
8	REMOUT	Remote serial line (out)
9-12	other disks	

Table 1

P FOR PERFECT?

Pascal doesn't count '—' as a significant character.

Floppy disk compensation

Several utilities exist to cater for the uncertainties of life as lived with a floppy disk system. These include a utility to enable a duplicate directory system (set up by Zero within the filer the first place) so that every entry into the 'proper' directory is reproduced in the duplicate. This feature is known as MARKDUPDIR and it has a counterpart, COPYDUPDIR for when the regular directory inevitably becomes corrupted and needs 'refreshing' from the duplicate. However these two directory areas are effectively next to each other (or even intermingled, with disk interleaving) rather than at opposite ends of the disk, which offers a speed advantage when updating the directory, but it is of course less secure.

Finally, there is the utility RECOVER which tries to extract information from a disk whose directory has effectively been 'wiped'.

The librarian

Libraries are, explicitly, large-scale UNITS for use within applications programs. When a segment within a particular compilation unit references an external segment, this generates a 'segment reference'. In general this will be resolved by the operating system when it incorporates the necessary UNIT as indicated by a USES statement. However, references to external segments within the system library and other system units are automatically resolved — eg, the segment WRITELN resides in a system unit called PASCAL10 which need not be explicitly declared. The utility LIBRARY is used to insert a UNIT into SYSTEM.LIBRARY or into another library.

Each library contains 16 'slots', each of which can contain a unit, program, segment routine or assembler routine. In fact a new library is created by LIBRARY and entries can be transferred into it from an old library, slot-by-slot, or inserted individually from the disk.

D = list CP/M directory
E = extended listing of CP/M directory
C = transfer CP/M file to p-System file
P = transfer p-System file to CP/M file
H = display Help file
Q = quit utility.

Table 2

12 — return CP/M version
13 — reset disk system
14 — select disk
15 — open file
16 — close file
17 — search directory for first occurence of filespec
18 — search directory for next occurrence
19 — delete file
20 — read file sequentially
21 — write file sequentially
22 — create a new file
23 — rename a file
24 — return logged drives
25 — return currently selected disk
26 — set DMA address
27 — return currently available blocks on disk
28 — write-protect disk
29 — return read-only disks
30 — set file attributes
31 — (not implemented)
32 — set or get user code
33 — read random record
34 — write random record
35 — return file size
36 — set random record position pointer

Table 3

Print spooling

The utility SPOOLER.CODE allows the user to create and manipulate a file SYSTEM.SPOOLER which contains a queue of up to 21 filenames. Spooler I/O occurs concurrently with other operations on the system. Interrupts are generated every time a key on the console is struck.

Zenofile

Xenofile is a package which allows access to CP/M formatted files. CPM.CNFIG must first be run to configure the package to the local hardware. Once that is done, CPM.FILER allows for directory access and file-transfer operations between UCSD and CP/M formatted disks. CPM2.UNIT, FCPM and BCPM are units which grant access to CP/M disks from within Pascal, Fortran and Basic programs respectively.

CPM.FILER has six commands as shown in Table 2.

The language-specific units contain a set of functions which operate as shown in Table 3.

Turtle graphics

This is a package of routines which allows for the production of graphical images on a display screen and for the storage and retrieval of those images from disk files (called FOTO files). In general, the user must write some assembler language control routines before Turtlegraphics can work on a particular system.

In Turtlegraphics, the cursor is a 'turtle' which can be faced in a particular direction and moved from point to point, drawing a line of a given colour or simply moving without drawing. More than one turtle is associated with a 'figure' which may or may not be displayed on the screen (active) at any given time. Commands sent to 'the turtle' will affect the turtle currently on the screen and all inactive figures are stored in memory. The package supports scaling and windowing. Specific procedures and functions defined within Turtlegraphics are shown in Table 4.

Implementation-specific routines which have to be supplied by the user deal with screen and character resolution; colour range; aspect ratio; amount of memory required to store a figure; pixel and background colouring mechanisms; and a line-drawing primitive.

Procedure
Move: move turtle a specified distance
Moveto: move turtle to a specified location
Turn: rotate turtle by a specified angle
Turnto: rotate turtle to a specific direction
Pen-Color: select a specified colour
Pen-Mode: draw a line of no colour (ie, no line); of the current colour or of the colour opposite (ie, complementary) to that found on the screen
Function
Turtle-x: return x-coordinate of turtle
Turtle-y: return y-coordinate of turtle
Turtle-angle: return direction of turtle
Procedure
Activate-Turtle: direct commands to a specified turtle
Fillscreen: fill figure with specified colour
Background: define background colour for figure
Wchar: write a character at the turtle position
Wstring: write a string at the turtle position
Display-scale: define coordinate limits to be mapped onto the screen
Function
Aspect-ratio: returns height/width/ ratio of screen
Create-figure: returns a number which references a new figure. When the number is passed to Activate-Turtle, drawing will commence
Procedure
Delete-figure: discards previously created figure
Getfigure: transfer a figure from memory onto the screen
Putfigure: transfer a figure from the screen to memory
Viewpoint: define a window on the screen
Function
Read-pixel: return the value of the colour at an individual point
Procedure
Set-Pixel: sets individual point to a specified colour
Function
Read-figure-file: open FOTO file of figures on the disk for reading
Write-figure-file: open FOTO file for writing
Load-figure: read figure from FOTO file
Store-figure: write figure to FOTO file.

Table 4

Documentation

All manuals from SofTech Microsytems have a professional appearance. They have white softcovers with orange, red and purple hexagons. Internally they are all paginated, have detailed tables of contents and appear to have been produced by a daisywheel typewriter.

The User Manual contains chapters on: system commands, file handling, both editors, the UCSD Pascal language, the adaptable assembler (a bit sparse for easy use), memory management, concurrent processors and utilities. In several of these chapters each command or function is given a page to itself with both description and examples.

The other manuals that come with the system are a 'User Manual Supplement'. 'Installation Guide', and 'Internal Architecture Guide'. None of these have either index or 'thumb marks'. The Supplement contains chapters on the latest releases — including the Symbolic Debugger, extended memory, native code generation, print spooling, interrupt handling, file transfers to CP/M and Turtle graphics.

Basic and Fortran each come with their own slim reference manual. Users of these languages are expected to read the User Manual for information about the system. The language manuals assume (including those for Pascal and Assembler) that the user is thoroughly familiar with the language and needs details of this particular implementation. For this purpose the manuals are quite adequate although it would have been useful if someone had gone through the Fortran manual and made sure that the page numbers matched the stated page numbers in the contents.

The language translators on the p-System will be discussed in full in our next article.

END

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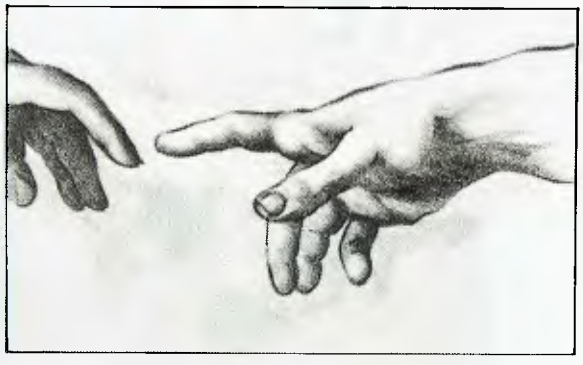

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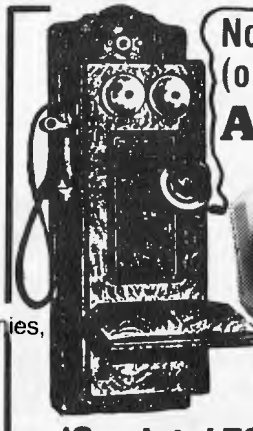

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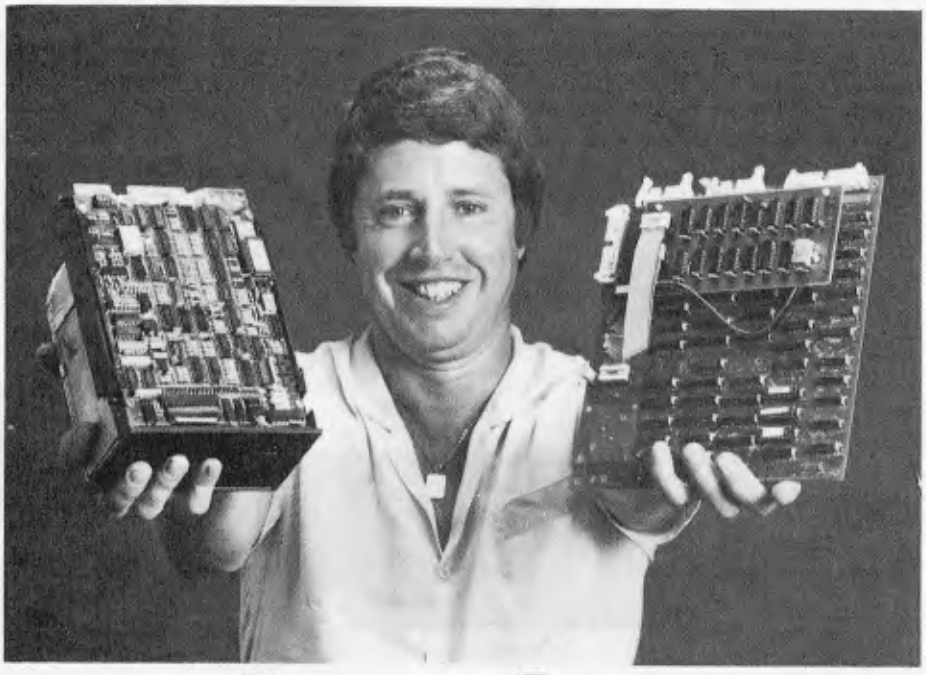

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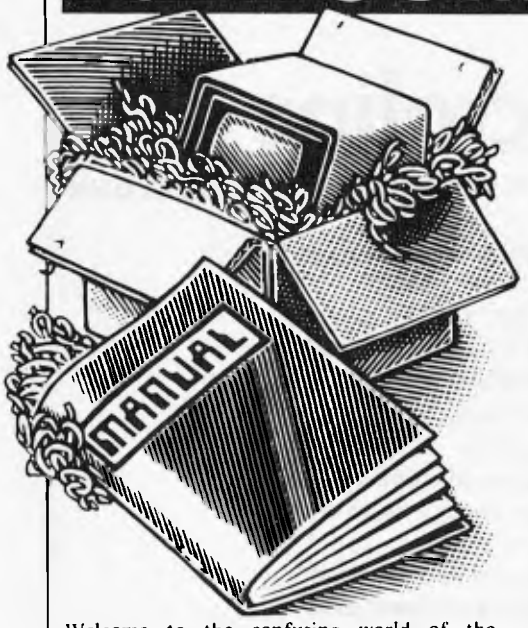

This is our unique quick-reference guide, reprinted every month to help our readers pick their way through the most important pieces of (necessary) jargon found in APC. While it's in no way totally comprehensive, we trust you'll find it a useful introduction. Happy microcomputing!

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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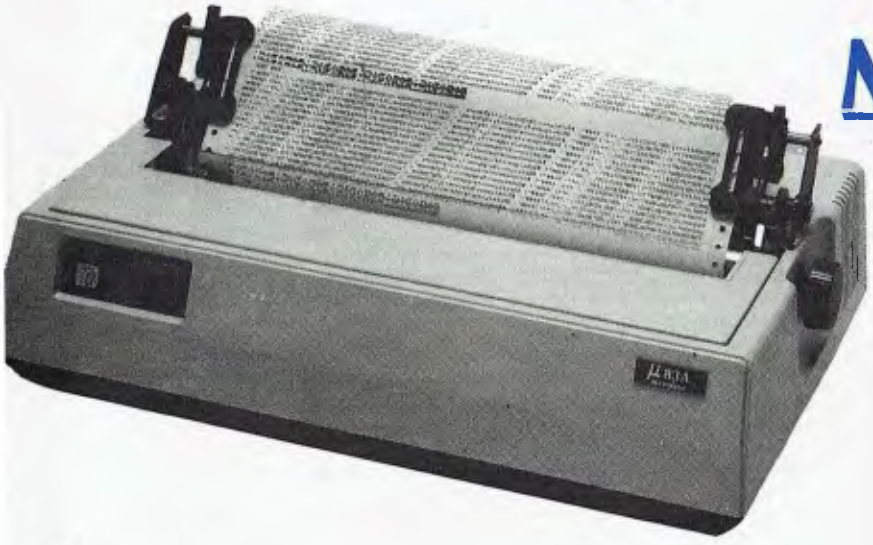

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'There's a hole in my Apple...'

M J Parrott describes a crafty way to fit an Apple program around the hi-res graphics area

From time to time it can be useful to leave a space within a Basic program to incorporate perhaps a machine code program or data space. This is also true for a special reason on the Apple II when one wishes to protect the hi-res pages from program text. The usual way round this particular problem is to load the Basic text above the hi-res pages either by changing the beginning of program pointer ($67,68) before loading it (usually in an EXEC file) or by letting the program relocate itself to above the hi-res page when it RUNs by using a utility such as the &LOMEM: developed by Neil Konzen.

The drawback with loading a program above the hi-res pages is that approximately 6k of memory is left fallow; it can only be used for machine code routines or shape tables. Also, the &LOMEM: utility does not work for very long programs because of the way in which it calculates the new link addresses of the relocated text.

It is desirable therefore to be able to load a program at the normal starting location ($801), to continue up to the area of memory to be protected (this is $2000 to $4000 for hi-res page 1 and $2000 to $6000 for hi-res pages 1 and 2 together), to jump over this area of memory and to continue up to the end of program text.

This is actually quite easy to do and the program listed will allow you to do it without problem. In essence the only work required is to move the latter part of the program and to change the link addresses where required. There are, however, a couple of provisos, but before pointing these out it is probably best to indicate the general construction of an Applesoft Basic program.

When you type in a Basic program it is constructed from memory location $801 (2049) upwards. Memory location $800 will contain a zero value. The actual line of Basic you type in is not stored exactly as you type it. If you call the monitor (CALL-155) and type 800L you can examine the start of any programs you have previously typed in or LOADed. The first two bytes of the line are the link address. In reverse order, these point to the start of the next line of Basic. Perhaps the best way of demonstrating this is via an example such as the short program:

```
10 PRINT "HELLO"
20 GO TO 10
```

If you type this in, call the monitor and type 800.817 and press ⟨return⟩ you will see the following:

```
0800— 00 0E 08 0A 00 BA 22 48
0808— 45 4C 4C 4F 22 00 16 08
0810— 14 00 AB 31 30 00 00 00
```

The values 0E,08 are the link addresses for line 10 and point to location $80E where the next line, 20, starts. At this location appear the link addresses for this line — they point to $816 where you will find the value 00,00. This is how Applesoft knows it has reached the end of a program.

Going back to the first line, the next two locations contain the line number expressed as a hexadecimal number stored in two bytes in reverse order, ie, 0A 00 for the decimal value 10. Next follows the text of the line. The PRINT command appears as a single byte in the 'tokenised' form BA. There then follow seven bytes which spell out "HELLO" in standard ASCII (with the high bit set low). Next is the end of line token, a zero byte. The next line has its link addresses, its line number and the tokenised form of 'GOTO', which is AB, followed by the number of the object line stored as ASCII values. Then come the end of line token (0) and the two zero value link addresses which signify the end of the program.

In general, then, any line of Basic is sandwiched between two zero bytes and this is the first proviso on relocating part of a program; the second part must start with a zero byte so that it looks like a normal line of Basic to Applesoft. The second proviso is that the last line of the first part of a split program must be one that does not simply move on to the next line (because it isn't there). In other words this last line must be either a GOTO or a RETURN.

If these two conditions are met and the link addresses are adjusted after splitting then a program will run quite

```
9  REM

'CLEARSPLIT' IS ASSEMBLED BY
THIS APPLESOFT PROGRAM

10  TEXT : HOME
20  PRINT "THE MACHINE CODE PROGRAM 'CLEARSPLIT'"
30  PRINT "IS NOW BEING ASSEMBLED UNDER HIMEM:"
39  REM

LOOK AT MACHINE'S HIMEM AND
CALCULATE STARTING LOCATION FOR 'CLEARSPLIT'
(I.E. $200 BELOW HIMEM)

40 P =  PEEK (116) - 2
50 HI =  PEEK (115) + 256 * P
60  FOR I = HI TO HI + 332
70  READ V: POKE I,V: NEXT
79  REM

NOW DATA HAS BEEN ASSEMBLED FOR
A 48K MACHINE.  IF YOURS IS
ALSO 48K LINES 80 TO 190
INCLUSIVELY MAY BE DELETED

80  IF P = 148 THEN  GOTO 200
90  POKE HI + 11,P: POKE HI + 35,P
100  POKE HI + 40,P: POKE HI + 56,P
110  POKE HI + 61,P: POKE HI + 75,P
120  POKE HI + 80,P: POKE HI + 85,P
130  POKE HI + 106,P: POKE HI + 133,P
140  POKE HI + 173,P: POKE HI + 182,P
150  POKE HI + 186,P: POKE HI + 189,P
160  POKE HI + 191,P: POKE HI + 197,P
170  POKE HI + 200,P: POKE HI + 287,P
180  POKE HI + 294,P: POKE HI + 300,P
190  POKE HI + 303,P
200  PRINT : PRINT : PRINT : PRINT "INSERT YOUR DESTINATION DISC"
210  PRINT "AND PRESS RETURN TO SAVE IT"
220  GET T$: IF  ASC (T$) <  > 13 THEN 220
230  PRINT  CHR$ (13) +  CHR$ (4)"BSAVE CLEARSPLIT ,A"HI",L333"
239  REM

THE DATA FOLLOWS

240  DATA  169,76,141,245,3,169,20,141,246,3,169,148,141,247,3,96,0,0,0,0,
     169,189,32,192,222,32,103,221,32,82,231,165,80,141,16,148,165,81,141,
     17,148,169,193,32,192,222,32,103,221,32,82
250  DATA 231,165,80,141,18,148,165,81,141,19,148,216,160,1,177,103,208,3,
     76,18,212,56,173,16,148,233,11,141,16,148,176,3,206,17,148,165,103,13
     3,80,133,94,165,104,133,81,133,95,160,1,177
```

```
260  DATA 80,240,221,205,17,148,240,17,176,33,133,95,136,177,80,133,80,133
     ,94,165,95,133,81,144,228,133,155,136,177,80,205,16,148,176,8,170,165
     ,155,133,95,138,144,228,56,165,94,233,1,133,155
270  DATA 165,95,233,0,133,156,24,165,175,105,1,133,150,144,2,230,176,56,2
     29,155,141,16,148,165,176,133,151,229,156,141,17,148,24,173,16,148,10
     9,18,148,133,148,133,175,170,173,17,148,109,19,148
280  DATA 133,149,133,176,168,138,32,147,211,165,117,72,165,118,72,160,3,1
     77,155,133,117,200,177,155,133,118,32,32,237,104,133,118,104,133,117,
     160,3,177,155,56,233,1,145,155,200,177,155,233,0,145
290  DATA 155,16D,5,169,171,145,155,162,255,232,189,0,1,200,145,155,201,0,
     208,245,24,165,155,105,1,133,155,144,2,230,156,24,169,1,109,18,148,16
     0,0,145,155,141,18,148,72,144,3,238,19,148
300  DATA 173,19,148,200,145,155,133,156,104,133,155,177,155,240,14,160,4,
     200,177,155,201,0,208,249,200,152,24,144,211,76,108,214
```

```
9  REM

DATA FOR THE MACHINE CODE PROGRAM 'CLOSESPLIT'

10  DATA 32,88,252,165,103,133,94,165,104,133,95,56,160,1,177,94,240,22,13
    3,81,229,95,201,1,240,2,176,15,136,177,94,133,94,165,81,133,95,56,176
    ,228,76,18,212,165,94,133,0,165,95,133,1
20  DATA 177,94,133,156,136,177,94,133,155,56,165,175,241,94,133,80,165,17
    6,200,241,94,170,160,0,177,155,145,94,136,208,249,230,95,230,156,202,
    48,6,208,240,164,80,208,236,200,177,0,240,34,200
30  DATA 200,200,177,0,208,251,200,24,152,101,0,160,0,145,0,133,80,165,1,1
    05,0,200,145,0,133,1,165,80,133,0,56,176,217,24,165,0,105,3,133,175,1
    65,1,105,0,133,176,32,108,214,76
39  REM

THE PROGRAM BEGINS HERE
BY BEING POKED IN

40  DATA 208,3
50  TEXT : HOME
60  PRINT "THE MACHINE CODE PROGRAM 'CLOSESPLIT'"
70  PRINT "IS NOW BEING ASSEMBLED AT $300 (768)"
80  FOR I = 768 TO 768 + 152: READ J: POKE I,J: NEXT
90  VTAB 10: PRINT "INSERT YOUR DESTINATION DISC"
99  REM

NOW SAVE IT TO DISC

100  PRINT "WHEN READY PRESS <RETURN>"
110  GET T$: IF  ASC (T$) <  > 13 THEN 110
120  PRINT  CHR$ (13) +  CHR$ (4)"BSAVE CLOSESPLIT,A768,L153"
```

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WF870/81

'There's a hole in my Apple...'

normally as long as the end of program pointer ($AF,B0) is adjusted and from it the pointers to variables, arrays and strings are also reset. If the program is SAVEd, however, in its split form everything will be there on a subsequent LOADing but the program will only LIST up to the end of the first part and it will not run correctly. The reason is not hard to find: all the link addresses are correct except for those in this last line. Therefore a split program must POKE in the two 'wrong' link addresses when it begins to execute. There is another annoying thing about a split program saved to disk; it wastes disk space. In the case of a program split around on hi-res page 34 sectors are lost and a massive 68 are lost for two hi-res pages. It is true that this space can be used to keep a hi-res picture for either introducing the program or starting it off but generally I would rather save the disk space. Clearly it would be better to let the Basic program be split after LOADing and RUNning and also it should all be as automatic as possible. Hence was born the '&CLEAR. . . TO. . . utility.

There are two ways of using the utility. One is to let the Applesoft program listed assemble the machine code program for you in memory and then save it to disk; when used, the machine code program is merely BRUNned from within the Basic program. The second is to incorporate the listed Applesoft program within your own program and then CALL the machine code routine after it has been POKEd in.

After the routine is BRUNned or CALLed, the area of memory wished to be kept clear is merely passed to it as two decimal values. These need not be simple numbers; they can be expressions. For example, to clear the area of memory required for two hi-res pages a line of Basic such as:

```
1 PRINT CHR$(13)+CHR$(4)"BRUN
  CLEARSPLIT":&CLEAR
  2*16*256 TO 6*16*256
```

will accomplish the split as long as the binary file 'CLEARSPLIT' is on the disk.

As long as the lower area is cleared first a second or third area can also be cleared merely by invoking the appropriate &CLEAR. . .TO. . .line. The utility can also be used in the immediate mode as long as it BRUNned first. Thus a program can be split and saved in the split form if wished as long as a line of Basic is incorporated which will POKE in the two link addresses as explained above. (You will have to determine the exact values after incorporating the line by either going through the memory following the link addresses yourself or by using a small program as described above.)

The utility can also be used to completely relocate a program above the hi-res page as in Neil Konzen's &LOMEN: utility but without the worry of losing part of a long program. This is accomplished by using the lines:

```
1 PRINT CHR$(13)+CHR$(4)"BRUN
  CLEARSPLIT":&CLEAR 1024 TO
  16384
2 POKE 104,64 :REM for page one
```

Five points are worth noting when using the &CLEAR. . .TO. . .utility. The first is it must be used early in a program before any of your variables or strings are defined since it does a CLEAR before returning to the Basic; the second is that it does not protect itself by resetting HIMEM: so it will be overwritten by any STRING activity; the third is that the line number corresponding to the first line in the latter part will be displayed on the screen; the fourth is that an attempt to set an initial value not within the program will result in an error message as will the wrong syntax in the line, and the fifth is that after splitting, a program cannot be edited.

There are three ways round this problem. In the first you must develop the program exclusively above the hi-res pages by changing the start of program pointers and using smaller arrays, etc, until you are convinced it is perfect then add the &CLEAR. . .TO. . . line. In the second you must keep on disk a version of the program which incorporates any changes you make but which is SAVEd before RUNning and it is this version which is edited. In the third you must use another program which will close up a split program. This is also listed and is called 'CLOSESPLIT'. Its use is very simple. To edit a split program either BRUN 'CLOSESPLIT' or, if it is already in memory, just CALL 768. If after splitting a program you LIST it you will notice that 'CLEARSPLIT' has introduced a line of Basic which is a GOTO. 'CLOSESPLIT' will remove this, recombine the program, reset the end of program pointer, and do a CLEAR before returning you to Basic.

To save space, I have presented both programs only as Applesoft programs. Both of these will assemble the appropriate machine code programs in RAM and will then save them to the required destination disk. 'CLOSESPLIT' resides at $300 and so the relevant Applesoft program will merely form it and SAVE it. 'CLEARSPLIT' however, was originally assembled at $9400 for a 48k machine with DOS. So the relevant Applesoft program has been written so that it will determine the size of memory available (from the HIMEM: pointer at $73,74) for any machine and then assemble the program as appropriate. Tape users can easily modify these two to their advantage and use 'CLEARSPLIT' in the immediate mode, or by incorporating the program within their own program can use it in the deferred mode.

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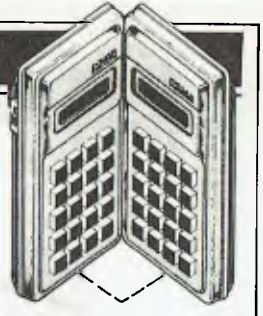


By Dick Pountain

HP'S DEDICATED DUO

The Hewlett Packard 11C programmable calculator, along with its sister the 120 financial calculator, were seen as HP's answer to Casio in terms of features and packaging, if not in price. It now transpires that these two machines were the advance guard of a whole new range of HP calculators designed for specific tasks. The two machines reviewed this month, the 15C and 16C, are the latest additions (don't ask me what happened to the 13 and 14; did I miss them?) and they are both far more exciting than the 11 in their different ways.

The 15C is mathematically oriented and has a range of operations never before offered on a programmable — nor for that matter on many micros that I know of. These include complex number arithmetic, matrix manipulation, numerical integration and equation solving/root finding, in addition to the normal maths and statistical functions.

The 16C is called the Computer Scientist and will be of interest to all terminal junkies rather than the regular readers of this column. It is aimed straight at that slot which the Texas Programmer has had to itself for some years now — machine code programmer's assistant. It has features that go well beyond what's offered by the ageing TI machine and will I suspect find its way into a lot of computer labs as well as the homes of well-equipped hobbyists.

Hardware

The 'TeenC' machines form a coherent range in that the physical packaging is identical; only the model numbers and the legends on the identically laid out keyboards differ. I will therefore refer you to the 11C review for the exact details and, to save space, will concentrate here on the internal differences. To recap briefly, though, both machines have constant memory and 10-digit LCD displays and are powered by three 'button' cells with a life of 60 hours' continuous use or 18 months' memory preservation. Both have built-in hardware diagnostic routines as well as the logic circuitry. It goes without saying that both use Reverse Polish arithmetic.

The 15C has 469 bytes of continuous memory and the 16C has 203; the way this memory is used and managed on the two machines, is very different however.

The 15C has manual memory management similar to that of the 41C — you decide what the highest numbered storage register is to be. There are two fixed storage registers so that only 448 bytes maximum can be allocated to program space. When the partition has been set any registers above the top one named are uncommitted; they are still available for data storage but are automatically converted to program steps when required. Some of this space is used by the 'advanced functions' — ie, matrix, complex, solve and integrate — when they are in use.

The 16C uses automatic memory management similar to that on the 11C; as you enter more program steps data storage space is converted, seven bytes at a time from the top down, into program space. Program space is protected once filled; ie, you can't overwrite program steps by accessing a nonexistent data register, but the reverse obviously cannot be true (ie, data is lost if its register is converted). I can't tell you how many data registers are available because one of the features of the 16C is variable word size. A data register is one word long and that could be anything from four to 64 bits! With a 16-bit (two-byte) word size you could have a maximum of 101 registers (203/2=101.5; the half is not usable for data but will be available for program steps).

On both machines one program line is usually one byte, sometimes two. Both use the same editing functions and numeric op-codes as the 11C.

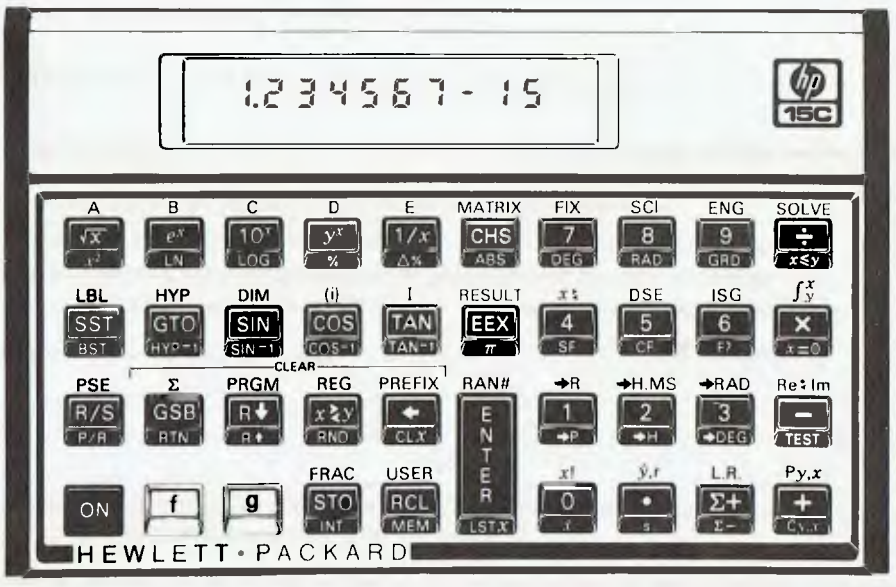
15C firmware

True to the new HP formula the 15C supports three numeric formats, FIX, SCI and ENG, while working internally with 10-digit mantissas. A nice touch, aimed at international markets, is that the digit separators for thousands and decimal point can be swapped to conform with usage in various countries — eg, 23.567.200,12 instead of 23,567,200.12. A very full range of functions is provided, including all the normal trig and logs, hyperbolics plus factorials and gamma functions, permutations, combinations, linear regression and full statistics routines. A random number generator is built in which can be seeded using the X-register contents.

The really interesting operations, however, are the four 'advanced functions'. Of these, solve and integrate have already been seen so I shall concentrate here on the complex arithmetic and matrix-manipulation features which are completely new.

The complex mode allows all those maths operations which are meaningful to be performed on imaginary and complex numbers as well as reals. This is achieved by creating a second stack, similar to the normal one, which holds the imaginary part of the numbers (critics of Reverse Polish should note the simplicity of this solution). The imaginary stack is actually formed from four uncommitted data registers and is created only when complex mode is entered.

To enter a complex number into the machine one merely types the real part followed by ENTER and the imaginary part followed by the 'I' key. This creates the complex stack and enters complex mode which is flagged by a C annunciator in the display; it also automatically transfers the imaginary part of your number into the imaginary stack. Arithmetic is then carried out as normal: since the display holds only one number it is necessary to exchange the X-registers of the two stacks to view the imaginary part using the 'Re⇌Im' key or to press the '(i)' key which displays the imaginary X-register only while held down. Complex mode remains set once selected and is cancelled only by clearing system flag 8. Real arithmetic is not affected at all by complex mode, as those operations which do not work on complex numbers simply ignore the imaginary stack. The only exception is the rectangular to polar coordinate conversion which operates somewhat differently in complex mode to allow the user of phasor notation. Operations which ignore imaginary numbers include some of the conditional branch tests and functions like factorial and INT. The memory operations STO and RCL work only on the real stack so that a complex number must be stored in two registers using Re⇌Im between the STOs.



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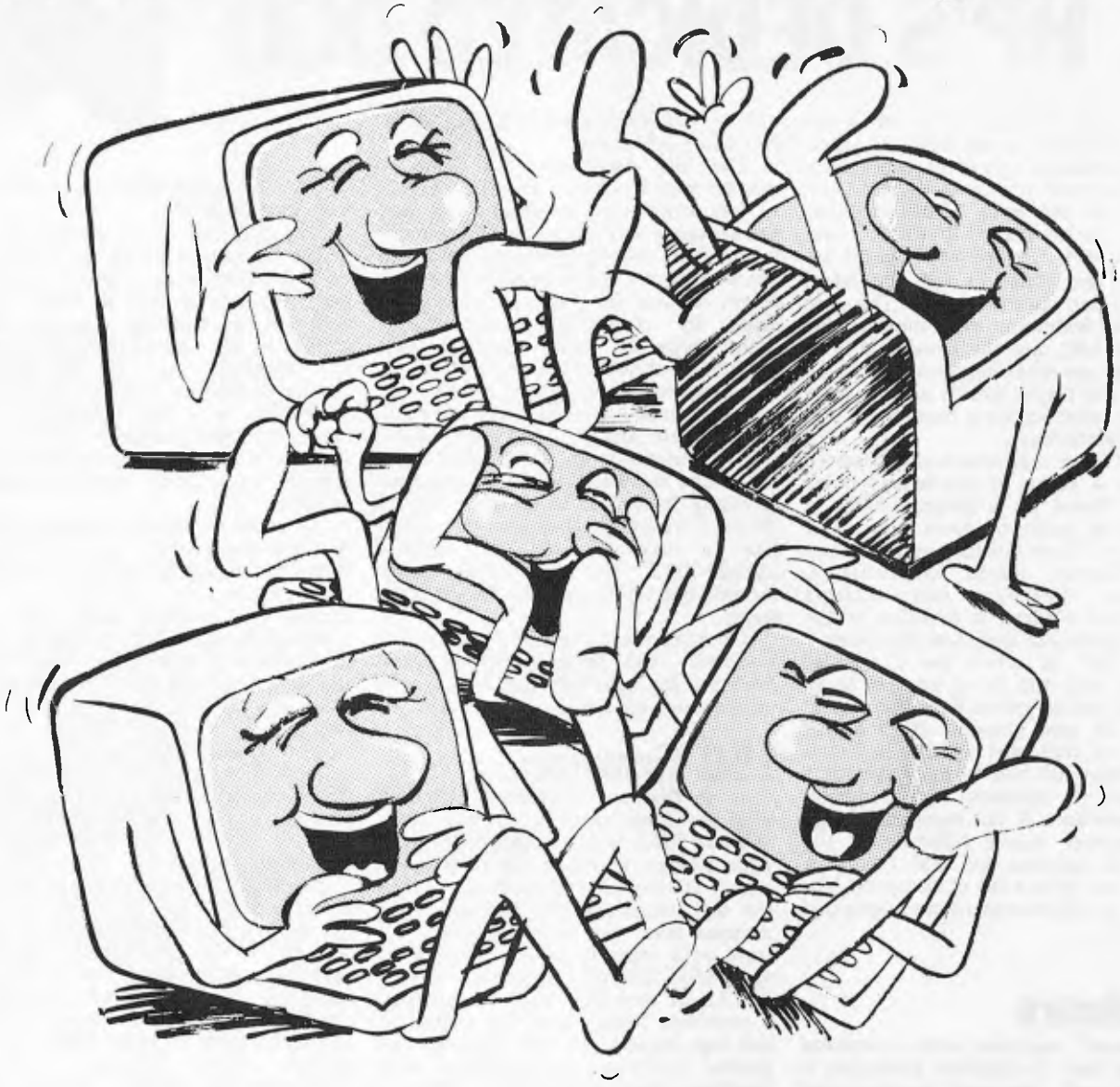

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It takes a while to become comfortable with the use of these two parallel stacks, only one of which is visible, but once you have the knack complex arithmetic is no harder than real. Certain operations like forming the complex conjugate require thought since the CHS key changes the sign of the real X-register only. Complex mode can be combined with both the solve and integrate routines to find complex roots and integrals; manipulation of complex matrices is rather different and will be discussed below.

Matrix operations

Though of necessity limited by the relatively small memory available, the matrix operations of the 15C are very comprehensive and ingeniously implemented.

A maximum of five matrices may be stored at one time and their combined number of elements is restricted to 64, so the largest possible is a single 8x8. Each matrix is named with a 'descriptor' consisting of one of the letters A-E and two numbers representing the dimensions. The letters are provided on five keys which also serve as branching labels and, in USER mode, to execute labelled programs. These descriptors behave like numbers in that they may be stored on the stack or in a single data-register and they are used to represent the matrix in arithmetic operations.

To create a matrix you must first allocate sufficient memory in the uncommitted area; each element needs one register. Then the matrix is dimensioned using the DIM and MATRIX keys.

A major obstacle to matrix manipulation on a calculator is that only one element can be displayed at a time. This problem has been solved by reserving a special function for the two registers R0 and R1; if the row and column numbers of a matrix element are stored in these registers then they are automatically incremented after any operation has been performed to give the next position to the left, wrapping round the end of rows and returning to 1,1 after the last element is reached. To store or recall elements it is sufficient to press STO or RCL and the matrix's name, eg, B. While B is held down the element's position is displayed, eg, B 2,5. As soon as B is released the operation is performed and the display shows the result. Storage arithmetic functions can be used on matrix elements, eg, STO+. To perform operations on the whole matrix RCL MATRIX is used to bring its descriptor into the display. n STO MATRIX will fill the whole matrix with the number n.

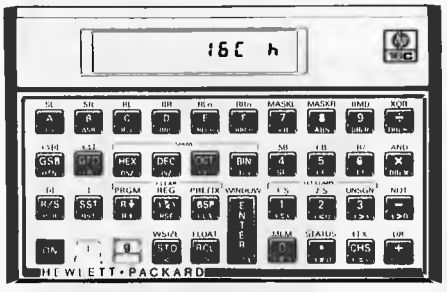
Permitted operations on matrices are: copy, invert, transpose, form the row norm or the Euclidean norm, extract the determinant, scalar addition, multiplication, subtraction and division and matrix addition, subtraction and three matrix products (XY, Y^T X, X^{-1} Y).

Some of these operations require a separate result matrix to be defined to hold the answer while others allow the original matrix to hold the result; the difference can be crucial with so little memory to play with. The operations are quite fast by calculator standards:

Invert 8x8 matrix	60 secs
Transpose 8x8 matrix	4 secs
Extract determinant 8x8 matrix	28 secs

Complex numbers may be stored in a matrix taking two elements each but complex mode will not support matrix calculations. Instead complex matrices are handled using a real representation which requires only one stack; several transformation routines are provided to allow entry of such matrices in an obvious form and then to turn them into a machine usable form.

Although limited by memory size, these matrix facilities are well designed and are highly suitable for applications such as the solution of simultaneous equations.



HP16C: The Computer Scientist

The 16C is a far more narrowly dedicated machine than the 15C; for instance, its arithmetic functions are limited to +, −, x, ÷ and square root.

It is, however, fully programmable with all the usual conditional tests and flags and an indirect register. Its intended use is as a 'toolkit' for the machine code programmer and it has some very sophisticated facilities for this purpose: it is much more than a hex-to-decimal calculator.

Numeric base conversion is nevertheless an important part of its job and to this end it has keys marked HEX, DEC, OCT and BIN whose functions should be clear. A nice touch is that when these keys are in use an alpha prompt at the right of the display tells you which base you're in. The normal operating mode is integer and it is in this mode that conversions are done. A floating point mode is provided which is decimal only, and pressing the HEX, OCT and BIN keys in this mode forces a return to integer mode. If you merely want to see the, say, octal representation of a number a key called SHOW will display it in this base for as long as the OCT key is held down.

Three sign conventions are supported in integer mode, namely 1s complement, 2s complement and unsigned. These are selected by the COMPL keys and affect the operation of the CHS (change sign) key in the appropriate fashion; in unsigned the CHS key takes the 2s complement and sets flag 5 and a G in the display to show the result is out of range.

The most powerful feature of the 16C is its variable word size. This can be set to anything between one and 64 bits with the WSIZE key. Once set all operations including input and output are performed in this word size; setting a 1-bit size renders the machine rather inarticulate! The smart kids at Corvallis fortunately made WSIZE 0 the same as 64 — without this you might never get out again. Since the displays holds only eight characters it's necessary to scroll it when showing binary in word sizes beyond eight. This can be done either character by character with the ⟨ and ⟩ keys or in eight character chunks with the WINDOW key. A displayed '.' at the right or left side tells you that there are undisplayed digits present at that side.

As well as the five function arithmetic (with carry and out-of-range flags) a full set of bitwise shifts, rotates and logical operators including XOR are provided. There are even MASKL and MASKR, which create left or right justified strings of one bits of chosen size for masking. Three double length operators, double multiply, double divide and double remainder return exact results of twice the current word size.

The #B key returns the sum of the bits in the display register and is handy for checksum calculations.

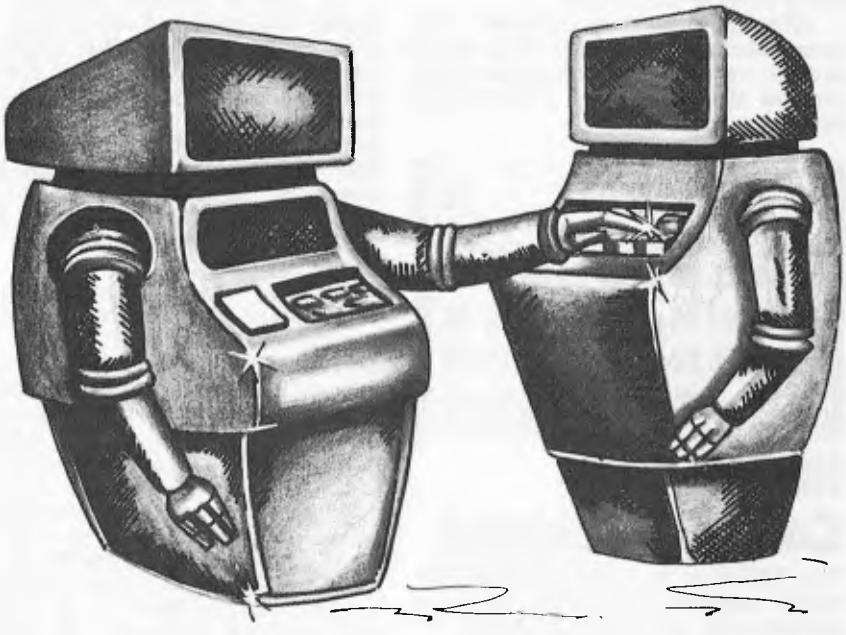
Given all these features it is possible to emulate virtually any processor ever devised, since even instructions such as complicated indirect jumps could be programmed as a subroutine and assigned to one of the A-E keys. It's quite nice to think that you might have a Cray 1 in your pocket even if its megaflop rate is rather disappointing! More seriously though I suspect that this machine will become almost indispensable to those poor wretches who will have to write for the 68000 or the new 32-bit chips which are threatened. Since it uses Reverse Polish it would be a nice toy for a Forth programmer to find in a Christmas stocking too (hint, hint).

Conclusions

These two machines are produced, packaged and documented up to the standard one has come to expect from Hewlett Packard. The prices are hardly bargain basement at $182 plus sales tax (recommended retail) for the 15C and $199 plus sales tax (recommended retail) for the 16C but if you need to do what they do it would be hard to do it any cheaper with such convenience. More interesting is the indication they give of the thinking at HP. For several years the trend was to ever more powerful general-purpose programmable calculators, culminating in the HP-41CV. You can do virtually everything these two machines do on a 41C given the time and ingenuity to write the programs and the patience to load them every time you need to use them. The point being that not everyone has all those requisites and so the dedicated programmable appears on the scene. Aimed at a specific profession with 90 percent of what you need hardwired in and sufficient programming flexibility for you to write the other 10 percent, this seems to me a shrewd choice of direction — and one which will sell a lot of calculators.

END

HOW COMPUTERS COMMUNICATE.



Part XI

INTERRUPTS AND BUFFERS

by Hewlett-Packard's Steve Leibson

In our discussions about I/O hardware, we considered the needs of a wide range of peripheral devices. Some devices are much slower than internal computer processes, some are about the same speed and some are faster than the computer can comfortably handle.

We discussed the three hardware handshakes associated with these three classes of peripherals. Slow devices are best handled by interrupts. Only when the device is ready for another data transfer is the processor interrupted so that it can service the peripheral.

Medium-speed devices can interact with the processor directly, since they will not degrade system performance. High-speed devices require special hardware for Direct Memory Access (DMA) because the processor alone is not fast enough to service them.

The hardware to perform interrupt I/O and DMA is useless unless there is software to support the capability. In the previous article, we discussed formatted I/O and referred only to the simpler handshakes or programmed I/O. Most computers support this type of I/O even if it is only by using the PRINT statement.

PROCESSOR INTERRUPTS

High-level languages frequently have subroutine capabilities. In HPL, subroutines are invoked with the "gsb" statement. Return to the main program is accomplished using "ret". Basic uses the corresponding statements GOSUB and RETURN.

User interrupt service routines are a variation of the subroutines. After interrupts are enabled, the subroutine is invoked because a peripheral interrupts.

The subroutine is written in the high-level language of the computer and is terminated with an interrupt return statement such as "iret" in HPL. The following HPL program fragment illustrates how user interrupt service routines are written:

```
10; 1 → I
11: oni 6, "send"
12: eir 6
.
.
.
87: "send" wtb 6,A$[I,I]
88: I + 1 – I;if I<= len(A$);eir 6
89: iret
```

Line 10 sets a counter that points to individual characters in string A$. Line 11 directs the program to line 87, labelled "send", when an interrupt occurs. Line 12 enables the interface hardware and software to accept interrupts.

Line 87 sends a single character from string A$ each time the user interrupt service routine is called. Line 88 increments the counter I to the next character and interrupts if there are more characters to transmit. Line 89 forces a branch back to the main program.

GETTING BITTEN

There are several things to note from this example. The "eir 6" enables the interface. The meaning of an interrupt is that the interface is not busy. The first interrupt will occur immediately after the computer executes line 12.

Novices at interrupt routines are always bitten by this the first time they write one. If the interface has not been made busy by sending it a character before interrupts are enabled, interrupt is immediate.

Note that a counter must be kept by the program to keep track of where the next character will come from in A$. Also note that interrupts must be re-enabled in the interrupt service routine if the transfer is not finished.

This is necessary because the "eir" is cancelled when it is invoked. That prevents the interrupt service routine from being interrupted.

BUFFERS ARE BETTER

High-level-language program lines are slow compared to the processor's machine code speed. Only low data rates can be supported with user interrupt service routines. Buffer transfers are a much better choice for data transfers, leaving user routines to service special situations.

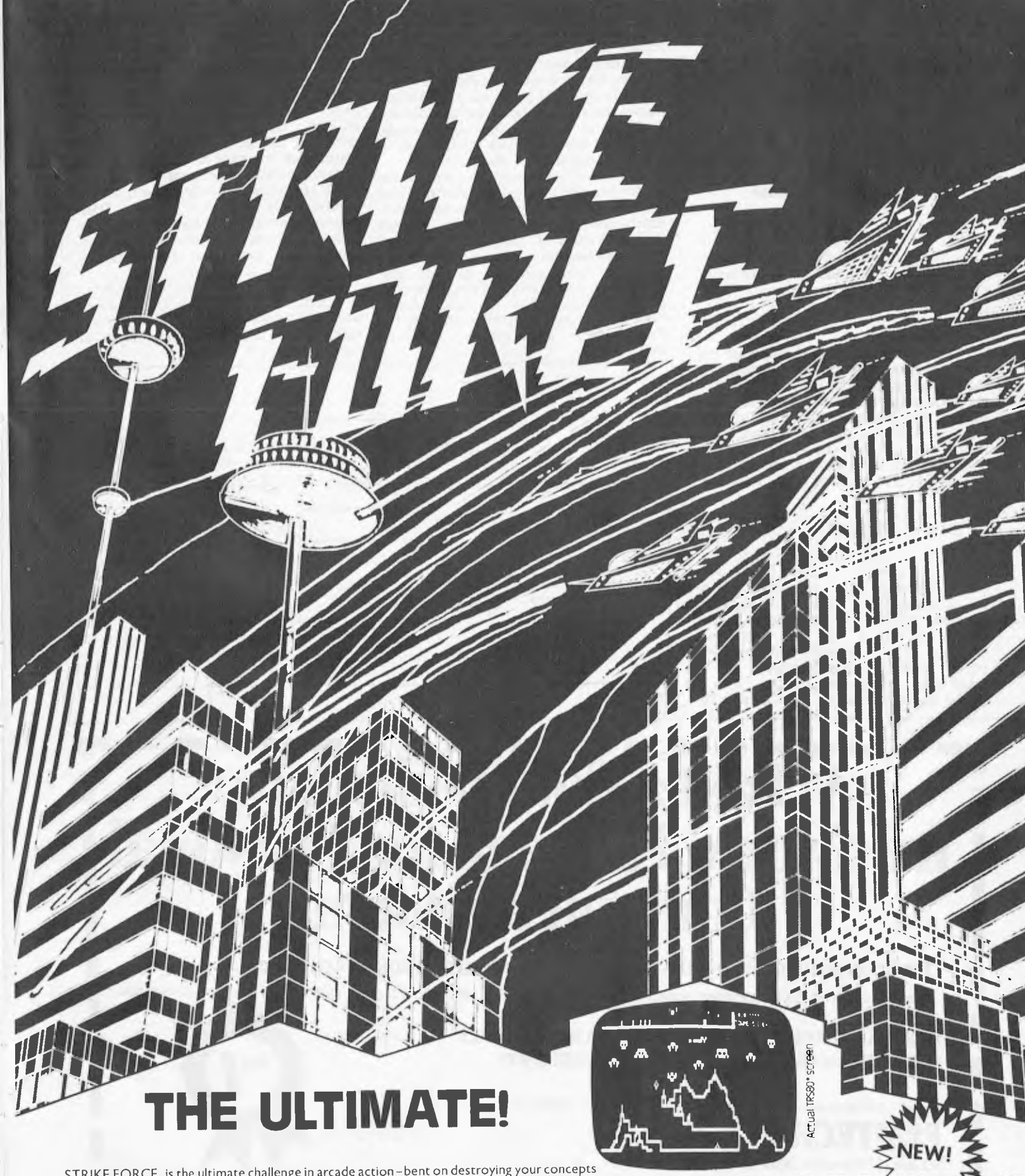
Buffers are blocks of computer memory allocated for I/O (see Figure 1). Data passes through the buffer on the way into or out of the computer. Enabling of interrupts and character counters is automatic.

Data transfers can be terminated on a count as in the above example or by a character match for buffered input. The following example performs the same task as the first, but uses buffered I/O.

```
10: buf "OUT",100,1
11: wtb "OUT"“A$
12: tfr "OUT",6
```

As you can see, this is much simpler.

STRIKE FORCE



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AI

Line 10 creates a buffer of 100 characters, line 11 fills the buffer with the contents of string A$ and line 12 sends the data to the peripheral. The 1 at the end of line 10 specifies an interrupt buffer.

Why is this technique superior to simply writing out the data directly to the peripheral? Line 12 only initiates the data transfer. After that process is started, the program will continue with line 13. When the peripheral interrupts, it will automatically be given the next character. Meanwhile, the computer is executing the rest of the program.

END OF THE LINE

Interrupt buffers are faster than user interrupt service routines for one primary reason. The only safe place to interrupt a high-level language program is at the end of a line. In the execution of a line of high-level language code temporary locations are set up, addresses are calculated and a whirl of activity is taking place.

An interrupt routine must be able to return to where the program left off after the interrupt is serviced. If the user routine accesses variables being used by the main program, or worse yet, changes them, there could be disastrous results.

That is why high-level language interrupts are restricted to the end of a line. Things are safe there.

Conversely, the routines used by the buffer transfer interrupt service routines are in machine code and are restricted. Their affect on the system is well known because all they are allowed to do is data transfer.

Buffer interrupts are allowed any time they are enabled. Thus, interrupt buffer transfers can be much faster than user interrupt service routines for data transfer. They are also easier to use.

LIMIT: ONE DMA

Once you understand interrupt buffer transfers, DMA buffers are easy because they work the same way. A buffer is set up, filled and transferred. The syntax is the same too. The only parameter that changes is the buffer type.

Only certain interfaces can support DMA transfers and only certain devices require DMA service. Since DMA requires special hardware, many computers have only one set of DMA hardware. Thus, only one DMA transfer may be active at one time.

Buffered I/O is a real convenience. It is another way of taking I/O hardware such as interrupt and DMA circuitry and making the capability available in an easy-to-use form.

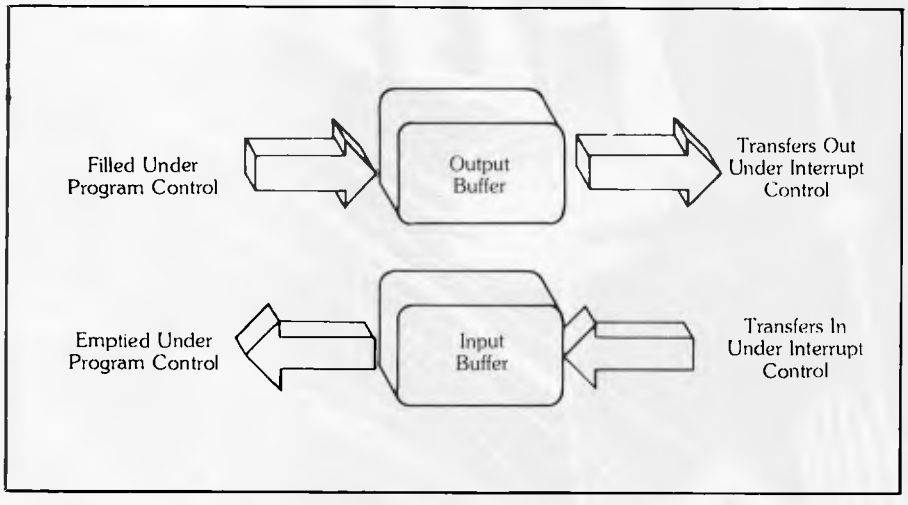

Figure 1

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TJ's WORKSHOP

Our monthly pot-pourri of hardware and software tips for the popular micros. If you have a favourite tip to pass on, send it to 'TJ's Workshop', APC, P.O. Box 280, Hawthorn, Vic 3122. Please keep your contributions as concise as possible. We'll pay $25 for any tips we publish.

ZX81 REVERSE VIDEO

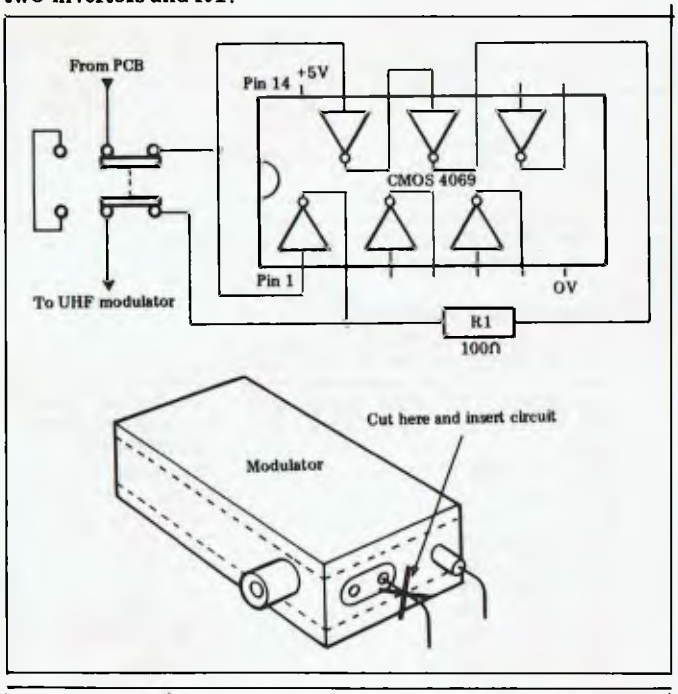
This is an idea to help all those ZX81 owners who are fed up with their black letters on a white background.

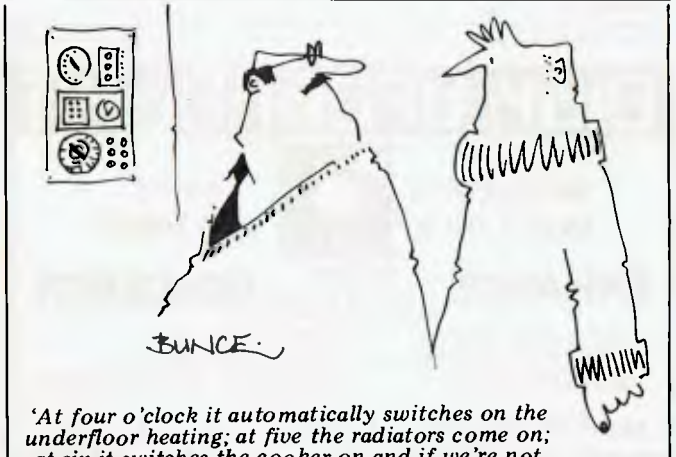
The circuit shown inverts the video signal, but, since it also inverts the TV sync signals, it is necessary to reconstitute them using the other two inverters and R1.

The UHF video input terminal (the one nearest the jack socket) has to be cut and the circuit inserted in the cut wire.

The +5V and OV power supplies can be obtained from the back plane.

Richard Wood





'At four o'clock it automatically switches on the underfloor heating; at five the radiators come on; at six it switches the cooker on and if we're not home by ten it automatically rings for the Fire Brigade.'

FASTER PET SCREEN

If you POKE to screen memory on an old PET, you'll notice a lot of flickering. To overcome this during screen display, the print character routine in ROM contains code which waits until the electron beam of the screen is returning from the bottom right hand corner of the screen to the top left hand corner. During this time the screen is inactive and so no flicker occurs. This is all very well, but this waiting slows down the screen handling a great deal.

Later on, Commodore improved the PET's hardware, so that unless the screen was accessed *very* rapidly, no flicker would ever occur. Unfortunately, these improvements came after Basic 3.0 was released, and so the wait routine is still there, even though it isn't needed. In Basic 4.0, however, the wait routine has gone, and the screen printing is much faster. If you have Basic 3.0 and you want the display speed of Basic 4.0, you could change a few bytes in the ROM, but there is a way of getting extra speed by using just two POKEs.

Bit 5 of I/O port B on the VIA is set to act as input, and it is this bit that is set to zero during the flyback period. What the two POKEs do is to set the bit to act as output, and then to set the bit itself to zero. When the wait routine is accessed, it sees that bit 5 is zero, thinks the beam is returning, and so waits no more.

Scrolling, however, is not speeded up and, if a lot of scrolling is involved, the increased speed will not be noticeable if only a few lines are involved. Under optimum conditions — that is, with no scrolling at all — printing is speeded up by about three and three-quarter times.

The two POKEs are:
POKE 59458,62:POKE 59456,223

It is important to do these two POKEs on one line, as the first defines bit 5 as output, and this bit may be set so that when the PET comes to print out READY, the computer will wait for this bit to go zero, which will never happen. The second poke ensures that this bit is set to zero before any more printing is done.

Finally, a word about monitors. I bought my PET new in January last year. It has the small keyboard and built-in cassette deck. It has only 8K (dynamic not static) but still has a monitor. Whether or not you have a monitor depends on which ROM you have and not, as many people think, on how much RAM you have. The rule is: if you switch on and see '***COMMODORE BASIC***', then you do not have a monitor as you have Basic 2.0, otherwise you *do* have a monitor.

J. Slodzik

RAMTOP REVISITED

Having read *APC's* tips for resetting RAMTOP on the ZX81, I enclose the 'follow-up' to Geoff Wilkins' idea. RAMTOP can be reset from a program, without stopping it, clearing memory or clearing variables; it simply involves CLS, as follows:

To set RAMTOP to 30000;
10 POKE 16388,48
20 POKE 16389,117
30 CLS.

As from line 30, RAMTOP will be at 30000 (7530H). This routine does not have to be at the beginning of the program.

T. Costigan

TJ's WORKSHOP

NUMBER FORMATTING

I was interested in D Gayler's program in the June TJ's workshop to print numbers, including values less than 0.01, to three places of decimals. If you input some numbers greater than 1, the decimal points no longer fall in line. If you input numbers between 0.0095 and less than 0.01 the system fails altogether and prints .00:

The effect sought by D Gayler, with the additional benefits of showing a leading zero for quantities less than 1 and keeping the decimal points in line when some values are greater than 1, can be achieved using PRINT USING as shown in Program 1.

In some circumstances it could be desirable for the actual number entered to be printed without rounding. Program 2 prints out all the entered figures without rounding and with all trailing zeros supressed to avoid giving a false idea of accuracy.

These programs were run on a TRS-80 Level II

Peter Davy

```
10 LPRINT"NORMAL";TAB(15)"IMPROVED"
20 INPUT N
30 LPRINT N;
40 LPRINT TAB(15) USING"##.###";N
50 GOTO 20
```

```
NORMAL          IMPROVED
 12             12.000
 12.2375        12.238
 9.5E-03         0.010
 9.2E-03         0.009
 .543            0.543
 4.67            4.670
 5.786           5.786
 .2039           0.204
 9.87654         9.877
 8.87654         8.877
```

```
10 LPRINT"NORMAL";TAB(15)"IMPROVED"
20 INPUT N
30 IF N=INT(N) THEN A$="##":GOTO 60
40 IF INT(N)=0 THEN M=N+1 ELSE M=N
50 A$="##."+STRING$(LEN(STR$(M))
     -LEN(STR$(INT(M)))-1,"
60 LPRINT N;
70 LPRINT TAB(15) USING A$;N
80 GOTO 20
```

```
NORMAL          IMPROVED
 12             12
 12.2375        12.2375
 9.5E-03         0.0095
 9.2E-03         0.0092
 .543            0.543
 4.67            4.67
 5.786           5.786
 .2039           0.2039
 9.87654         9.87654
 8.87654         8.87654
```

ROUNDING

With reference to D Gayler's note about printing floating point numbers to three decimal places *(APC* June) perhaps some of your readers do not know that B=INT (A*10 ↑ D+0.5)/10 ↑ D gives B the value of A rounded to D decimal places.

Peter Howard

TRS-80 EXIT

Here's a routine to deal with situations where your main program calls subroutine A, which then calls subroutine B, then subroutine B wishes to return straight back to the main program without going through subroutine A.

Some Extended Basics allow this, using a POP or EXIT command which deletes from the stack all information concerning the last GOSUB statement executed. So in our example a POP followed by a RETURN in subroutine B would go straight back to the main program.

Program listing 1 contains a short 12-line program to implement such a command on a 16k LII TRS-80.

If the program is typed in and executed it will reserve memory at the top of memory for a short machine code routine; it will also POKE the routine into memory and link the routine to the LINE command, which is only used if you have disks.

The routine poked into memory is only 10 bytes long, and all that it does it to clear all information concerning the last GOSUB from the stack before returning to the program.

Program listing 2 illustrates how the statement is used. If the LINE command in line 50 were not present then the RETURN in line 60 would return execution of the program to line 30, but the LINE command in line 50 clears all information about the GOSUB 50 in line 30 from the stack.

Once program listing 1 has been run the machine code routine will stay in memory until the computer is switched off or crashes — a NEW command will not delete the routine.

The program is short enough to load every time you have a session with your computer and you do not need to set the memory size as the program does it itself. It was written on a Model I, but it should work on a Model III or a System 80 without any alterations.

Tim Pile

```
10 PRINT"LINE 10": GOSUB 30
20 PRINT"LINE 20": END
30 PRINT"LINE 30": GOSUB 50
40 PRINT"LINE 40": RETURN
50 PRINT"LINE 50": LINE
60 PRINT"LINE 60": RETURN

RUN
LINE 10
LINE 30
LINE 50
LINE 60
LINE 20
```

Listing 2

```
0  POKE 16562, 127: POKE 16561, 245  'SET TOP OF MEMORY
1  POKE 16545, 127: POKE 16544, 195  'SET STRING SPACE
2  CLEAR                             'REINITIALISE
3  FOR I = 32758 TO 32764            'THIS LOOP POKES
4  POKE I,51                         'SEVEN "INC SP"'S
5  NEXT I                            'INTO HIGH MEMORY
6  POKE 32765, 195                   'THIS POKES THE
7  POKE 32766, 30                    'CODE FOR
8  POKE 32767, 29                    '  JP 1D1EH
9  POKE 16803, 195                   'THIS LINKS THE
10 POKE 16804, 246                   'LINE STATEMENT
11 POKE 16805, 127                   'TO BASIC
```

Listing 1

$1-60 INTERFACE

I have always looked on the Commodore VIC 20 as the ideal personal computer since the advertising listed so many 'built in' features. I was disappointed to find that to use the 'built in RS232' port, one should purchase an add-on extra for $40 – $80. As this was beyond my pocket, I investigated cheaper ways.

A normal RS232 port uses voltages of +20 and -20 for the zero and one bits and the VIC User I/O +5 volts and 0 volts. This is not a problem and provided the connecting wires are kept short, the system works well.

The User I/O at the back of the VIC is shown in figure 1 (looking at the back of the VIC) and a standard RS232 connector is shown in figure 2 (looking at the socket).

Note that pin M on the VIC is the signal out, pin 3 on the RS232 is for the signal in and pins N and 7 are the signal ground.

When I first tried connecting these two, only complete garbage was received on the printer and an investigation with a CRO showed up an important anomaly. The VIC puts out a 1 bit as +5V and an 0 bit as an OV and the RS232 port requires a 1 bit as a negative voltage and an 0 bit as a positive voltage.

Consequently, a direct connection will not work and you need an inverter as shown in figure 3.

For the less technical minded, there are a variety of inverters available. The easiest way is to go to the nearest electronics shop and buy an 'inverter'. It will come as a small black chip and will probably contain three or six in one package. You will need to ask for an explanation of the pins. I have found that ones purchased from Tandy have a diagram of the chip on the back of the package.

For people with some chips around, you can easily use NAND or NOR gates or an inverting buffer.

Whatever inverter is used, it will need a 5 Volt power supply and this can be obtained from the User I/O. Pin 2 of the port is +5V and pin 1 the corresponding ground. The final circuit is shown in figure 4.

Working on a very low budget, I did not buy either a 12 pin, double sided edge connector (of 4mm spacing) for the VIC I/O or even a standard 25 pin for the RS232 port. I attached wires to the port of the VIC with small aligator clips making sure that I put a small plastic cover on the other side to prevent shorting. The wires to the printer were simply pushed into the correct holes. For connection to the 'chip' I soldered wires to a 16 pin socket and then carefully pushed the chip into the socket.

Having connected it, a small amount of computer programming is needed to drive the printer. I organised the printer for 300 baud, 1 stop bit and no parity which, for the VIC, is easiest to set up. I must admit that I tried different baud rates and they were not successful.

The program for the VIC is simply:

```
POKE 659,38 (this set up
   the VIC for the above)
OPEN 128,2  (this initial-
   ises the RS232)
CMD#128     (instructs
   that all print and list
   will go to the RS232)
LIST        (lists the
   program)
```

There are some other commands that will work well. They are PRINT#28 (without CMD) which will enable you to have printing to both the printer and the screen. The command may be used in either direct mode (without a line number) or in a program with a line number.

A little bit of care is needed with the OPEN instruction. An OPEN 128 will automatically add a line feed after a carriage return, an OPEN 127 will not. If you don't know which to use, try both. Do remember that an OPEN 127 must be followed by 127 and not 128. When the open command is initiated, it takes 512 bytes of memory. If you have less than this amount of free space, (FRE(0)), it will overwrite some of your program. The OPEN also initialises all variables so you will need to use it very early in the program.

I used an ANADAX printer with 2k of memory and the printing rate is noticeably slow.

A couple of simple programs are listed below:

```
10  POKE 659,38
20  OPEN 128,2
30  FOR A = 1 TO 30
40  PRINT#128,A,A*A
50  NEXT A
60  CLOSE 128
```

```
POKE 659,38
10  OPEN 128,2
20  INPUT A$
30  CMD#128
40  PRINT A$
```

J. Goodsell.

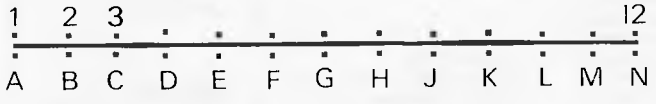


Figure 1

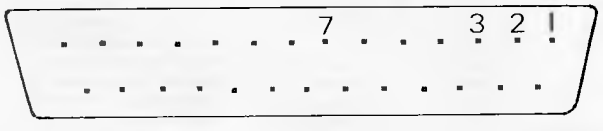


Figure 2

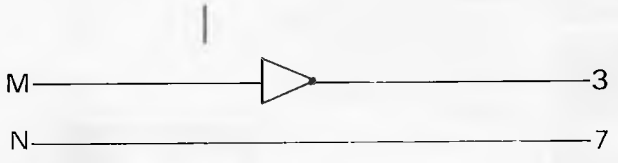


Figure 3

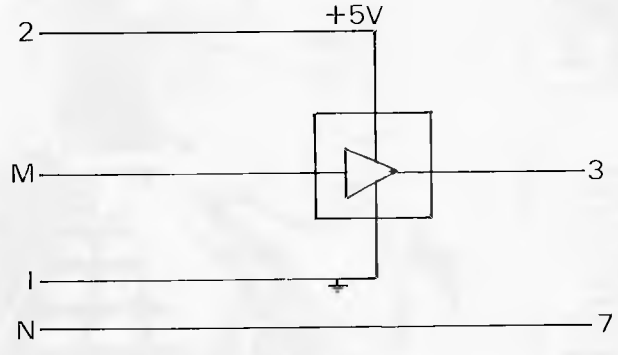


Figure 4

BACK ISSUES SERVICE

Here is a complete guide to available back issues of APC. A quick guide to their contents is shown here. Check the coupon for the issues you require.

Volume 1 Nos. 1, 2, 3, 5 & 12 and Volume 2 Nos. 1 & 2 are no longer obtainable, but photocopies of any article published in these issues are available on request at a cost of $2.00 each. Please state clearly volume and issue number.

Volume 1 No. 3
Benchtest: Tandy TRS-80 Model II. Animistics. M68000-Motorola's Sweet 16. Computer Games: Big trees and the Alpha-Beta algorithm. Plotting in Three Dimensions. The Complete Pascal: Loops. Checkout: Exatron Stringy Floppy. Z80's control signals. Programming the Simple Approach. Z80 Instruction Set. Programs: Byte Saver (TRS-80), TRS-80 Graphics, Word Processor (Sorcerer), Space Slalom (Apple), Robot Nim (PET).

Volume 1, No. 4
Benchtest: Hewlett Packard's HP85. Benchtest: Texas TI 99/4 Home Computer. Gateways 'o Logic. Adding a different family of chip to your micro. Computer Games: Speeding up the Search The Complete Pascal: Data Structures. Programs: 3D Noughts & Crosses (TRS-80), PET Backgammon

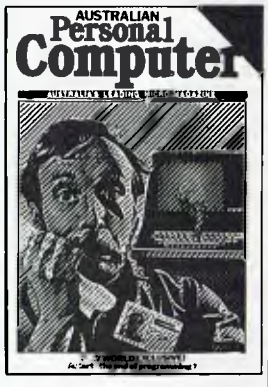
Volume 1 No. 5
Limited supplies only available
Benchtest; Sinclair ZX80. Marketing Strategies of Micro Manufacturers. Computer Games. Gateways to Logic: Boolean Algebra. Micro Chess: A brief history of chess programming. The Complete Pascal: Control Structures II. Whistling up Colour: Apple "hands off" control. Programs: Showpiece (Apple), Dots & Boxes (PET).

Volume 1 No. 6
Benchtest: CBM Model 8032 'SuperPET'. Microchess. Basic Basic. Benchtest: Super-Brain. Programs: Lunar Lander (TRS-80), PET Fighter Pilot, Apple Plotting, Lprint to Print Utility (TRS-80), ZX80 Breakout, Graph (TRS-TRS-80).

Volume 1 No. 7
Robotics. Micro Chess. Computer Games: Guessing the odds. APC-80. The Complete Pascal: Records and files. Calculator Corner: Speed up your TRS-80 pocket computer programs. Programs: TRS-80 Tarot, PET Bloobers, PEEK & POKE for Apple Pascal, PET Demolition, Superboard Bug Bypass, String Function, Several Sorts.

Volume 1 No. 8
Benchtest: Atari 400 & 800. The Complete Pascal. Gateways to Logic. APC-80. Helping the Handicapped: A look at a US company specialising in this field. Programs: Reading 'System' Tapes into the System 80, Monster Multiplier (Apple II), Read-write Routines (PET), Program Formatter.

Volume 1 No. 9
The Last One: The program which writes programs. Multi-user Systems. Computer Games. Disk Basics: What makes them click? Get Well Soon: How to recover from a data tape disaster. APC-80. Gateways to Logic. Ultra-fast Tape Storage: Data-transfer rates of up to 9600 baud for the Ohio Scientific Superboard. The Complete Pascal. Forth: A review of the language. Programs: TRS-80 Target Practice, TRS-80 Four in a Row, PET Anagram, PET Obstacle Course, Minefield (TRS-80).



Volume 1 No. 10
Slow Scan TV: How micros are putting themselves in the picture. Disk Basics: More on disk drive interfacing. APC-80. On The Level: Cure those tape troubles. Computer Games: Draughts. The Complete Pascal. Choosing a Computer System: Hints on buying your first business computer. Word Processing: How to define your needs. Profile: Rudi Hoess, the man behind Apple in Australia. Multi-user Systems. Systems Development: Program development and implemementation. Searching String Arrays. Turning USR(X) Routines into Data Statements. Pack It In: Squeeze more data onto your disks or tapes. Programs: TRS-80 Rocket Attacks, Superboard Mines, PET Brick Stop.

Volume 1 No. 11
Benchtest: Acorn Atom. Switch in Time: For when 'Dallas' is too important to miss . . . Gateways to Logic Another Dimension: Three-dimensional plotting. The Complete Pascal. APC-80. Computer Games: Chess. Wordprocessor Benchmarks. WP Benchtest: Word Pro 4 Plus. Multiuser Test: MP/M. Systems Development: Profile: Dick Smith. Program Packing. Single Key Keyword Entry: Superboard. Search/Change in Applesoft. Put Your Hooks into OSI Basic. Programs: Sorcerer Simple Word Processor, Compucolor II Function Plotting, TRS-80 Auto Fuel Consumption, TRS-80 Towers of Hanoi, PET Aircraft Landing, TRS-80 Giant Trap, PET Wire, PET Convoy.

Volume 1 No. 12
Inside Printers. Computer Games. Benchtest: Bigboard, Gateways to Logic. TRS-80 Compiler. OSI Basic-in-ROM. WP Benchtest: Magic Wand. Profile: Nigel Shepherd. Parliament House in Micro: The role of Crome co. Multi-user Test: MVT/Famos. Solar System Simulation. Drawing Lines on PET's 80 x 50 Grid. Single Key Key Development: Abbreviating commands. Programs: PET Replace, TRS-80 Demon Hunts, PET Chords, ZX80 Sliding Letters.

Volume 2 No. 1
Printer Review: Dick Smith's offering. Gateways to Logic. Joystick Interfacing: Control on the TRS-80. Classroom Zest: A computer aided instruction package described. TRS-80 Compiler. APC-80. The End of Flowcharting. Wordprocessor Comparison: Spellbinder vs Wordstar. Multiuser Test: Onyx C8002. Choosing a Programmer. Profile: The Tandy Corporation. Unix: A Review. Define Your Own Function Key on PET. Superboard II Edit: Extra function key. Multiplexing PET: Increasing I/O data handling. Programs: Program Packing (6502), Cosmic Wars '80 (TRS-80), TRS-80 Worm, System 80 Dodgem.

Volume 2 No. 2
Apples for the Handicapped. TRS-80 Tiny Compiler. Profile: Bill Anderson. Facing the Future: Barry Jones. Print Using for Applesoft. SBII Plus: Improve the Super board II. Multiple File Tape Backups. Relocating OSI Basic-in-ROM. Programs: Bigboard Real Time Clock, APC-80 Alien Invasion, PET Radio Technician Course.

Volume 2 No. 3
Benchtests: Sinclair ZX81. APC-80. Building a Bigboard. Keystroke Reduction: TRS-80. WP: The Sanders Printer. Profile: Bill and Niki Saunders. CP/M by Rodnay Zaks. Rapid Bubble Sort. Encryption with RND and USR. The 6502 Dream Machine. Vectors and the Challenger IP. Programs: TRS-80 Input Routine, Treasure Hunt (PET).

Volume 2 No. 4
Benchtest: Vic 20. Software Review: MCMON. Computer Games. Tree Access Routines. Gateways to Logic. Is it a Bird? What is a personal computer. How Computers Communicate. Benchtest: Tandy III. Profile: Gary Blom. Program Planning. 6502 Assembler in Basic. Increase Your Word Power. Programs: PET Arithmetic Test. Apple Mondrian.

Volume 2 No. 5
Benchtests: IBM, NEC PC-8000, Spellbinder. The Gates are Wide Open. Winchester Hard Disks. Computer Games: Poker. Gateways to Logic. Hal Towards 2000. Applesoft Mystery Parameter. Pet Symbolic Disassembler. Programs: TRS-80 Sailing Simulation, ZX80 Eldorado, PET Gomoku.

Volume 3 No. 1
Newsbrief. TD's Workshop. Hitachi 'Peach' Review. Benchtest: Tandy TRS-80 Color. Profile: Rodnay Zaks. The BBC Proton. Disk Sorting Routine. Getting More out of your system 80. Computer Games: Go-Moku. Patterns. Go Forth (and Multiply). Stext Graphics. Checkout: Le Sharp Microtranslator. Man, Machine and Mouth. Rubik Cube Simulation. Polygons. Programs: Apple II Get Simulation, Bug Bug, Superboard Cryptography.

Volume 3 No. 2
Apple III Review. Cubic Spline Fitting. Man, Machine and Mouth. Computer Games: Bridge. Relocatable Assembly Language Code. Binary Sort. March to a Different Drummer. Number Crunching. Inside the Interpreter. ZX81 Printer Checkout. APC-80 Rides Again. Putting Arrays on Tape. Frames of Reference. How Computers Communicate. Microcomputer Databases. Programs: Alien Seabattle (TRS-80/System 80).

Volume 3 No. 3
Checkout: The Australian Beginning. Videotext – An Overview. Benchtest: Hewlett Packard HP-125. Frames of Reference. The Man Behind the West Coast Faire. How Computers Communicate. Software Benchtest: Scripsit 2.0. User Group Index – a complete listing. TJ's Workshop. Checkout: Dick Smith's Votrax Type 'N Talk. Hi Res for the TRS-80. Computer Games. Programs: Galacti-Cube (Apple II), PET Fantasy, ZX80 Labyrinth, PET Jungle.

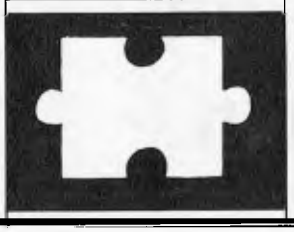
Volume 3 No. 4
A Machine For All Seasons: The Commodore 64. Screenplay: Atari 400. Adam Osborne: A Profile. ANS Basic. Patterns: Frames of Reference. High Density VDU Card. How Computers Communicate. APC-80: Recovery after Syntax Errors. TJ's Workshop. Calculator Corner: HP's networking system. Benchtests: Osborne 01, Applied Technology's Micro Bee. Programs: TRS-80 Reaction Timing, ZX81 Graphplot, PET Cheese, Superboard II Spin-Fighter, TRS-80 Extra.

Volume 3 No. 5
Calculator Corner: Casio's printer. TJ's Workshop. Screenplay: Tandy TRS-80. Frames of Reference. How Computers Communicate. 3D Made Easy. Getting to the Roots. High Density VDU Card. Logo – An Overview. Printer Survey. Benchtests: Texas Instruments TI 99/4A, Rank Xerox 820. Software Benchtest: FMS-80 Database. Programs: TRS-80 Double Precision Maths and Trig, Apple 3D Maze, Atari Sums for Kids, Apple Air Fight.

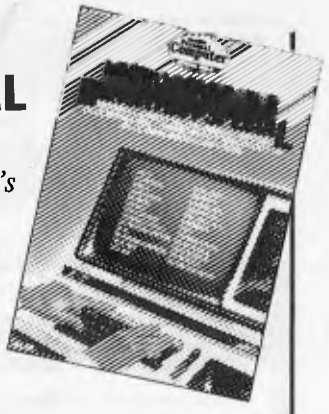
Volume 3 No. 6
7th West Coast Faire. Checkout: Ampec F-10 Daisywheel printer. Checkout: The Arfon Expandaboard. Benchtests: ZX Spectrum, Sirius 1, dBase II. How Computers Communicate. Frames of Reference. Twenty Three Matches. High Density VDU Card. Pouring Schooners into Midies. Lisp – An Artificial Intelligence Language. Screenplay: VIC 20 games. CP/M System Calls. APC Sub Set. Programs: Invader, PET Mini-animate, VIC-20 Trailblazer, ZX81 Book Index, Weebug Monitor, VIC-10 Large Characters.

Volume 3 No. 7
Screenplay. Checkout: The Micro-Professor. APC-80. Version 7. Patterns. Frames of Reference. How Computers Communicate. Shmunck. Benchtests: Sharp MZ80B, Monroe OC 8820. Programs: ZX81 Hypocycloids, TRS-80 Truth, PET Doc, TRS-80 Screen Dump, PET Boxes, Atari Earth.

Volume 3 No. 8
NCC Show Report. Sirius Graphics. Sony SMC-70. Patterns. P for Perfect. IBM Micro – The New Chapter. Apple Trees. How Computers Communicate. APC-80: Program Packer Utility. APC4EX. One Bit at a Time. Apple II Screenwriter. Benchtest: Sord M23. Programs: TRS-80 Quadrangle, PET Mopup, Randomization Tests.



APC SPECIAL



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* Volume 1 Nos 1, 2, 3, 5, 8, 10, 11 & 12 and Volume 2 Nos 1, 2 & 4 are unavailable.
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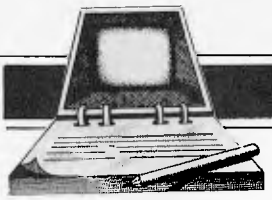


DIARY DATA

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'.

Melbourne	Data 82, Melbourne Showgrounds	November 9–11, 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

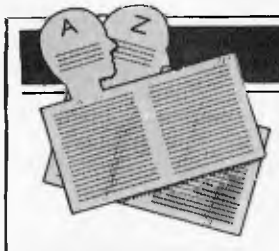
Here is a list of all Australian personal computer networks. As more networks appear – and as more facilities are added to existing ones – we'll report them in this section, which appears monthly.

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.

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

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

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

AUSOM
Apparently the number we've been publishing is incorrect so we'd (and the poor Telecom subscriber with number 878 0219) ask that communications in future be in writing to P.O. Box 43, Forest Hill, 3131 until a new number is advised.

EASTERN SUBURBS 80 USERS GROUP
The group meets on the fourth Wednesday of each month (except August) at Kingswood College, 355 Station Street, Box Hill, 3128. Starting time is 7pm.

For more information telephone Cameron McKern on (03) 288 1713 AH or via MCCKCHESSURR on The Australian Beginning.

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

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

Apple-Q is affiliated with Apple Core.

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

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

FMS SOFTWARE AND HARDWARE FOR CP/M BASED SYSTEMS

Agent for: Lifeboat Associates, Sigma International, Compuview, Westico, Memtech, Anderson Digital Equipment, AWA.

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New products appear in red.

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DESPOOL
DISILOG
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EDIT
EDIT-80
FILETRAN
IBM/CPM
MAC
MACRO-80
MINCE
PASM
PLINK
PLINK II
PMATE
RAID
Reclaim
SID
TRS-80 Model II Customization Disk
Unlock
WordMaster
XASM: 05, 09, 18, 48, 51, 65, 68, F8, 400
XMACRO-86
ZAP80
ZDT
Z80 Development Package
ZSID

Telecommunications:
BSTAM
BSTMS
MicroLink-80
RBTE-80

Languages:
ALGOL-60
APL/V80
BASIC Compiler
BASIC-80
baZic II
BD Software C Compiler
CBASIC-2
CIS COBOL (Standard)
CIS COBOL (Compact)
COBOL-80
FORTRAN-80
KBASIC
muLISP/muSTAR-80
Nevada COBOL
JRT Pascal
Pascal/M
Pascal/MT
Pascal/M +
Pascal/Z
PL/I-80
STIFF UPPER LISP
S-BASIC
Tiny-C
Tiny-C Two
UCSD Pascal
Whitesmiths' C Compiler
XYBASIC

Language and Applications Tools:
BASIC Utility Disk
DataStar
FABS
FABS II
Form 1 for CIS COBOL
Form 2 for CIS COBOL
MAGSAM III
MAGSAM IV
M/SORT for COBOL 80
PSORT
QSORT
STRING/80
STRING BIT
SUPERSORT
ULTRASORT II
VISAM

Word Processing Systems and Aids:
Benchmark
MicroSpell
Letteright
Magic Wand
Spellguard
TEX
Textwriter III
WordIndex
WordStar
WordStar Customization Notes

Data Management Systems:
CONDOR
HDBS
MDBS
MDBS:DRS,.QRS,.RTL
dBASE II
PRISM/LMS
PRISM/I MS
PRISM/ADS

General Purpose Applications:
CBS
Selector III-C2
Selector IV

Mailing List Systems:
Benchmark Mailing List
Postmaster
Mailing Address
MailMerge for WordStar
NAD

Financial Accounting Packages:
BOSS Financial Accounting System
Peachtree Financial Packages
Structured Systems Group Financial Packages
GLector

Numerical Problem-Solving Tools:
T/MAKER II
fpl
PLAN80
Analyst
Microstat
muSIMP/muMATH
Statpak

Professional And Office Aids:
Angel
American Software Property Management Package
Cornwall Apartment Management
Datebook
ESQ-1
Guardian
Professional Time Accounting
Property Management
PAS 3 Medical
PAS 3 DENTAL
Sales Pro
Univair 9000 Series Family Medical Management
Univair 9000 Series Family Dental Management
Univair 9000 Series Insurance Agency Management
Univair 8000 Medical Management
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The CP/M Handbook (with MP/M)
The C Programming Language
8080/Z80 Assembly Language Techniques For Improved Programming
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H.W.Sams Crash Course in Microcomputing
Introduction to Pascal
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Pascal User Manual and Report
The Pascal Handbook
The Pascal Primer
Payroll with Cost Accounting —CBASIC
Structured Microprocessor Programming
Using CP/M—A Self-Teaching Guide
Smartmodem
DC Data Cartridges
Flippy Disk Kit
Floppy Saver
Diskette Drive Head Cleaning Kits
Vari Clean Cleaning Kit

Disk Operating Systems
Software Bus Family
SB-80
CP/M-80
MP/M

Hard Disk Integration Modules

Media and Formats

These are diskette, cartridge disk and cartridge tape format codes, to be specified when ordering software for listed computer or disk systems. All software products have specific requirements in terms of hardware or software support, such as MPU type, memory size, support operating system, or language.
New formats appear in **red.**

ADDS Multivision	RT
Altair 8800	B1
Altos	A1
Apple CP/M-80 13 Sector	RG
Apple CP/M-80 16 Sector	RR
BASF System 7100	RD
Blackhawk Micropolis Mod II	Q2
California Computer Sys 8 in	A1
CDS Versatile 3B	Q1
CDS Versatile 4	Q2
Columbia Data Products 8 in.	A1
Columbia Data Products 5.25 in.	S4
COMPAL-80	Q2
Computer Ops N.C. HQ	S2
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
DEC VT 18X	SD
Delta Systems	A1
Digi-Log Microterm II	RD
DTC Micro 210A	SC
Durango F-85	RL
Dynabyte DB8/2	R1
Dynabyte DB8/4	A1
Exidy Sorcerer + Lifeboat CP/M-80	Q2
Exidy Sorcerer + Exidy CP/M-80 5.25 in.	RW
Exidy Sorcerer + Exidy CP/M-80 8 in.	A1
EXO	A1
Findex	P6
Heath H8 + H47	A1
Heath H89 + Magnolia CP/M-80	P7
Heath H89 + Heath CP/M-80	P7
Helios II	B2
Hewlett-Packard 125, 5.25 in.	SB
Hewlett-Packard 125, 8 in	A1
IBEX 7100	RQ
iCOM 2411 Micro Floppy	R3
iCOM 3712	A1
iCOM 3812	A1
IMSAI VDP-40	R4
IMSAI VDP-42	R4
IMSAI VDP-44	R5
IMSAI VDP-80	A1
Industrial Microsystems 5000	RA
Industrial Microsystems 8000	A1
Intel MDS SD	A1
Intertec Superbrain DOS 0.1	R7
Intertec Superbrain DOS 0.5-2.x	RJ
Intertec Superbrain DOS 3.x	RK
Intertec Superbrain QD	RS
ISC Intecolor 8063/8360/8963	A1
Lexitron VT1303 DSDD	SB
Lexor Alphasprint Model S1	S1
Meca Delta-1 5.25 in.	P6
Micromation	A1
MicroMega 85	SC
Micropolis Mod I	Q1
Micropolis Mod II	Q2
MITS 3200-3202	B1
Morrow Discus	A1
Mostek	A1
MSD 5.25 in.	RC
MULTI-TECH-I	Q2
MULTI-TECH-II	Q2
Nascom (Gemini drives)	R3
NCR 8140/9010	A1
NEC PC-8001	RV
NNC-80	A1
NNC-80W	A1
North Star SD	P1
North Star DD	P2
North Star QD	P3
Nylac Micropolis Mod II	Q2
Ohio Scientific C3	A3
OKI IF-800	RZ
Osborne-1	SA
Pertec PCC 2000	A1
Processor Technology Helios II	B2
Quay 500	RQ
Quay 520	RP
RAIR DD	RE
Research Machines 5.25 in.	RH
Research Machines 8 in.	A1
Sanco 7000 5.25 in.	RQ
SD Systems 5.25 in.	R3
SD Systems 8 in.	A1
Spacebyte	A1
Tarbell 8 in.	A1
TEI 5.25 in.	R3
TEI 8 in.	A1
Televideo DD/DS	S5
T.I.P. (Alloy Engineering, Inc.)	T3
Toshiba T200	SF
TRS-80 Model I Standard	M-R2
TRS-80 Model I + Shuffleboard 8 in.	A1
TRS-80 Model II	A1
Vector MZ	Q2
Vector System 2800	A1
Vector System B	Q2
Vector VIP	Q2
Vista V-80 5.25 in. SD	R8
Vista V200 5.25 in. DD	P6
Wangwriter	SE
XEROX 820, 5.25 in.	S6
XEROX 820, 8 in	A1
Zenith Z89 + Magnolia CP/M-80	P7
Zenith Z89 + Zenith CP/M-80	P7

COMING SOON!
ARCHIVES 1
AVL Eagle II
Commodore CBM/Pet 2000/3000/4000 Series
Commodore CBM/Pet 8000 Series
Dysys ESC 4500
EXO
Heurikon
Heuristics
MULTI-TECH III, IV
Nascom/Lucas
NCR 2950
Northern Telecom 503
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TRS-80 Model III
Zeda 580

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The list of available formats is subject to change without notice. In case of uncertainty, call to confirm the format code for any particular equipment.

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

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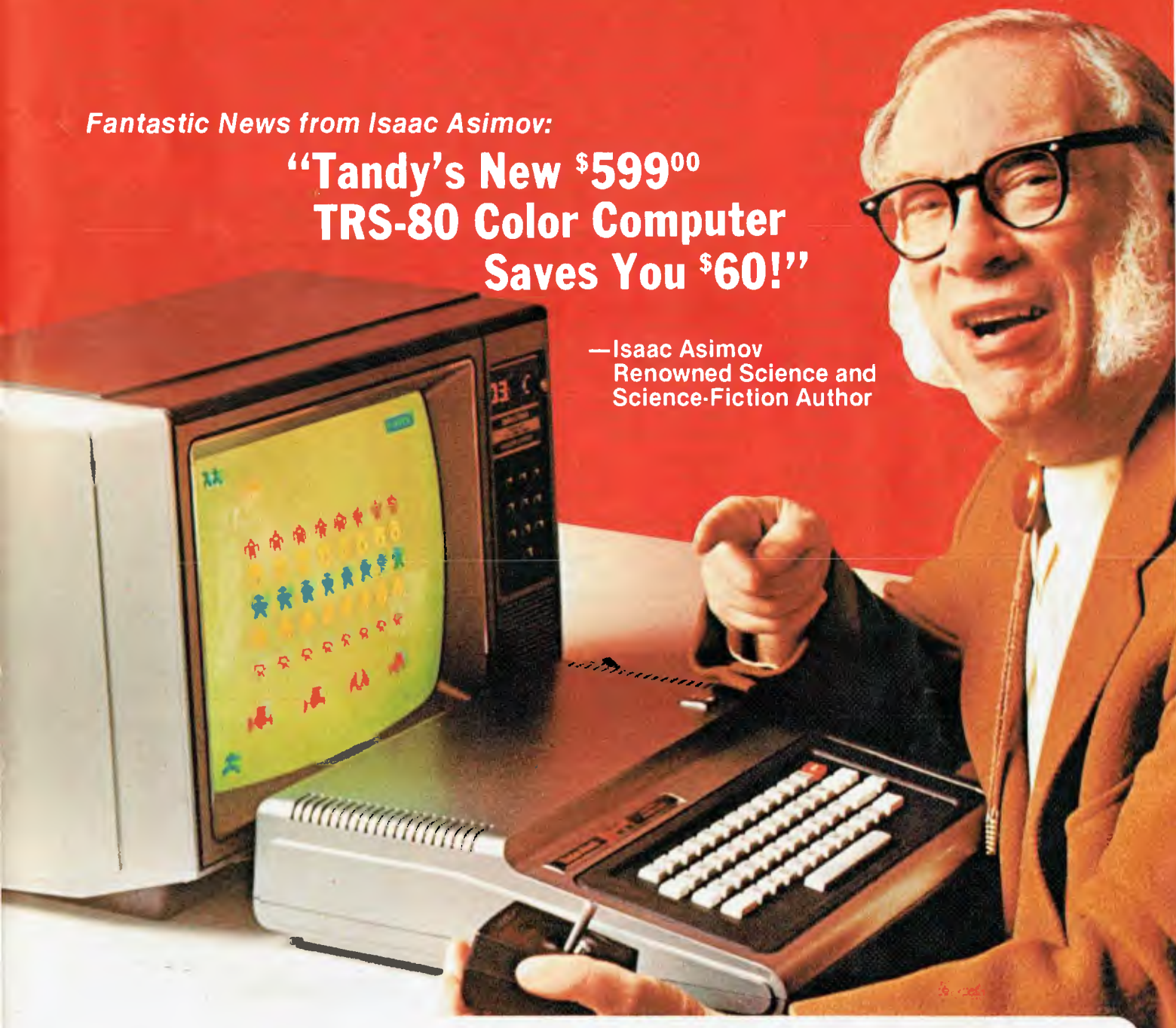

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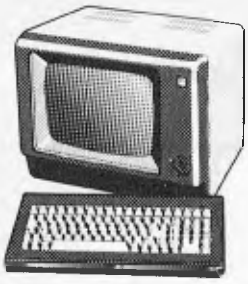
Continued from page 19.



ICL Personal Computer

Two other pieces of software were provided with the test system: WordStar and CalcStar, the latter being MicroPro's answer to Visicalc. CalcStar worked smoothly once I had SET the console parameters correctly. A SUBMIT file was provided for the purpose, but I had altered some of the default settings. A feature of CalcStar that I have not previously seen in a spreadsheet program was that it includes functions which allow linear regression to be performed. This technique, when applied with care and understanding, can be useful for forecasting purposes.

As for WordStar (the new version with improved menus and horizontal scrolling), it works as well on the PC as on any other machine I have seen, although I do not think the copy I received was fully configured to make the maximum use of the terminal's features (e.g. line and character insertion). In addition, neither it nor CalcStar utilise the function keys, but it would be a simple matter to program the terminal appropriately. More extensive alterations could be made to WordStar to give the editing keys their appropriate function (e.g. making 'Line Del' actually delete the current line). Such changes would only be an advantage if users were unlikely to run WordStar on a different terminal.

Documentation

The documentation for the system comes in several sections. To start with, there is a small (but fairly thick) spiral bound book giving a clear guide to setting up the machine and the basics of its use. This type of manual is becoming increasingly common, and should be of value to new users. As it includes details of irregularly performed operations like changing printer ribbons, as well as sensible advice about the care of diskettes, it would be worth keeping this user guide close to the machine (preferably tied on with string so it can't walk away!).

The CP/M documentation is not the often criticised set of Digital Research manuals. Rair produced its own manual covering the standard features of the operating system as well as enhancements, leaving out all unnecessary information. It is definitely an improvement, but it's still not the gentle introduction that I would have liked when I was first introduced to CP/M.

Although the MP/M manual carries a Rair copyright notice, it reads like a Digital Research publication. Regardless of authorship, the manual presupposes a working knowledge of CP/M, and does little apart from outlining the differences between the two systems. Neither operating system manual give sufficient information to allow customisation beyond the setting of the options described earlier, although that is understandable given the market sector at which the system is aimed.

The Basic manual is simply a reprint of the Microsoft publication. Since it is a reference guide, I wish they had arranged the keywords in simple alphabetical order. I know there is an index, but keywords are classified into commands and statements, or functions. If this distinction were removed, the index would be unnecessary. A minor point, I know, but it is something that has irritated me on many occasions.

A manual for the terminal is also supplied. This is essential reading for anyone wishing to make the most of its features, but there are some strange expressions to be found within its covers. For example, under 'Trouble-shooting' we find:

> Symptom . . . The buzzer not sound.
> Check . . . . . Isn't power cable loose?

You guessed it: the terminal was made in Japan. I find it surprising that a company which supplies a rewritten CP/M manual has not checked the standard of documentation issued under its own name.

Expansion

As mentioned above, the four models in the range differ only in terms of memory size, disk capacity, and number of serial ports fitted. Upgrading to a higher specification is therefore a matter of plugging in extra memory, adding a hard disk drive and controller, or changing the serial interface card. No internal expansion of the Model 32 is possible, although the addition of a second floppy drive should be feasible.

Conclusions

The ICL Personal Computer is a straightforward business micro, and makes no pretentions at being anything else. As such, there are several other machines with which it must compete. In its favour, it has a 'big name', it looks nice, and reliability will not be a problem (according to Black Box owners I have spoken to). Working against it will be the fact that in some respects (e.g. the use of the 8085 CPU) it is somewhat old-fashioned compared with other recently launched machines. An example is the Sirius, with its unusually flexible display, 128k of memory and an 8088 semi-16-bit processor, selling at a similar price to the Model 10 plus a terminal.

I'm pretty sure that the PC will sell, and I doubt that many purchasers will be dissatisfied with their computer. I just feel that ICL has left it too late to launch a machine of this type for it to be a real winner.

Technical specifications

Processor:	8085.
Memory:	256k, dynamic RAM. Bootstrap ROM.
Disks:	One 5Mb 5¼ inch Winchester, one 250k double-sided, double density, 40 track 5¼ inch floppy.
I/O:	Eight RS-232 serial ports.
Terminal:	80*24 plus status line. 12 inch green screen. 100 keys, full qwerty plus numeric keypad, function keys, editing keys, cursor control. Extensive features.
System Software:	CP/M, MP/M.
Languages:	Microsoft Basic (others available).

Prices

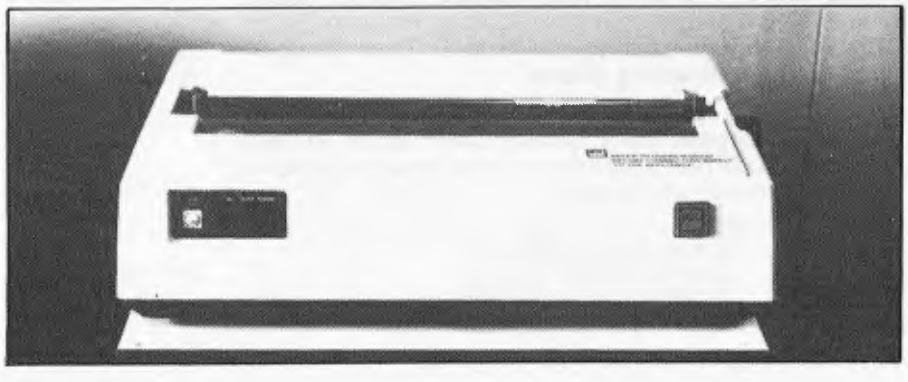
(including Sales Tax)

Model 10	$ 4811
Model 20	$ 8099
Model 31	$ 9215
Model 32	$10389
Terminal	$ 1197
Printer (83A)	$ 1399

Benchmarks

All timings in seconds, disk timings relate to hard disk.

BM	TIME	DT	TIME
1	1.5	1	0.5
2	4.5	2	6.5
3	13.0	3	6.5
4	13.5	4	4.5
5	13.5	5	4.5
6	25.5		
7	40.0		
8	7.0		



APC SUBSET

by Ian Davies

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

Z80 Square roots

The first two SUB-SET routines for this month provide more arithmetical functions for the popular Z80 processor. SROOT extracts the square root of a 16 bit quantity and DSROOT is for 32 bit values. Figure 1 illustrates the technique by finding the square root of 2840. The result shows the answer to be 53 with a remainder of 31.

Both routines are independent, requiring no other subroutines previously defined in APC SUBSET, and return with the Z flag set and no action taken if the input value is negative.

Datasheet

```
;=SROOT- 16-bit square root
;/CLASS: 2
;/TIME CRITICAL? no
;/DESCRIPTION: Calculates the square root of a positive 2's
;/             complement binary number.
;/ACTION: Shifts pairs of binary digits in LA left through HLA;
;/        subtracts 1 from a pair >1;
```

```
1.      28  40    Split the number into pairs of digits from
                  the decimal point.

2.       5        Find the largest square that can be subtr-
        28  40    acted from the first pair of digits. Write
        25        it below the first pair, with the root
         3        above the line. subtract the square from
                  the first pair.

3.       5        double the number on the top line and write
        28  40    it on the left, level with the difference
        25        found previously. Bring down the next two
    10   3  40    digits.

4.       5        Find a digit, 0-9, which, when added to the
        28  40    right hand end of the number (10) on the
        25        left and multiplied by that digit, produces
   10?  3  40    the highest result that is less than the
    ?x            right (340). ie, since 101 x 1 = 101, 102
                  x 2 = 204, 103 x 3 = 309, 104 x 4 = 416. the
                  digit we want is 3.

5.       5   3    Write the digit so found (3) on the next
        28  40    position on the top line and subtract the
        25        product (309) from the last number (340)
  103    3  40
    3    3  09
  309       31
```

Fig 1

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commodore COMPUTER

```
;/        shifts into the least significant end of answer D 1
;/        if there has been a subtraction, otherwise 0.
;/SUBr DEPENDANCE: none
;/INTERFACES: none
;/INPUT: HL contains a positive binary number for which the
;/       square root is required.
;/OUTPUT: HL contains the square root, DE the remainder. The Z
;/        flag is set if the input was negative.
;/REGs USED: B,AF,DE,HL
;/STACK USE: nil
;/LENGTH: 37
;/PROCESSOR: Z80
SROOT:  XOR  A        ;clear carry                      AF
        DEC  A        ;set A to -1                      3D
        BIT  7,H      ;test sign of input               CB 7C
        JR   NZ,SR30  ;if -ve, exit setting Z           20 1D
        LD   A,L      ;set up                           7D
        LD   L,H      ;24-bit working                   6C
         LD   H,+0    ;accumulator                       26 00
         LD   DE,40H  ;and subtrahend                    11 40 00
         LD   B,+8    ;load loop counter                 06 08
SR10:   SBC  HL,DE    ;try subtraction                  ED 52
        JR   NC,SR20  ;                                 30 01
        ADD  HL,DE    ;if unsuccessful, re-add          19
SR20    CCF           ;carry set if successful          3F
        RL   D        ;shift carry state to answer      CB 12
        ADD  A,A      ;shift working accumulator        87
        ADC  HL,HL    ;1 bit left                       ED 6A
        ADD  A,A      ;shift working accumulator        87
        ADC  HL,HL    ;1 bit left                       ED 6A
        DJNZ SR10     ;do 8 times                       10 F0
        LD   E,H      ;get remainder                    5C
        LD   L,D      ;and result                       6A
        LD   H,A      ;set top 8 bits of                67
        LD   D,A      ;each to 0 (A is 0)               57
SR30:   INC  A        ;reset Z for a valid result       3C
        RET           ;return                           C9
```

Datasheet

```
;*DSROOT - 32-bit square root
;/CLASS: 2
;/TIME CRITICAL? no
;/DESCRIPTION: calculates the square root of a positive 2's
;/             complement binary number
;/ACTION: shifts pairs of binary digits in (SP), IX left through
;/        HL,(SP),IX;
;/        subtracts 1 from a pair >1
;/        shifts 1 if there has been a subtraction, otherwise 0,
;/        into the least significant end of answer DE
;/SUBr DEPENDANCE: none
;/INTERFACES: none
;/INPUT: BC,DE contains a positive binary number for which the
;/       square root is required
;/OUTPUT: BC,DE contains the square root, IY the remainder. The Z
;/        flag is set if the input was negative.
;/REGs USED: AF,BC,DE,IX,IY
```

```
;/STACK USE: 4
;/LENGTH: 62
;/PROCESSOR: Z80
DSROOT: LD   A,+16    ;load counter                     3E 10
        BIT  7,B      ;test sign of input               CB 78
        JR   NZ,DSR30;if -ve, exit setting Z            20 35
        PUSH HL       ;save HL                          E5
        PUSH DE       ;put low half of                  D5
        POP  IX       ;number in IX                     DD E1
        PUSH BC       ;top half to (SP)                 C5
        OR   A        ;reset carry                      B7
        SBC  HL,HL    ;zeroise HL                       ED 62
        LD   BC,4000H;set subtrahend                    01 00 40
        LD   D,H      ;   "                             54
        LD   E,L      ;   "                             5D
        EX   (SP),HL ;top part to HL,0 to (SP)          E3
DSR10:  SBC  HL,BC    ;try                              ED 42
        EX   (SP),HL ;                                  E3
        SBC  HL,DE    ;                                 ED 52
        EX   (SP),HL ;subtraction                       E3
        JR   NC,DSR20;jump if successful                30 05
        ADD  HL,BC    ;add                              09
        EX   (SP),HL ;back                              E3
        ADC  HL,DE    ;if                               ED 5A
        EX   (SP),HL ;not.                              E3
DSR20:  CCF           ;carry set if successful          3F
        RL   E        ;shift carry state                CB 13
        RL   D        ;to answer                        CB 12
        LD   C,+2     ;load counter                     0E 02
DSR22   ADD  IX,IX    ;shift                            DD 29
        ADC  HL,HL    ;                                 ED 6A
        EX   (SP),HL ;working                           E3
        ADC  HL,HL    ;                                 ED 6A
        EX   (SP),HL ;accumulator                       E3
        DEC  C        ;                                 0D
        JR   NZ,DSR22;and again                         20 F5
        DEC  A        ;                                 3D
        JR   NZ,DSR10;do 16 times                       20 DE
        RES  6,B      ;set BC=0                         CB B0
        POP  IY       ;get remainder                    FD E1
        POP  HL       ;restore HL                       E1
DSR30:  ADD  A,-16    ;reset Z for a valid result       C6 F0
        RET           return                            C9
```

6502 Delays

This routine implements an adjustable delay timer which takes into account the different clock rates that are around. There are two factors governing the length of the delay. The first factor is fixed, and determines the minimum delay length. In the datasheet, this value is called FRACS, and is located at FRACHI and FRACLO. For example, for delays which are a multiple of 1/50th of a second running on a 2 Mhz clock, the FRACS delay would be 40,000 or 9C40H (2 million divided by 50).

The second delay determining factor selects the number of the above defined units of time. This value is termed X. For example, to generate a delay of 1/10th of a second with FRACS, set as above, X would have the value of 5 (5/50 = 1/10). Hence the FRACS delay is multiplied by the X value to give the total delay in seconds.

Datasheet

```
;=UDRS- Universal Delay Routine 6502
;/CLASS: 1
;/TIME CRITICAL?  yes
;/DESCRIPTION: Accurate delay of 1-256 times assembled
;/             fraction of system clock hertz.
;/ACTION: REPEAT UNTIL X=0
;/        AY<- FRACS - UDRS operating time (first
;/        iteration
;/                    (NUMLPS operating time
;/                    (subsequent iterations))
;/        repeat until AY<0
;/        AY<- AY-18
;/        REPEAT 17 TIMES TO USE REMAINING TIME STATES
;/        Y<-Y+1
;/        IF Y=0 THEN Y<-Y-1
;/SUBr DEPENDANCE: none
;/INTERFACES: none
;/INPUT: X= Numerator ($00=256)
;/OUTPUT: Delay of X/ Denominator seconds
;/        X=0
;/REGs USED: X
;/STACK USE: 4
;/LENGTH: 45
;/TIME STATES: FRACS*X (including JSR UDRS)
;/             (inaccurate if branches cross page
;/             boundary)
;/PROCESSOR: 6502
FRACS= system clock hertz / denominator (245<FRACS<65536)
FRACHI= INT(FRACS / 256)
FRACLO= FRACS-(FRACHI*256)
UDRS:   PHP         ;save flags, A & Y          T states= 3  08
        PHA         ;                                     3  48
        TYA         ;                                     2  98
        PHA         ;                                     3  48
        CLD         ;clear for binary arith               2  D8
        LDA #$0B    ;lo-byte negated routine T states     2  A9 0B
NUMLPS: CLC         ;using 2s complement addition with    2  18
        ADC #FRACLO ;subtrahend being first in accumulator 2  60 XX
        TAY         ;subtract UDRS optime (1st iteration) or2  A8
        LDA #$FF    ;NUMLPS optime (subsequent iterations) 2  A9 FF
        ADC #FRACHI ;from FRACS giving result in A,Y      2  69 XX
DIVLPS: PHA         ;use 18 T states per loop             3  48
        TYA         ;of repeated subtraction              2  98
        SBC #$12    ;until A,Y<0                          2  E9 12
        TAY         ;                                     2  A8
        PLA         ;                                     4  68
        SBC #0      ;                                     2  E9 00
        BCS DIVLPS  ;(y reset on exit                     2/3D0 F6
        LDA #$EF    ;so count up T state remainder        2  A9 EF
REMLPS: INY         ;repeat 17 times using 10 T states    2  C8
        BNE REMCTS  ;per iteration normally               2/3D0 01
        DEY         ;but 11 for each remainder            2  88
REMCTS  ADC #+1     ;                                     2  69 01
        BNE REMLPS  ;                                     2/3D0 F8
        LDA #$33    ;lo-byte negated subseq iter T states 2  A9 33
        DEX         ;decrement Numerator                  2  CA
        BNE NUMLPS  ;and repeat until done                2/3D0 CF
        PLA         ;restore                              4  68
        TAY         ;Y                                    2  A8
        PLA         ;A                                    4  68
        PLP         ;and flags, esp decimal mode          4  28
        RTS         ;                                     6  60
```

TIMING EFFECTS.

Operating time T states in:	NUMLPS	UDRS
(JSR UDRS)		6
sequence (bytes 1 to 7)		15
sequence (bytes 8 to 15)	10	10
DIVLPS (bytes 16 to 25)	17	17
instruction (bytes 26 & 27)	2	2
REMLPS(bytes 28 to 35)	169	169
NUMLPS Test (bytes 36 to 40)	7	6
sequence (bytes 41 to 45)		20
	205	245
converted to Hexadecimal	$CD	$F5
Negated for complement addition lo-byte	$33	$0B

Z80 Random numbers

The final routine for this month is a 31 bit pseudo-random number generator. There are quite a few 16 bit generators around, but these are generally not good enough for serious applications which require a 2^{32} modulus.

Apparently random number generators which have a modulus which is a power of two tend to produce rather non-random numbers. This routine uses the series

$$r_{i+1} = (2^9 + 1)\, r_i \bmod (2^{31} - 1),$$

which produces nicely randomised numbers. It will repeat after $2^{31} - 2$ numbers, giving all possible combinations of 31 bits, except the all-zero and the all-one combinations.

The routine uses four bytes starting at any point RN as its output area. RN should be left intact between calls as it becomes the seed for the next call. Prior to the first call to this routine, RN may be initialised to some known seed value (to repeat previous random sequences), or can be set to an unknown value by loading the current time of day, or picking up the Z80 refresh register.

Datasheet

```
;= RD31 - 31-bit pseudo-random number generator
;/CLASS: 2 (not position independent)
;/TIME CRITICAL? No
;/DESCRIPTION: Generates a 31-bit pseudo-random
;/             number from the series r(i+1) = u*r(i) (mod M)
;/             where M=2^31-1 (a Mersenne prime) and u=2^9+1,
;/             one of M's primitive roots
;/ACTION: Let r(i)=X+2^22*Y where X is the 22-bit number
;/        consisting of bits 0-21 of r(i) and Y is the 9-bit
;/        number consisting of bits 22-30.  Form P, the 31-bit
;/        number Y+2^9*X and Q, the 32-bit number P+r(i).  Then
;/        Q=u*r(i)-YM so that r(i+1) = Q(mod M).  But, since
;/        (as can be shown) 0<Q<2M, r(i+1)=(if Q<M) then Q
;/        else Q-M; note also that if bit 31 of Q is zero,
;/        then Q<M but (since Q=M does not occur) if bit 31
;/        of Q is 1 then Q>M.
;/SUBr DEPENDENCE: None
;/INTERFACES: Four bytes of directly-addressable RAM; RN,
;/             RN+1, RN+2, RN+3 are used to store the
;/             previous number r(i)=(RN)+2^8*(RN+1)+2^16*(RN+2)
;/             +2^24*(RN+3) or a selected seed, for which the
;/             most significant bit of RN+3 must be zero and
;/             the remaining 31 bits are arbitrary, except
;/             that they must not be all zeros or all ones.
;/INPUT: A seed or the previous random number
;/OUTPUT: The new random number r(i+1) is built up in RN,
;/        RN+1, RN+2, RN+3
;/REGs USED: AF,BC,DE,HL
;/STACK USE: None
;/LENGTH: 53
;/TIME STATES: 242 (average)
;/PROCESSOR: Z80
;
RD31: LD   HL,(RN+2)   ; Begin to form P=          2A XX XX
      RL   L           ;  BC+2^16*DE               CB 15
      RL   H           ;                           CB 14
      RL   L           ;                           CB 15
      RL   H           ;                           CB 14
      LD   C,H         ; C=bits 22-29 of r(i)      4C
      LD   A,(RN)      ; Carry flag = bit 30       3A XX XX
      RLA              ; A=bits 30,0-6; carry=     17
      LD   B,A         ; bit 7;BC=bits 22-30,0-6   47
      LD   DE,(RN+1)   ;                           ED 5B XX XX
      RL   E           ;                           CB 13
      RL   D           ;                           CB 12
      RES  7,D         ;DE=bits 7-21;P now formed  CB BA
      LD   HL,(RN)     ; Begin to form Q in (RN)   2A XX XX
      ADD  HL,BC       ;  (RN+3)                   09
      LD   (RN),HL     ;                           22 XX XX
      LD   HL,(RN+2)   ;                           2A XX XX
      ADC  HL,DE       ;                           ED 5A
      RES  7,H         ; Reset bit 31 of Q (but    CB BC
      LD   (RN+2),HL   ;  its value is preserved   22 XX XX
                       ;  in the sign flag
      RET  P           ; Return if                 F0
      LD   HL,RN       ;  Q<M with r(i+1)=Q        21 XX XX
INC:  INC  HL          ;                           34
      RET  NZ          ; Return if Q>M with        C0
      INC  HL          ;  r(i+1)=Q-2^31+1          23
      JR   INC         ;                           18 FB
```

Contributions

I don't want to harp about this, but any contributions *would* be gratefully received and published. So if you have got a collection of handy routines, just document them as shown here and send them in.

APC SUBSET will continue next month.

LAZING AROUND

by J J Clessa

First out of the hat with a correct answer was Phil Sutherland of Shoalwater, WA. Congratulations Phil – a $20 book token should have reached you by the time this is published.

No quickie

In the maelstrom of moving from one office to another, Leisure Lines has suffered the sad loss of the only copy of September's Quickie. As we're all up in arms at the time of writing (far too late, we fear) a humble apology for this dreadful omission is all we could think of to fill up the space.

Prize puzzle

This month's Prize Puzzle is based on an old chestnut — or should I say coconut?

Six men are shipwrecked on a desert island. The only food on the island is coconuts. They therefore decide to collect all the coconuts and divide them equally among themselves.

They spend one complete day gathering all the coconuts into a single pile, and by the time sunset arrives they are so tired that they decide to postpone the share-out until the following day. They therefore all go to sleep.

During the night one man awakes and decides to take his share and hide it before the others awake. He divides the pile into six equal shares and finds that there is one coconut remaining which he throws to a nearby monkey. He hides his share, puts the rest back into a single pile and goes back to sleep.

A little later, a second man awakes and repeats the process, again finding one coconut remaining which he gives to the monkey. He takes and hides his share and goes back to sleep.

This performance is repeated by each man in turn during the night. Each time the coconuts are divided into six and each time there is one left which the monkey gets.

Next morning all six men awake and decide to share out the remaining coconuts. Again they divide them into six equal shares and again there is one left over which is given to the monkey. What is the least number of coconuts that there could have been in the beginning?

Answers, *on postcards please*, to: September Prize Puzzle, Australian Personal Computer, P.O. Box 280, Hawthorn, Vic, 3122, to arrive not later than 30 October 1982.

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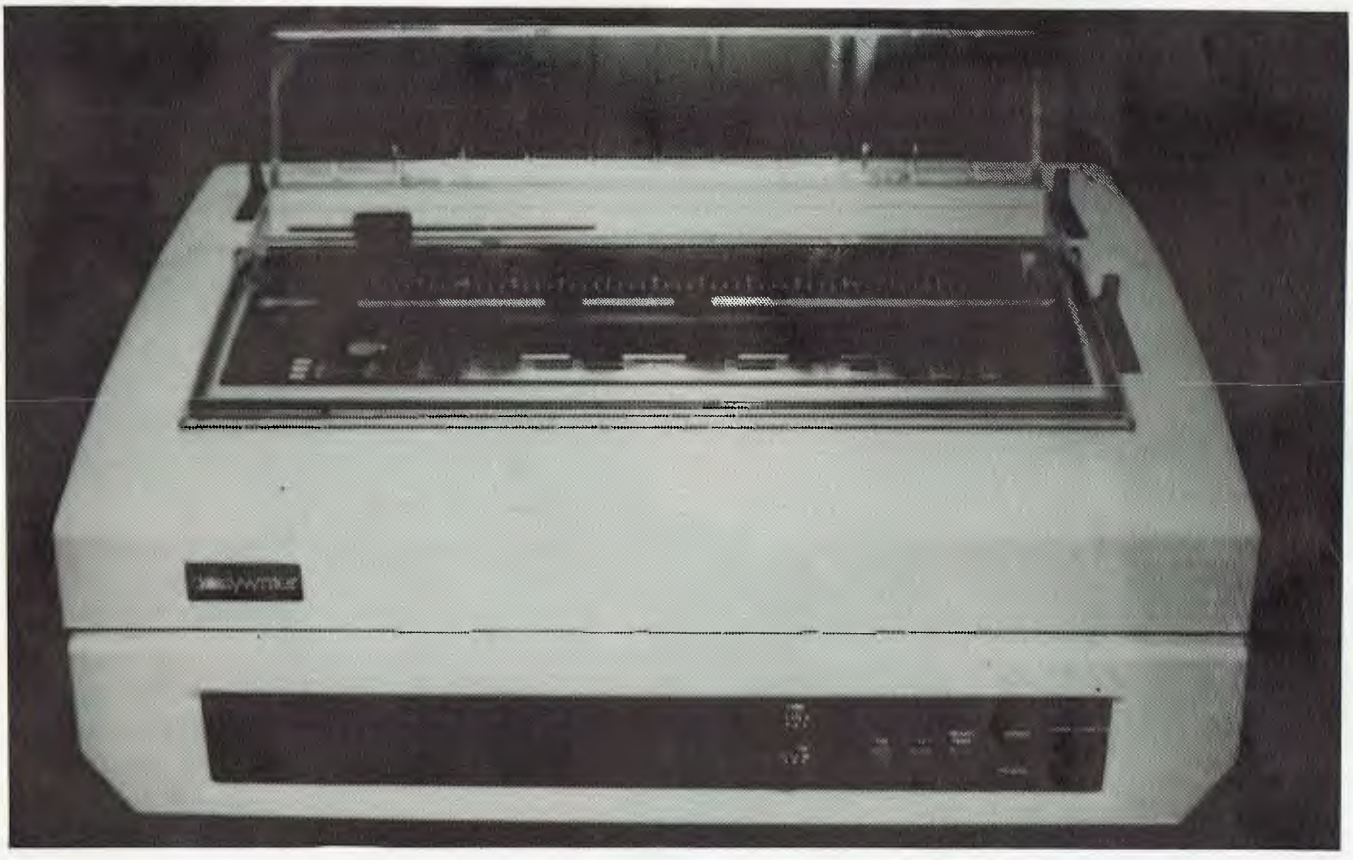

by Stephen Save

The growth in the printer industry is very similar to that of computers as far as the amount of different brands, speeds, prices and capabilities go. Up until recently some well known brand names have done a good job in monopolising the higher speed, heavy duty, higher price market where the printer is called upon to operate at high duty cycles. Now this market is making way for personal computers and small business markets: Up until now many of the latter markets have been forced to limit their printer usage to lower cost dot-matrix type printers due to the unavailability of a low cost reliable, letter quality printer. It is estimated by present microcomputer dealers and distributors that 20-25% of their customers would purchase a letter quality printer provided it was reliable, of good quality and priced in the $1,000 to $1,500 range.

Independent sources in the USA such as the group Dataquest, major computer OEM's and leading daisywheel printer manufacturers, all concur that the fastest growing segment of the daisywheel market will be in the 15 – 20 cps speed range with retail prices below $2,000.

ORIGINS OF DAISYWRITER

CII – Computers International, Inc. have been in the business of marketing and servicing computers and computer peripherals for over 20 years. Early in 1981 associates of CII saw a new Brother electronic typewriter which employed a daisywheel print mechanism, and recognised it as a potentially viable letter quality printer for the computer industry – CII purchased several of these typewriters and modified them to interface with a micro computer, exhibiting them at the 1981 National Computer Conference in Chicago. The name "Daisywriter" was selected since it denoted a daisywheel printer without any need for further description. After receiving encouraging results from the Conference CII approached Brother with the idea of having Brother manufacture the "Daisywriter" using the Brother typewriter mechanism and electrical interfaces built to CII specifications.

UNIVERSAL INTERFACE

At first there were a few teething problems. Most software programs had been designed to work with the special

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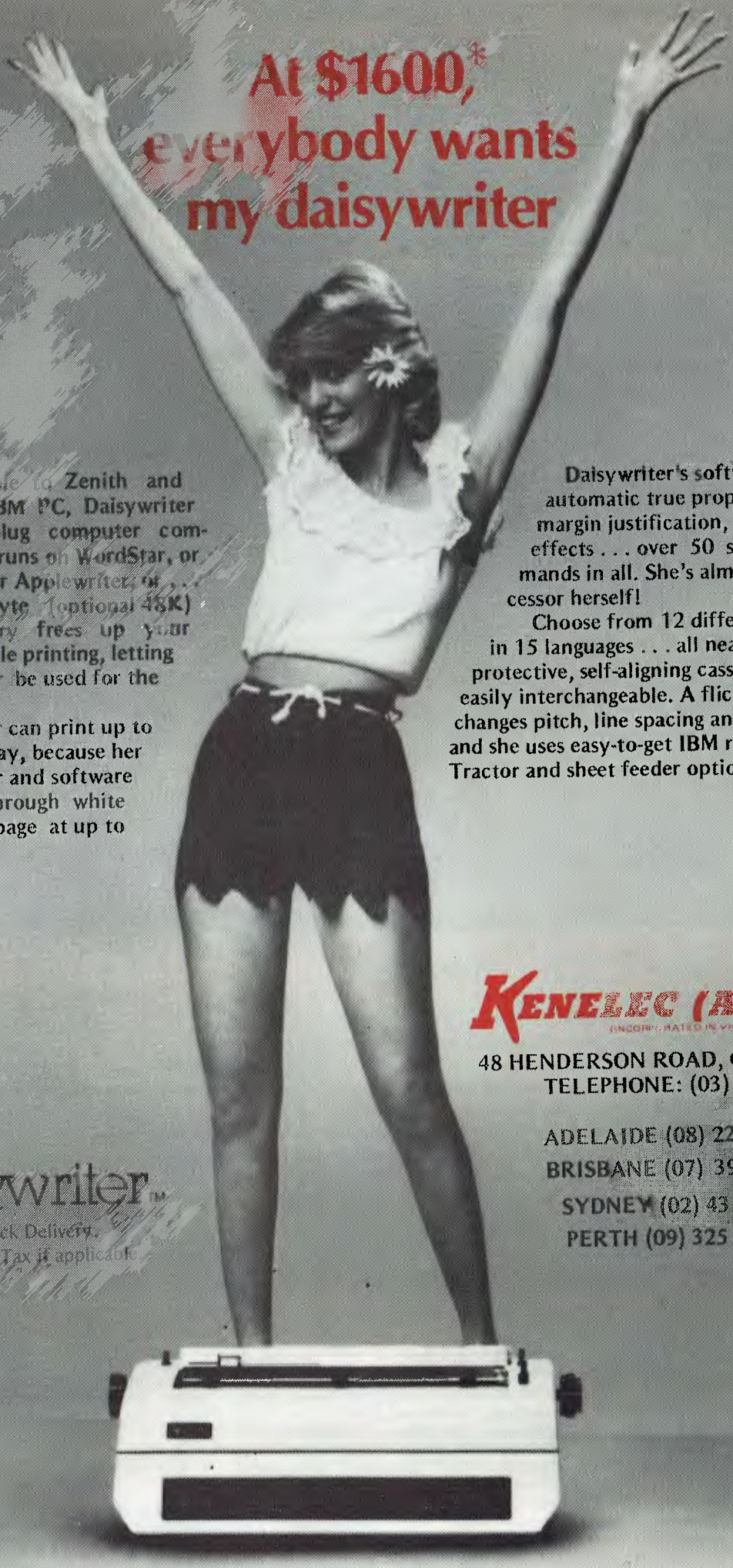

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command codes originated by Diablo, Qume and NEC, therefore Daisywriter should be able to "emulate" one or more of these printers since microcomputers seldom use the same interface.

In order for a printer to be used with a computer, they must first be "matched" to each other by an electrical "interface" that allows an orderly transfer of data from the computer and an acknowledgement from the printer that it is receiving and printing the data correctly. Over the years a number of industry standards has been developed, some of these are determined by industry association and some by common usage. Again from market surveys it has been indicated that four standard interfaces would be sufficient to accommodate 90 – 95% of the computer market. The four are: RS232, Centronics 8 bit parallel, Current loop and IEEE 488.

CII licensed the required software under the name of COPIES (Computer Optimized Printer Interface and Emulation System). The original software was enhanced and the design of a true "universal" interface was now complete. With this interface installed, any computer becomes compatible with the Daisywriter. All that require alteration are the dip switches and a matching computer cable, compatible with any software programs designed to be used on any other daisywheel printer.

DESCRIPTION

Daisywriter 2000 daisywheel printer is designed for word and data processing applications where letter-quality printing is desired.

PRINTWHEEL

The printwheel cassettes can be changed with ease as they are encased in a plastic cassette which is slotted into place in about 2 seconds – very handy if the operator requires a different style of lettering in a document. There are at least 12 different type styles in 15 different languages, e.g. Spanish (South America), Finnish and Swedish, Norwegian and Danish, Dutch (South African) etc. The printwheels are self aligning and are assured for at least 25,000,000 impressions.

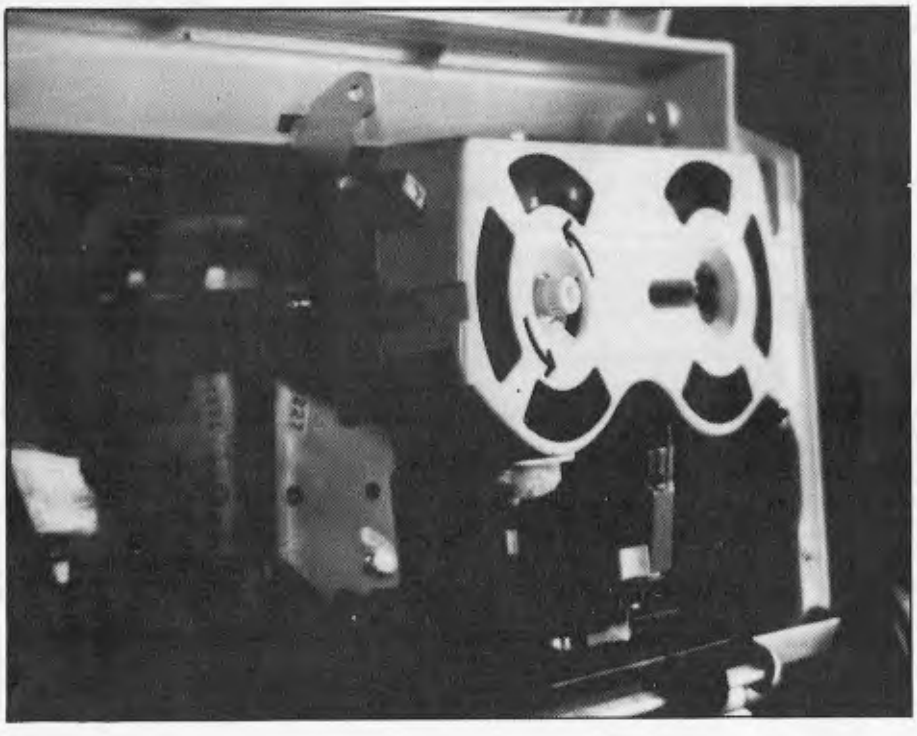
PRINTING MECHANISM

The printing mechanism is devoid of belts, wheels, cables and pulleys. A microprocessor utilising three CPU's has reduced the need for these parts and a linear motor is used to simplify the drive mechanism. The carrier containing the motor is magnetically driven along a sturdy steel track which by all rights should contribute to a long life of relatively trouble free operation. The printing mechanism incorporated in this printer has already been in production for two years in Brothers' EM-2 electronic typewriter.

MODULAR CONSTRUCTION

Five units make up the modular construction: Platen, Carrier, Controller, Power Supply and Interface Board.

When on site replacements are required the cover can be easily removed by loosening two captive screws and most parts can be replaced in less than 15 minutes. All of the cables between modules are terminated through connectors for a quick disconnection.



The printing mechanism.

RIBBONS

Standard IBM ribbon cartridges can be used in the Daisywriter – a built in detector warns the operator of the lack of ribbon both visually and audibly. Step by step instructions are supplied in the manual, which fortunately is a no mess operation. Ribbons are also reasonably priced.

BUFFER

The Daisywriter has 16kbytes (16,000 bytes) of built-in buffer memory. This allows computers that have only a single task limitation to "spool" by loading the buffer memory, and the printer will then print for up to an hour. Once the memory has been loaded the host computer is then free to be used for other operations.

DIP SWITCHES

The dip switches are located on the front panel. It houses 24 dip switches and allows selection of some of the following:

Invert Reverse Channel (inverts polarity of RSSCA I/O signal)
Vertical Motion Increment (6 or 8 lines per inch)
Continuous or cut sheet paper
Language hammer inprint (up to 16 languages including English)
Automatic Baud Rate
Protocols
Serial/Parallel
Polarity on/off

Clear print and reprint buffer commands are controlled by dip switches or software. There are a total of 75 software commands that can be used.

PITCH AND LINE SPACING

The pitch and line spacing selection switches are placed conveniently on the front panel. These allow for more versatility in your printing composition. Although not often used, they are an absolute must.

OPERATION

In use we found the Daisywriter a reliable printer that gave little trouble. The quality of the print is excellent and the low speed did not prove to be a problem at all. The only operational problems we found were that single sheet feed tends to fold down one corner of the sheet. (Maybe this is an adjustment problem), and the error indication is not explicit, i.e. if the error light comes on it may take five minutes to find the problem. We feel that a few more lights wouldn't go astray.

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System 80 Extended Basic

by W Burgar

This program will add nine useful commands to TRS-80 Basic, using the DOS commands to call routines from high memory. Because it works in this way, the top of memory needs to be set before the program can be loaded. When the machine has just been switched on, type 32680, return and then load the program.

The reserved words added by this program are: GET — waits for any key (excluding shift) to be pressed; NAME — works in the same way as GET except that the character pressed is printed in the cursor position; KILL — disables the break key; PUT — turns break key back on; CLOSE — turns off the video driver so that all print statements are suppressed; OPEN — turns video driver back on; LOAD — loads a program from tape straight after the current program so that the current program is not lost; MERGE — combines two programs after a LOAD. It is best here to renumber the second program with higher line numbers than the first program; FIELD — this is a graphics command which literally reverses the whole of the screen, turning black characters white and vice versa.

These additions use 88 bytes at the top of RAM. After typing the program in, save it before running as other wise it will be lost by NEWing itself out of memory.

```
  5 REM AFTER TYPING THIS PROGRAM IN, SAVE IT
  6 REM BEFORE RUNNING IT!
 10 CLS:PRINT"EXTENDED BASIC BY W J BURGAR* "
 20 PRINT"COMMANDS ARE: GET* NAME* KILL* PUT*
    CLOSE* OPEN* LOAD* MERGE* FIELD*"
 30 REM READ IN JUMP ADDRESSES TO DOS MEMORY
 40 FOR I=16761 TO 16788: READ C: POKE I,C:
    NEXT I
 50 REM READ IN MACHINE CODE TO TOP OF MEMORY
 60 FOR I=32680 TO 32751: READ C: POKE I,C:
    NEXT I
 70 NEW: REM FINISHED
 80 REM DATA FOR JUMP ADDRESSES IN ORDER
 81 REM OPEN, FIELD, GET, PUT, CLOSE, LOAD, MERGE,
    NAME, KILL
 90 DATA 195,168,127,195,174,127,195,73,0,195,192,
    127,195,198,127
100 DATA195,203,127,195,221,127,127,195,228,127,195,
    234,127,201
110 REM DATA FOR MACHINE CODE
120 DATA 62,7,50,29,64,201,1,0,4,17,0,60,26,47,203,
    255,18,19,11,120
130 DATA 177,32,245,201,62,201,50,12,64,201,175,50,29,
    64,201,58,249
140 DATA 64,214,2,50,164,64,58,250,64,50,165,64,205,31,
    44,201,33
150 DATA 233,66,34,164,64,201,205,73,0,195,51,0,62,7,50,
    12,64,201
160 REM DON'T WORRY ABOUT SN ERROR AFTER MERGE
 65 PRINT*"PRESS ANY KEY":GET
 66 REM THESE ARE 65&66; NOT 165&166!
```

(signifies '↓')*

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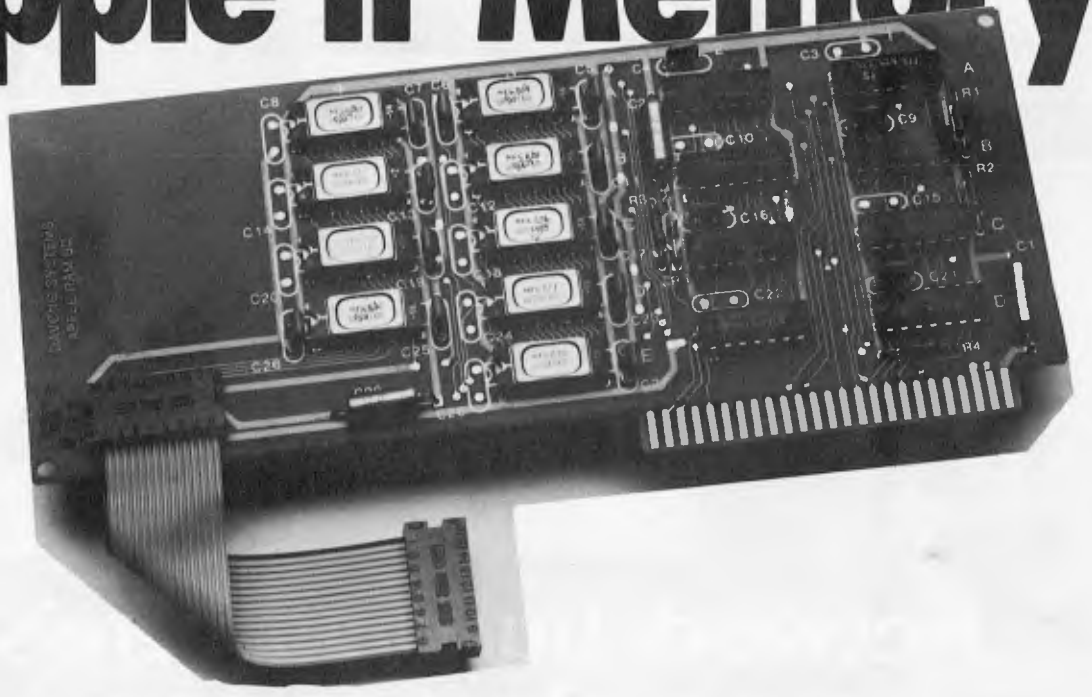

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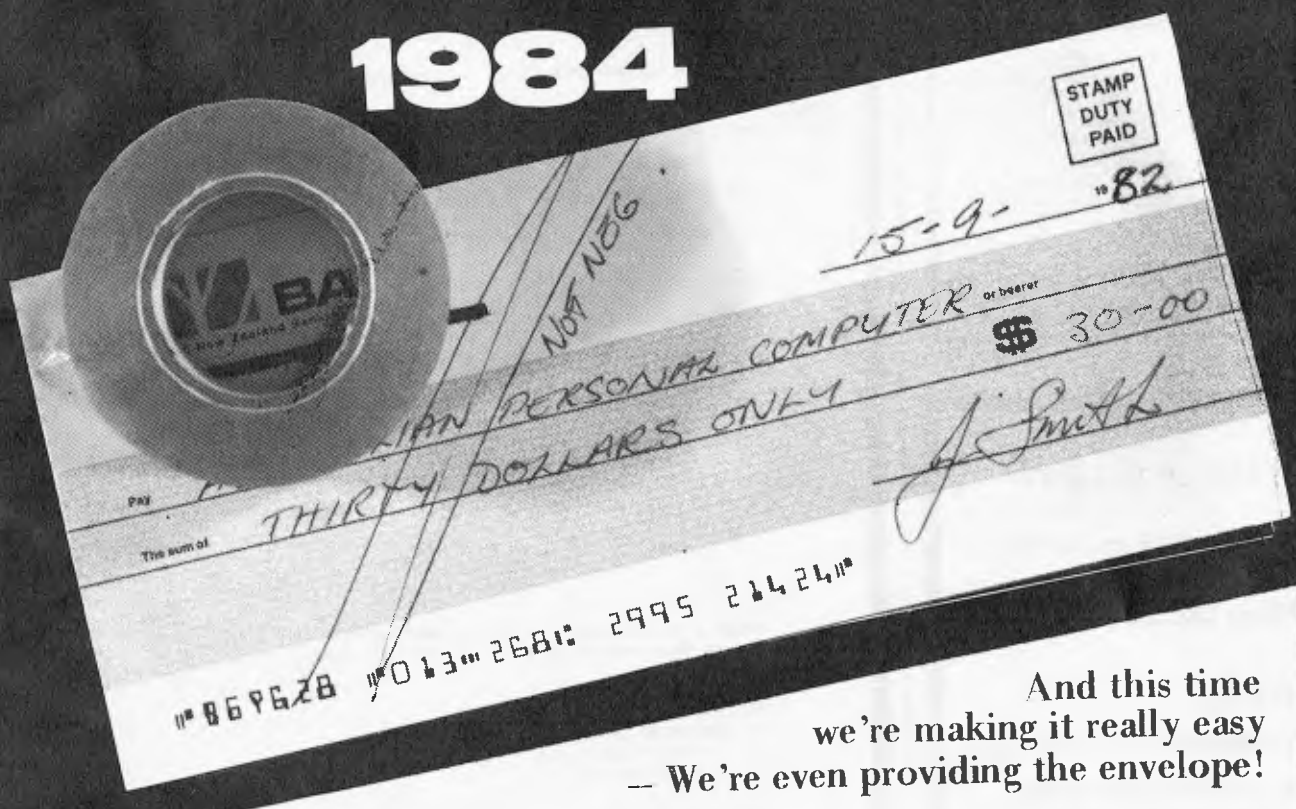

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PROGRAMS

Apple Trees

by P Nowosad

Although this program has no use for an applications freak, it does draw some very pretty pictures. To run, it needs Apple Pascal and the Apple Turtle Graphics package.

Trees takes about a minute to run and will produce an accurate picture of a tree — accurate, that is, as far as branch formation is concerned. Each tree is different as random number routines are employed, so the possibilities are almost infinite.

The basic theory of the program is fairly simple: a trunk is drawn, and from that branches of a reduced length which split into still smaller branches, which in turn end in small clumps of 'leaves' (green squares).

All this program requires, apart from the specified software, is to be typed in and run.

```
PROGRAM TREE;

USES TURTLEGRAPHICS,APPLESTUFF;          (*Include APPLE libraries*)

CONST   XMAX=279;                        (*X max. on screen*)
        YMAX=191;                        (*Y max. on screen*)

VAR OFFSET:INTEGER;                      (*Base offset angle of branches*)
    FACTOR:REAL;                         (*Base ratio of branch sizes*)

PROCEDURE BRANCH (LENGTH:REAL);          (*Draw branch of given length*)

LABEL 1;                                 (*Branch termination label*)
VAR X,Y,ANGLE,Z,I:INTEGER;               (*Variables on stack for recursion*)

BEGIN
        (*Save end postion and orientation of parent branch*)

        X:=TURTLEX;Y:=TURTLEY;ANGLE:=TURTLEANG;

        (*Calculate length of new branch*)

        LENGTH:=LENGTH*(FACTOR*(85+(RANDOM MOD 31))/100);

        IF LENGTH<4
        THEN
                (*Length below low limit so end with green leaves*)

                BEGIN
                VIEWPORT (X-1,X+2,Y,Y+3);        (*Leafy square*)
                FILLSCREEN(GREEN);
                VIEWPORT (0,XMAX,0,YMAX);        (*Restore full screen*)
                GOTO 1;
                END;


        (*Set Z to branching factor for end of this branch*)
        (*Note that branching decreases further out*)

        Z:=3;
        IF LENGTH<35 THEN Z:=2;
        IF LENGTH<25 THEN Z:=1;
        IF LENGTH<17 THEN Z:=0;
        Z:=Z+RANDOM MOD 2;

        FOR I:=0 TO Z DO

                (*For each branch*)

                BEGIN

                (*Turn turtle to new branch vector*)

                TURNTO (TRUNC (ANGLE+OFFSET*(I-Z/2)) + (RANDOM MOD 19) - 9);

                (*Branches are brown*)

                PENCOLOR(ORANGE);

                (*Unless out on a limb when leaf covered*)

                IF LENGTH<19 THEN PENCOLOR(GREEN);

                (*Draw branch*)

                MOVE (ROUND(LENGTH*FACTOR*(90+(RANDOM MOD 21))/100));

                (*Recursive call for branches at end of current branch*)

                BRANCH (LENGTH);

                (*Back to end of parent branch*)

                MOVETO (X,Y);
                END;
```

```
1:      PENCOLOR (NONE);          (*Done so no pen colour*)
        MOVETO (X,Y);             (*Back to end of parent branch*)
        TURNTO (ANGLE);           (*Restore orientation*)

END;

(*Main program*)

BEGIN
        INITTURTLE;                       (*Initialise graphics*)
        RANDOMIZE;                        (*Random start position*)
        PENCOLOR (ORANGE);                (*Draw tree trunk*)
        OFFSET:=30;                       (*Base for branch join angles*)
        FACTOR:=0.72;                     (*Base factor for branch length*)
        VIEWPORT (137,144,0,50);          (*Define trunk window*)
        FILLSCREEN (ORANGE);              (*Fill trunk*)
        PENCOLOR (NONE);                  (*Switch of pen colour*)
        VIEWPORT (0,XMAX,0,YMAX);         (*Reset window to full screen*)
        MOVETO (140,45);                  (*Move to trunk top*)
        TURNTO (90);                      (*Point vertically up*)
        BRANCH (55);                      (*Draw branches*)

END.
```

ZX81 Alphabetising

by Ian Kingston

For any form of indexing this program should come in useful. It allows the user to compile an alphabetical index of up to 800 words of 15 characters maximum. The lengths of words accepted by the program can be altered by changing the values in lines 50, 105, 150, 155, 160, 230, 250 and 285 although this will affect capacity and running time. If a paper printout is required, line 285 should read LPRINT Q$(F,1 TO 15). The graphics symbol used in line 100 is a shifted graphics 'H' and the program needs 16k to run.

```
  10 REM "ALPHABETIZING"
  15 REM (C) 1982, I.KINGSTON
  20 PRINT TAB 5;"GIVE A GENEROU
S ESTIMATE"
  25 PRINT
  30 PRINT TAB6 ;"OF THE NUMBER
OF WORDS"
  35 PRINT
  40 PRINT TAB 8;"TO BE ALPHABET
IZED"
  45 INPUT Q
  50 DIM Q$(Q,15)
  55 CLS
  60 LET X$="----------------"
  65 LET Z$="                "
  70 LET N=1
  75 PRINT TAB 2;"TYPE IN EACH W
ORD SEPERATELY",,,
  80 PRINT "FOR A SPACE ENTER SH
IFTED EIGHT",,,
  85 PRINT " ENTER "" "" AT END
OF WORD LIST"
  90 LET NN=0
  95 PRINT AT 10,0;"WORD  ";N;TA
B 22;"MAX = ";Q
 100 PRINT AT 15,0;"
   "
 105 PRINT AT 16,15;"MAX 15 LETT
ERS"
 110 IF INKEY$ "" THEN GOTO 110
 115 LET C=CODE INKEY$
 120 IF C=118 THEN GOTO 165
 125 IF C=23 THEN GOTO 180
 130 LET NN=NN+1
 135 IF C=119 THEN LET NN=NN-2
 140 IF C=115 THEN LET Q$(N,NN)=
CHR$ 0
 145 IF C>28 AND C<64 THEN LET Q
$(N,NN)=CHR$ C
 150 IF N>=1 THEN PRINT AT 15,0;
Q$(N,1 TO NN);Z$(1 TO 15-NN)
 155 PRINT X$(1 TO NN);Z$(1 TO 1
5-NN)
 160 IF NN<15 THEN GOTO 110
 165 PRINT AT 15,0;Z$,,Z$
 170 LET N=N+1
 175 IF N<>Q THEN GOTO 90
 180 FAST
 185 CLS
 190 FOR F=1 TO N-1
 195 FOR M=1 TO N-1
 200 IF F=M THEN GOTO 215
 205 IF CODE Q$(F,1)>CODE Q$(M,1
) THEN GOTO 230
 210 IF CODE Q$(F,1)=CODE Q$(M,1
)THEN GOTO 250
 215 NEXT M
 220 NEXT F
 225 GOTO 275
 230 LET Z$=Q$(F, 1 TO 15)
 235 LET Q$(F,1 TO 15)=Q$(M,1 TO
 15)
 240 LET Q$(M,1 TO 15)=Z$
 245 GOTO 205
 250 FOR G=2 TO 15
 255 IF CODE Q$(F,G)>CODE Q$(M,G
) THEN GOTO 230
 260 IF CODE Q$(F,G)<CODE Q$(M,G
) THEN GOTO 215
 265 NEXT G
 270 GOTO 215
 275 SLOW
 280 FOR F=N-1 TO 1 STEP -1
 285 PRINT Q$(F,1 TO 15)
 290 NEXT F
 295 STOP
 300 SAVE "ALPHABETIZING"
 305 RUN
```

PET File Comparison

by Lionel Kremer

For those PET users who keep several versions of program under development at once, this program will be of help in keeping track of changes made. It will compare sequential program files line by line, prepare two output files which consist of the unmatched lines (or blank ones) and then list

PROGRAMS

them on screen and printer if required. The listing feature of this program can also be used on its own to list and print out any sequential file, whether numbered or not.

Before loading and running the program, the files to be compared must be prepared. This is done using the follong sequence of commands: DOPEN#1, 'filename', W/CHD1/ LIST PRINT#1/CLOSE#1 'Compare' can then be loaded and run. Output files are assumed to be on drive 0 and can be specified for re-use by the @ prefix.

Absent-minded readers should be reminded that all programs to be compared must first be copied.

'Compare' was tested on a 32k PET with Basic 4 and DOS2. It was, in fact written for the 8032 PET. 40 column users will find that pairs of lines appear truncated. This will not affect the usefulness of the program as the lines of interest (only) can be read in full from the files @TEMP1 and @TEMP2. Another 40 column complication is that the bottom of the display gets overwritten. This, again, can be solved by accessing the comparison files.

```
0 REM"$=DSAVE"@COMPARE
100 REM****** COMPARE SEQUENTIAL PROGRAM FILES ******************************
110 SY=PEEK(52)+PEEK(53)*256:MC=SY+255:REM SY$ AND M.C. ABOVE TOP OF MEMORY
120 IFPEEK(MC)+PEEK(MC+77)=287THEN150:REM M.C. INSTALLED
130 SY=SY-333:MC=SY+255:POKE53,INT(SY/256):POKE52,SY-PEEK(53)*256
140 GOSUB7000:CLR:GOTO110:REM LOWER TOP OF MEMORY AND INSTALL M.C.
150 SYSMC,0:REM INITIALISE SY$ AT TOP OF MEMORY
160 REM****** END OF M.C. AND SY$ INSTALLATION ******************************
1000 DIMF$(2):CR$=CHR$(13):OPEN15,8,15
1010 PRINT"□R□OMPARE OR R■IST ?":
1020 GETA$:IFA$<>"C"ANDA$<>"L"THEN1020
1030 PRINT"■";A$:IFA$="L"THEN3000
1040 INPUT"FIRST READ FILENAME";F$:INPUT"DRIVE▶▶▶▶■■■■";D:D$=STR$(D):LF=1
1050 GOSUB4000:IFVAL(DE$)>0THEN1040
1060 INPUT"SECOND READ FILENAME";F$:INPUT"DRIVE▶▶▶▶■■■■";D:D$=STR$(D):LF=2
1070 GOSUB4000:IFVAL(DE$)>0THEN1060
1080 INPUT"FIRST WRITE FILENAME▶▶▶@TEMP1■■■■■■■■";F$:D$="0":LF=11
1090 GOSUB4000:IFVAL(DE$)>0THEN1080
1100 INPUT"SECOND WRITE FILENAME▶▶▶@TEMP2■■■■■■■■";F$:D$="0":LF=12
1110 GOSUB4000:IFVAL(DE$)>0THEN1100
2000 REM****** START COMPARISON ***********************************************
2010 M%=-1:PRINT"■■■■FILE 1          FILE 2          LINES■"
2020 IFE1%THEN2040:REM END OF FILE 1
2030 LF=1:GOSUB5000:L1$=SY$:N1=N:E1%=EF%:IFNOTM%THEN2060
2040 IFE2%THEN2300:REM END OF FILE 2
2050 LF=2:GOSUB5000:L2$=SY$:N2=N:E2%=EF%
2060 IFN1<>N2THEN2200:REM UNMATCHED LINE
2100 REM****** LINE NUMBERS MATCH **********
2110 M%=-1:IFL1$<>L2$THENGOSUB6000:PRINT#11,L1$:PRINT#12,L2$
2120 IFE1%ORE2%THEN2300
2130 GOTO2020:REM GET 2 MORE LINES
2200 REM****** UNMATCHED NUMBERS ***********
2210 M%=0:GOSUB6000:IFN1>N2THEN2230
2220 PRINT#11,L1$:PRINT#12,STR$(N1):GOTO2020:REM GET 1 MORE
2230 PRINT#12,L2$:PRINT#11,STR$(N2):GOTO2040:REM    DO.
2300 REM****** END OF A FILE ***************
2310 EF%=0:LF=1:IFE1%THENLF=2:GOTO2340
2320 IFEF%THEN2340
2330 GOSUB5000:GOSUB6000:PRINT#11,SY$:PRINT#12,STR$(N):GOTO2320
2340 IFE2%OREF%THENDCLOSE:OPEN15,8,15:GOTO3000
2350 GOSUB5000:GOSUB6000:PRINT#12,SY$:PRINT#11,STR$(N):GOTO2340
3000 REM****** LIST NEW FILES ************************************************
3010 F$=F$(1):REM 1ST O/P FILE
3020 PRINT"▶▶▶▶▶▶▶▶▶▶▶▶▶▶▶▶F$:INPUT"□LOOK AT FILE";F$:D$="0":LF=3
3030 GOSUB4000:IFVAL(DE$)>0THEN3020
3040 PRINT"WITH PRINTOUT - Y/N ?"
3050 GETA$:IFA$<>"Y"ANDA$<>"N"THEN3050
3060 P%=A$="Y":IFP%THENOPEN4,4
3070 GOSUB5000:IFF%THENPRINT#4,SY$
3080 IFNOTEF%THEN3070:REM REPEAT UNLESS EOF
3090 CLOSE3:PRINT:IFP%THENCLOSE4
3100 IFF$=F$(1)THENF$=F$(2):GOTO3020
3110 F$="":GOTO3020:REM ANY MORE FILES?
4000 REM****** OPEN SEQ FILE - BASIC3 TRAPS MISMATCH ***********************
4010 IFF$=""THENPRINT"■INVALID":DE$="1":RETURN
4020 IFLEFT$(F$,1)="@"THENF$=MID$(F$,2):D$="@"+D$
4030 FF$=D$+" "+F$+",SEQ"+IFLF>3THENFF$=FF$+",WRITE":F$(LF-10)=F$
4040 OPENLF,8,LF+1,(FF$):INPUT#15,DE$,A$
4050 IFVAL(DE$)>0THENPRINT"■"F$" - "A$:CLOSELF
4060 RETURN
5000 REM****** ASSEMBLE LINE FROM INPUT FILE ********************************
5010 POKE158,0:IFPEEK(151)<>255THENFORI=1TO800:NEXTI:REM DELAY IF KEY DOWN
5020 IFLF>3THENPRINT"□□W"TAB(LF-1)*15+3)"*":PRINT"□□";
5030 SY$=MC,LF:REM READ LINE FROM FILE LF INTO SY$
5040 EF%=ST=64:PRINT"■"SY$:IFLF=3THENRETURN
5050 N=VAL(SY$):IFN=0THEN5070:REM NON-NUMERIC
5060 PRINTTAB(LF-1)*15)"■■■"RIGHT$(" "+STR$(N),5):RETURN
5070 PRINTTAB(LF-1)*15)"■■■ ****":IFNOTEF%THEN5020:REM IGNORE UNLESS FINAL
5080 N=65535:RETURN:REM DUMMY FINAL LINE IF NON-NUMERIC
6000 REM****** COUNT LINES FOR NEW FILES ************************************
6010 LF=1:PRINTTAB(30)"□"RIGHT$("    "+STR$(N),5):RETURN
7000 REM****** MACHINE CODE ***********************************************
7010 FOR I=0 TO 77:READ D:POKE MC+I,D:NEXT I:RETURN
7020 DATA 32,160,189,32,135,189,32,234,194,160,88,133,66,24,169,89
7030 DATA 105,128,133,67,32,135,193,166,98,208,11,160,2,185,51,0
7040 DATA 145,66,136,208,248,96,32,138,255,160,0,32,207,255,201,13
7050 DATA 240,20,145,52,200,208,244,32,204,255,169,13,166,210,32,224
7060 DATA 242,162,176,76,207,179,152,160,0,145,66,76,204,255
8000 REM****** ALTERNATIVE LINES IF M.C. NOT REQUIRED ***********************
8010 REM UNIT LINES 110-160, 7000-7060
8020 REM 5025 SY$="":REM NOT TO BE USED IN M.C.VERSION
8030 REM 5030 GET#LF,X$:IFX$<>CHR$(13)THENSY$=SY$+X$:GOTO5030
READY.
```

PROGRAMS

PET German Game

by Jeff Aughton

This is a board game for the 8k 'new ROM' PET. It's called 'the German Game' because it was discovered in a toy shop in Germany and the real name (which was probably very long) has subsequently been forgotten. It's a computer-player rather than a two-player game and the object is to surround your opponent's piece. The program includes full instructions.

```
100 REM ** THE GERMAN GAME **
110 REM * BY J.AUGHTON 4/82 *
120 REM
130 POKE53,31:B=826:P=7937
140 READX:IFX<0THEN160
150 POKEP,X:P=P+1:GOTO140
160 REM
500 REM SET UP STRINGS ETC.
510 REM
520 B$="                    "
530 C$="       "
540 D$="QQQQQQQQQQQQQQQQQQQQQQQQ"
550 H$="         "
560 N$="      '-'"
570 V$="|    |    |    |    |    |    |"
580 Z$="     "
600 FORP=BTOB+175
610 POKEP,9:NEXT
620 P=-1:GOSUB8000
1000 REM
1010 REM MAIN LOOP
1020 REM
1030 PRINT"QQDO YOU WANT TO START (Y/N)";
1040 INPUT"     ";A$
1050 IFA$<>"Y"ANDA$<>"N"THEN1030
1060 C=-(A$="N")
1140 GOSUB5000
1150 FORI=2TO7:FORJ=2TO8
1160 POKEB+I+16*J,0
1170 NEXTJ,I
1200 X1=5:Y1=2:X=X1:Y=Y1
1210 F=1:A$=C$
1220 GOSUB7700
1230 X2=4:Y2=8:X=X2:Y=Y2
1240 F=2:A$=H$
1250 GOSUB7700
1260 IFCTHEN3000
1270 REM
2000 REM HUMAN MOVE
2010 REM
2020 GOSUB7200
2030 PRINT"IT'S YOUR MOVE"
2040 GOSUB7300
2100 IFABS(X-X2)<=1ANDABS(Y-Y2)<=1THEN2170
2110 GOSUB7500
2120 PRINT"YOU ARE TRYING"
2130 PRINT"TO MOVE TOO FAR"
2140 PRINT"TRY AGAIN!"
2150 GOSUB7600:GOTO2000
2170 IFPEEK(B+X+16*Y)=0THEN2240
2180 GOSUB7500
2190 PRINT"THAT SQUARE IS"
2200 PRINT"ALREADY OCCUPIED"
2210 PRINT"TRY ANOTHER!"
2220 GOSUB7600:GOTO2000
2240 REM IT'S O.K.-HI TRISHA!!
2250 X3=X:Y3=Y:X=X2:Y=Y2
2260 F=0:A$=Z$
2270 GOSUB7700
2280 X2=X3:Y2=Y3:X=X2:Y=Y2
2290 F=2:A$=H$
2300 GOSUB7700
2310 GOSUB7200
2320 PRINT"NOW PLACE A"
2330 PRINT"NEUTRAL PIECE-"
2340 GOSUB7300
2350 IFPEEK(B+X+16*Y)=0THEN2420
```

PROGRAMS

```
2360 GOSUB7500
2370 PRINT"■YOU CAN'T MOVE"
2380 PRINT"■■■■THERE - IT'S"
2390 PRINT"■■■■ALREADY TAKEN"
2400 GOSUB7600:GOTO2310
2420 REM IT'S O.K.
2430 P=9:A$=N$
2440 GOSUB7700
2450 C=C+1
2460 REM
3000 REM COMPUTER MOVE
3010 REM
3020 GOSUB7200:MA=0:K=0
3030 PRINT"■IT'S MY TURN -"
3040 PRINT"■■■■ LET ME SEE..."
3045 IFC<2THENGOSUB7100:GOTO3150
3050 FORI=X1-1TOX1+1:FORJ=Y1-1TOY1+1
3060 IFPEEK(B+I+16*J)=0THENGOSUB6000
3080 NEXTJ,I
3085 IFMATHEN3150
3090 IFKTHENGOSUB7000:GOTO3150
3100 GOSUB7600:GOSUB7200
3110 PRINT"■I CAN'T MOVE"
3120 PRINT"■■■■■■YOU WIN"
3125 PRINT"■■■■IN";C;"MOVES"
3130 GOSUB7600:GOSUB7600
3140 GOTO4500
3150 REM I CAN MOVE
3160 GOSUB7200
3170 PRINT"■I WILL MOVE TO"
3180 PRINT"■■■■■■■■■■";CHR$(X3+63);Y3-1
3190 X=X1:Y=Y1
3200 P=0:A$=Z$
3210 GOSUB7700
3220 X1=X3:Y1=Y3:X=X1:Y=Y1
3230 P=1:A$=C$
3240 GOSUB7700:GOSUB7600
3250 GOSUB7200
3260 PRINT"■I WILL PLACE A"
3270 PRINT"■■■■PIECE AT :"
3280 X=X4:Y=Y4
3290 PRINT"■■■■■■■■■■";CHR$(X+63);Y-1
3300 P=9:A$=N$
3310 GOSUB7700:GOSUB7600
3320 FORI=X2-1TOX2+1:FORJ=Y2-1TOY2+1
3330 IFPEEK(B+I+16*J)=0THENC=C+1:GOTO2000
3340 NEXTJ,I
3350 REM YOU LOSE
3360 GOSUB7200
3370 PRINT"■YOU CAN'T MOVE"
3380 PRINT"■■■■■■I WIN!!"
3385 PRINT"■■■■IN";C;"MOVES"
3390 REM
4000 REM GAME OVER
4010 GOSUB7600:GOSUB7600
4020 PRINT"■■I WAS OBVIOUSLY TOO GOOD FOR YOU!!"
4030 PRINT"■■DO YOU WANT YOUR REVENGE(Y/N)?";
4040 GOTO4530
4500 REM YOU WIN (FLUKE!)
4510 PRINT"■■AMAZINGLY,YOU WON-BUT I WASN'T TRYING!"
4520 PRINT"■CAN I HAVE ANOTHER CHANCE(Y/N)?";
4530 GETA$:IFA$="Y"THEN1000
4550 IFA$<>"N"THEN4530
4600 PRINT"■■":END
4700 REM THAT'S ALL FOLKS!!
4780 REM
5000 REM DRAW BOARD
5010 REM
5020 PRINT"■"SPC(21)"A  B  C  D  E  F"
5030 PRINT"■ THE GERMAN GAME     ┌──┬──┬──┬──┬──┬──┐"
5040 FORI=1TO6
5050 PRINTSPC(20)V$
5060 PRINTSPC(17)I;V$
5070 PRINTSPC(20)"├──┼──┼──┼──┼──┼──┤"
5080 NEXT
5090 PRINTSPC(20)V$
5100 PRINTSPC(17)I;V$
5110 PRINTSPC(20)"└──┴──┴──┴──┴──┴──┘"
```

```
5120 PRINTLEFT$(D$,17);"  MY  PIECE:"
5130 PRINTD$;" YOUR PIECE:"
5140 A$=C$:A=14:D=16:GOSUB7800
5150 A$=H$:D=22:GOSUB7800
5160 RETURN
5990 REM
6000 REM WISE MOVES
6010 REM
6020 POKEB+I+16*J,1
6025 POKEB+X1+16*Y1,0
6030 FORK=X2-2TOX2+2:FORL=Y2-2TOY2+2
6040 IFPEEK(B+K+16*L)THEN6300
6050 POKEB+K+16*L,9
6060 X=I:Y=J:GOSUB7920
6070 E=M+1
6075 X=X2:Y=Y2:GOSUB7920
6080 E=E/(M+1)
6090 IFE<MATHEN6200
6100 MA=E:X3=I:Y3=J:X4=K:Y4=L
6200 POKEB+K+16*L,0
6300 NEXTL,K
6310 POKEB+I+16*J,0
6315 POKEB+X1+16*Y1,1
6320 RETURN
6330 REM
6500 REM ASSORTED SUBROUTINES
6510 REM
7000 REM RANDOM MOVE(1)
7010 REM
7020 FORX3=X1-1TOX1+1:FORY3=Y1-1TOY1+1
7030 IFPEEK(B+X3+16*Y3)=0THEN7050
7040 NEXTY3,X3
7050 FORX4=2TO7:FORY4=2TO8
7060 IFPEEK(B+X4+16*Y4)=0THEN7080
7070 NEXTY4,X4
7080 RETURN
7090 REM
7100 REM RANDOM MOVE(2)
7110 REM
7120 X3=X1-2+INT(3*RND(1)+1):Y3=Y1+1
7130 IFPEEK(B+X3+16*Y3)THEN7120
7140 X4=INT(4*RND(1)+3)
7150 Y4=INT(2*RND(1)+5)
7160 IFPEEK(B+X4+16*Y4)THEN7140
7170 GOSUB7600
7180 RETURN
7190 REM
7200 REM CLEAR MESSAGE & PLACE CURSOR
7210 REM
7220 PRINT"■■■■■"
7230 FORI=1TO9
7240 PRINT" ■";B$
7250 NEXT
7260 PRINT"■■■■■■■■■■";
7270 RETURN
7290 REM
7300 REM INPUT MOVE
7310 REM
7320 PRINT"■■■■■■■LETTER ";
7330 MI=65:MA=70:GOSUB7400
7340 X=T-63
7350 PRINT"■■■■■■■NUMBER ";
7360 MI=49:MA=55:GOSUB7400
7370 Y=T-47
7380 RETURN
7390 REM
7400 FORI=0TO9:GETA$:NEXT
7410 PRINT"■■";
7420 FORI=0TO220:NEXT
7430 GETA$:IFA$=""THEN7450
7435 T=ASC(A$)
7440 IFT>=MIANDT<=MATHEN7480
7450 PRINT"■ ";
7460 FORI=0TO220:NEXT
7470 T=RND(1):GOTO7410
7480 PRINT"■";A$
7490 RETURN
7495 REM
```

PROGRAMS

```
7500 REM NAUGHTY MOVE
7510 REM
7520 PRINT"■■■**ILLEGAL MOVE**"
7530 GOSUB7600:GOSUB7200
7540 RETURN
7590 REM
7600 REM 2 SECOND DELAY
7610 REM
7620 FORI=0TO2000:NEXT
7630 RETURN
7690 REM
7700 REM CONVERT X,Y TO A,D
7710 REM
7720 A=3*X+16:D=3*Y-3
7730 REM
7800 REM PRINT A$ AT (A,D)
7810 REM
7820 PRINTLEFT$(D$,D+1);SPC(A-1)A$
7830 IFP<0THENRETURN
7840 POKEB+X+16*Y,P
7850 RETURN
7890 REM
7900 REM COUNT 'MOVES' FROM (X,Y)
7910 REM
7920 POKE35,X:POKE36,Y:POKE37,0
7930 SYS7937
7940 M=PEEK(37)
7950 RETURN
7995 REM
8000 REM RULES
8010 REM
8020 PRINT"■           THE GERMAN GAME■"
8030 PRINT"THIS IS A NEW BOARD GAME FOR TWO PLAYERS"
8040 PRINT"EACH PLAYER (YOU AND I) HAS ONE PIECE■"
8050 PRINT"AND THE OBJECT OF THE GAME IS TO PREVENT"
8060 PRINT"THE OPPONENT FROM MOVING.THE PLAY■"
8070 PRINT"CONSISTS OF ALTERNATE TURNS AND YOU MAY■"
8080 PRINT"CHOOSE WHO STARTS.TO MOVE,FIRST PLACE■"
8090 PRINT"YOUR PIECE    ON ANY ADJACENT EMPTY CELL"
8100 PRINT"AND THEN PLAY A NEUTRAL PIECE    ANY-■"
8110 PRINT"WHERE ON THE BOARD.I WILL PLAY LIKEWISE■"
8120 PRINT"AND THE WINNER IS THE LAST TO MOVE."
8130 A=12:D=13:A$=H$:GOSUB7800
8140 A=31:D=15:A$=N$:GOSUB7800
8150 PRINT"■■■":GOSUB8700
8160 PRINT"■REMEMBER THAT THE OBJECT IS TO TRAP MY■"
8170 PRINT"PIECE    (AND THAT I WILL TRY TO DO THE■"
8180 PRINT"SAME TO YOU).■"
8190 PRINT"NOTE THAT I DO NOT INSIST ON YOU PRESS-■"
8200 PRINT"ING ■ RETURN ■ WHEN YOU ENTER YOUR MOVE■"
8210 PRINT"OF COURSE YOU MAY DO SO IF YOU WISH BUT■"
8220 PRINT"I WILL PROBABLY IGNORE YOU.LET'S GO...."
8230 A=7:D=1:A$=C$:GOSUB7800
8240 PRINT"■■■■■■■■■■■■":GOSUB8700
8600 RETURN
8700 PRINT"■      PRESS ■ SPACE ■ TO CONTINUE"
8710 GETA$:IFA$<>" "THEN8710
8720 RETURN
9000 REM
 9010 DATA 169,42,141,30,31,162,48,165,36,10,10,10,10,24,101,35,125,70,31
 9020 DATA 168,185,58,3,208,22,230,37,202,224,42,240,21,152,24,125,70,31
 9030 DATA 168,185,58,3,208,240,230,37,208,234,202,202,202,202,202,202,232
 9040 DATA 202,208,1,96,173,30,31,56,233,6,141,30,31,76,8,31
 9050 DATA 1,1,240,240,15,239,0,31,1,1,239,240,16,16,1,1,239,241,0,242
 9060 DATA 16,16,239,255,0,238,16,16,241,1,1,1,16,16,239,15,0,223,1,1
 9070 DATA 15,16,255,255,16,16,241,17,-1
READY.
```

'Well, here's to computer dating. Let's hope they iron out the bugs soon. . .'

MEET THE GROWTH SOLUTION

From the people who introduced SUNDANCE

The C50/MU Computer: A compact multi-user system, which supports one to five users, features a 5¼-inch Winchester disk with a 6.7M-byte capacity. RAM configurations of 128K to 256K. It offers most of the high-performance features of the larger units, including a high-speed Z80A processor and high-density cartridge tape backup, but with a lower price tag.

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The C80/MU Computer: A powerful Z80-based multi-user system that can support one to five simultaneous users. RAM configurations of 128K and 256K, along with either a 10M-byte, 20M-byte, or 40M-byte Winchester disk, are available. C80/MU supports both MP/M and MOASIS operating systems, along with several versions of BASIC and COBOL languages.

The C8000 Computer: A powerful Z8000-based advanced 16-bit system with expandable memory (256 KB to 1 MB).

The C8000 runs the UNIX operating system. This is a full-featured multi-tasking, time-sharing system. It is capable of supporting one to eight simultaneous users. Multiple languages will run concurrently. C and CBASIC II languages are available, along with industry standard versions of COBOL and PASCAL.

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- Automatic semiconductor memory check (parity check).
- Over two years of cartridge tape backup use on in field products. Data integrity is assured on every backup by CRC (cyclical redundancy check).

Dorado Model	Number of Simultaneous Users	RAM Capacity Range min–max	Disk Storage Range min–max
SUNDANCE	1–3	64K-256K	6.7MB
C50/MU	5	128–256K	6–126MB
C80/MU	5	128–256K	10–126MB
C8000	8	256–1024K	10–160MB

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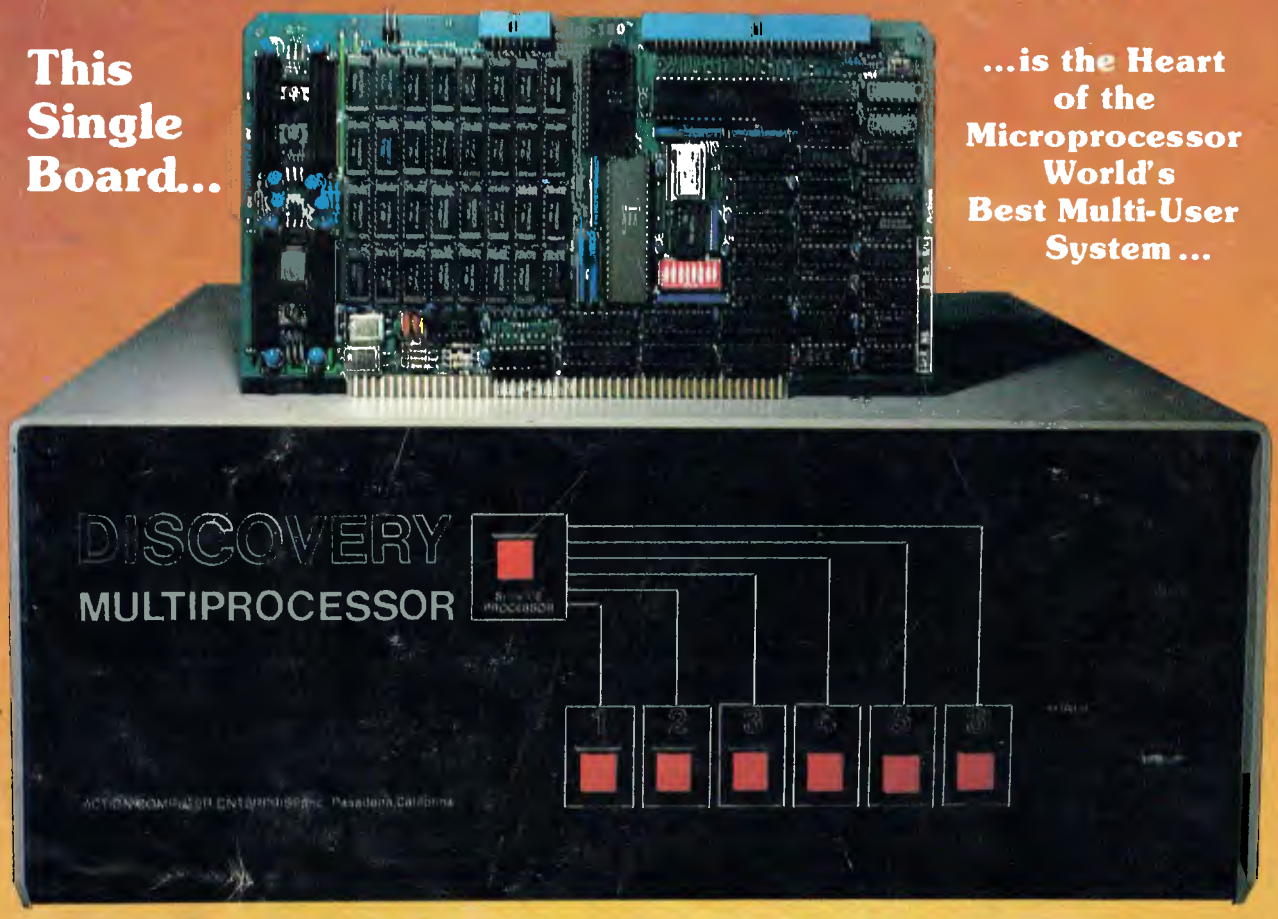
This Single Board...



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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.

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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.

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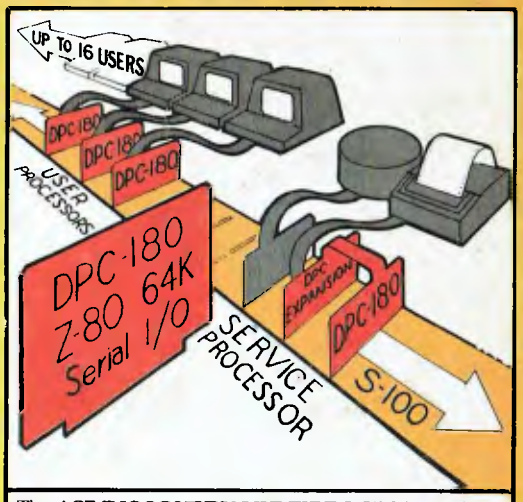
The ACE 64K Distributed Processing Single Board Computer, the **dpc-180**™ gives the **DISCOVERY** MULTIPROCESSOR its own unique architecture. One DPC is dedicated to each user providing exclusive use of the onboard Z-80, 64K ram and serial I/O. Access to the shared resources is provided by an expanded 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.



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