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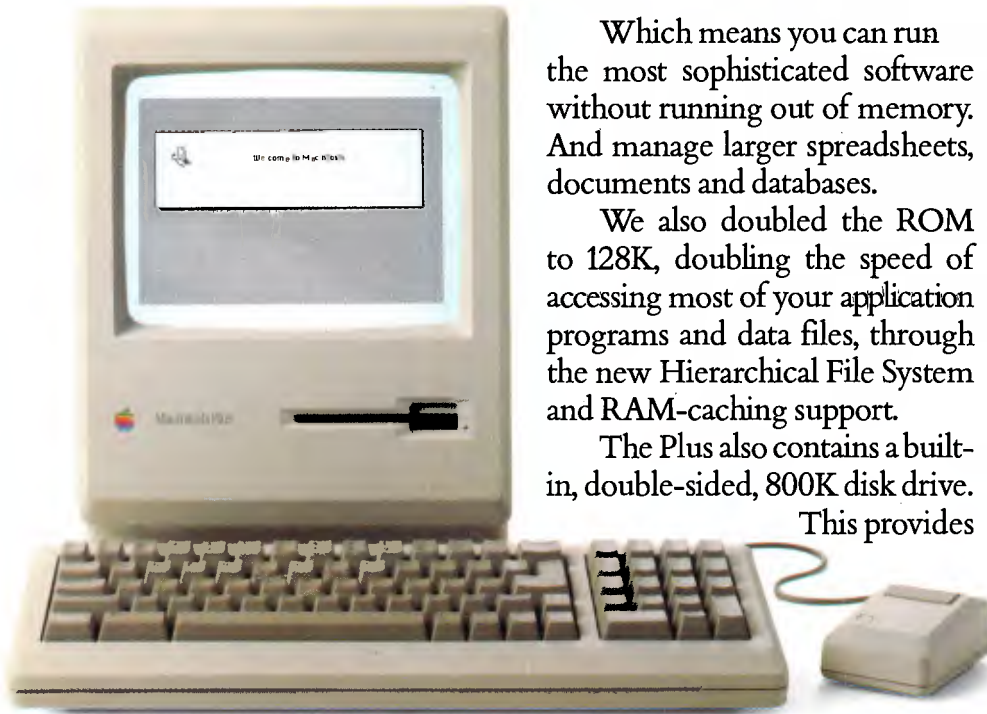
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AUSTRALIA'S TOP SELLING COMPUTER MAGAZINE



UNIX WARS!
Exclusive Test-AT & T's new PC

New Macintosh Plus. We've added



This year Apple introduces a new Macintosh.
Macintosh Plus.

As the name suggests, it's evolutionary, rather than revolutionary

(It's not our policy to bring out totally new computers for the sake of it. Instead we strive to perfect existing ones.)

Macintosh Plus is as simple to learn and use as before.

But there are some big differences, encouraged, we don't mind admitting, by current Macintosh owners.

Some of you asked for more power, others speed. Some needed greater storage capacity, others expandability.

Some heavy number-crunchers wanted a numeric key pad and conventional cursor keys built into the keyboard rather than remote.

Done. Done. And done.

The pluses of this new Macintosh include a full megabyte of RAM (expandable to four megabytes).

Which means you can run the most sophisticated software without running out of memory. And manage larger spreadsheets, documents and databases.

We also doubled the ROM to 128K, doubling the speed of accessing most of your application programs and data files, through the new Hierarchical File System and RAM-caching support.

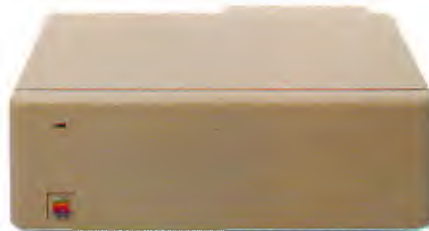
The Plus also contains a built-in, double-sided, 800K disk drive.

This provides

twice the capacity of the previous Macintosh and the equivalent of 400 typed pages, or a bulging file drawer.



If that's still not enough, you can always plug in another 800K external drive.



Or you can really go all out and add our new Hard Disk 20. (Its 20 megabytes are about 10,000 pages worth.)

Just plug in a Macintosh Hard Disk 20 and you can keep all your software, files, worksheets and

documents within a moment's notice of your screen.

Add the Apple program Switcher, and you can actually work with several applications at once, moving information from one into another with the greatest of ease.

So you can transfer notes from an outline to a report – or numbers from a data file to a spreadsheet – as fast as you can click your mouse.

AppleCare.

All Apple products come with an automatic 3-month warranty covering all parts and labour.

But this year, Apple introduced a sort of "Warranty Plus" through the AppleCare service programme.

If you fill out and mail to us the registration form enclosed with your equipment, you will receive nine extra months' cover on top of the normal three.

Macintosh Plus also features a new SCSI connection port (dubbed "Scuzzy" in typical fashion by the development team).

SCSI stands for Small Computer Systems Interface and it's an industry standard.

We've virtually opened up the architecture. But what we've really done, of course, is open up a whole new world of possibilities.

The Scuzzy port let's you daisy-chain up to seven high-performance (and often low-priced) peripherals like hard disks, file servers and tape backups from all sorts of third parties.

Given all this power, it made sense to team it with equally impressive printers.

The new LaserWriter Plus is just such, producing documents with text and graphics of publishing quality.

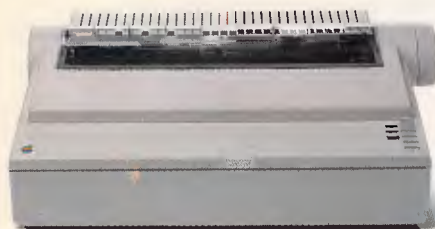
everything except complications.

And it maintains this fidelity on copy paper, letterhead, labels, envelopes or overhead transparencies.



LaserWriter Plus has 35 different typefaces built in, a choice that would embarrass your local printer (and his invoices).

But if you don't need publication-quality printing, you can have near letter-quality by teaming up your Macintosh with the ImageWriter II.



It prints in three different modes: high-quality, standard and draft. And churns it out at speeds of up to 2½ pages per minute.

You can feed in single sheets automatically with the optional SheetFeeder.

And print up to seven colours using appropriate software.

ImageWriter II can also be shared with other Macintosh users via AppleTalk.

But this Macintosh isn't called Plus for nothing. You can just add and add.

Items like an AppleTalk Personal Network.

It's the most flexible, low-cost, easy-to-set-up, easy-to-use network around.

It'll connect up an office full of Macintoshes, LaserWriters, ImageWriters and file and disk servers – 32 devices in all.

Using an electronic mail package, you can send messages to any Macintosh screen on the network.



Or with EtherMac software you can share information with other computers. (Our computer is so friendly it'll even talk to IBMs.)



Add an Apple Modem 1200 to your Macintosh and you can talk to anyone virtually anywhere.

With a communications program like MacTerminal, a standard telephone and an Apple

modem, your Macintosh can plug into electronic information services like Viatel, Minerva and Midas and communicate with mainframes and minicomputers.

If you already own a Macintosh, there's another plus.

You can upgrade your machine to the new one megabyte. Ask your dealer for upgrade details.

You can also upgrade your LaserWriter to become a LaserWriter Plus.

Get hands-on with the new Macintosh Plus.

You should like it.

You helped design it.



The Apple business card.

If you wish to own a Macintosh system, you can take advantage of the Apple Credit Card, available from participating dealers.

You can use it to purchase computers, peripheral equipment and software with no down-payment and less impact on your cash flow.

If you qualify, in most cases you can take your own Macintosh with you and dive straight into work with it the same day.

For an authorised Apple dealer near you outside Sydney, you call toll-free (008) 22 1555 or Sydney 908 9088.

AP 219/Palace



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Editorial Managing Editor Sean Howard; Assistant Editor Maria Bokic; Consultant Editors: Steve Withers, Ian Davies. Advertising Advertising Manager Mark Reiss; NSW and Qld Sales Manager Gerard Kohne (02) 264 1266; Vic, SA, WA and Tas Sales Manager Jenny Gold (03) 531 8411. Production Graphic Heart Pty Ltd. Distribution Subscriptions Manager Judy Welsh (02) 264 1266; Subscription rates Australia \$35 per annum, overseas A\$47.00 (surface) A\$130 (airmail); Newstand sales Network Distribution Co. 54 Park Street, Sydney 2000. Publishers Computer Publications Pty Ltd (a subsidiary of Consolidated Press (Holdings) Ltd).

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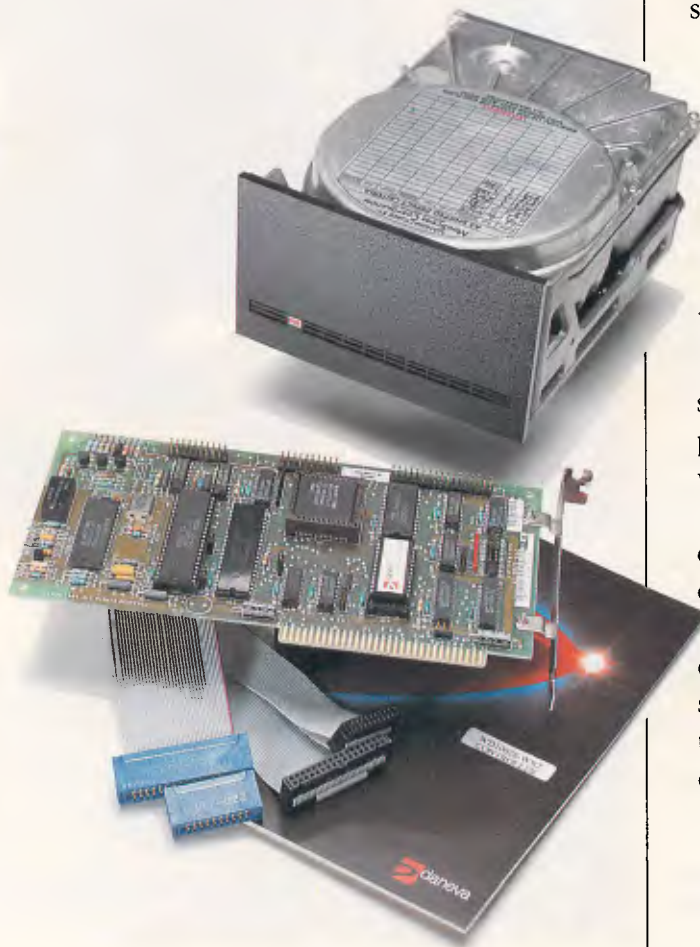
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All the news that's fit to print from APC's world-wide network of reporters.

Against expectation

A lot of people were expecting Olivetti's PC/AT lookalike to be a lot bigger and faster than the new M28, seen by a favoured few in a lock-up room at the APC Show.

Mostly, people expected this because Olivetti has a reputation for making super-fast imitations of IBM machines, and has already announced the 'special performance' SP version of the M24, which it said was a rival to the AT.

In fact, the M28 is faster than the IBM AT, but only by about 30 per cent, and even runs at the same 8MHz clock speed, rather than the 10MHz which people guessed would be the case.

The way in which the big M28 will be sold will be a surprise only to people who didn't read Newsprint on the subject of Xenix V, Microsoft's version of Unix on the 80286 chip (inside the M28) last year.

Word had reached me, back then, that despite Olivetti's close relationship with American phone giant AT&T, the AT&T 6300 Plus with Unix V was not regarded as the way to go.

The AT&T 6300, confusingly, is the Olivetti M24 in a slightly different box. The Plus doesn't have an equivalent.

Olivetti, however, wants a more powerful multi-user box than the 6300 Plus, and wants the Xenix, rather than Unix, version of the operating software, probably because it is more like MS-DOS.

The other new box is the ultra-small M19. This could be used as an 'affordable' (rather than cheap) MS-DOS machine with good graphics. However, Olivetti sees it as the way to give network

users a compatible workstation.

The similarities with Apricot's announcement of NET II are obvious — the super-powered server box, and the low-cost terminals. Apricot, of course, has gone for much faster terminals, with the diskless Xen. Olivetti seems to be more interested in multi-user Xenix systems.

Both decisions are gambles with the future, and

it will be fascinating for the rest of us to watch and see which works better.

The M28, by the way, has been subjected to internal Olivetti tests, still secret at press time, but which excited executives couldn't keep to themselves. Apparently, they show the M28 running faster than DEC's VAX 780 supermini. *Guy Kewney*

On the Rampage

There are two ways of

extending memory on the IBM family: Intel/Lotus's Above Board, and AST Research's Rampage.

Why should you consider Rampage rather than the original? To help you make up your mind, AST has started giving away a multi-tasking operating system, Desqview, with the boards.

Desqview is reported to be better than IBM's TopView in that it handles graphics rather better. It isn't Microsoft Windows, but it does take advantage of the extra features of the Rampage, rather than the (comparatively) limited features of the Above Board, says AST. *Guy Kewney*

Campaign not fizzling

Imagineering has replied to the statement in last month's Newsprint headed "Pirate sails off" which included the statement "The action against Down Under Software... appears to have largely fizzled out."

Peter Heining on behalf of Jodee Rich, MD of Imagineering, writes:

"In the light of John Le Fevre's *Computing Australia* article "Software Pirate Escapes With Wrists Slapped," February 10, 1986, and follow-on articles which appeared in the March issue of APC, I feel the time is ripe to highlight the successes of the Anti-Software Piracy Association, of which Imagineering is a founding member.

ASPA, both here in Australia and in Hong Kong, has shown on more than one occasion that it has the necessary will to act against proven microcomputer software piracy.

Last year, a Victorian dealer was successfully prosecuted for illegally copying microcomputer soft-



MicroBee Systems doesn't deserve this, after giving an 'also-ran' magazine first look at its latest machines, but here goes (grudgingly):

This is the Gamma, and it's chock full of microprocessors. It has two Z80s and a 68000; runs both CP/M-86 and a Unix-like operating system and, by the addition of an 80186 co-processor card is also capable of running MS-DOS. Most existing MicroBee software should also run on the Gamma.

The basic machine comes with 512k of RAM (expandable to 4Mbytes on the main board) and twin 3.5 inch 800k capacity floppy disk drive; it drives a hi-res screen of 720 by 350 pixels using up to 16 colours from a total of 4096 hues.

For more information definitely don't call us; MicroBee is on (02) 487 2711.

ware. The dealer's stocks of pirated software were seized.

With the assistance of Hong Kong's Customs Department, ASPA also mounted several successful raids last year against software pirates working out of such notorious havens as The Golden Arcade shopping centre. Those raids — the first ever mounted in the colony — netted more than \$US1 million worth of pirated software.

More raids were successfully carried out in Hong Kong in recent weeks. The Customs and Excise Department sent 170 officers into the field, and more than 40 stores were raided. A total of 17 arrests were made.

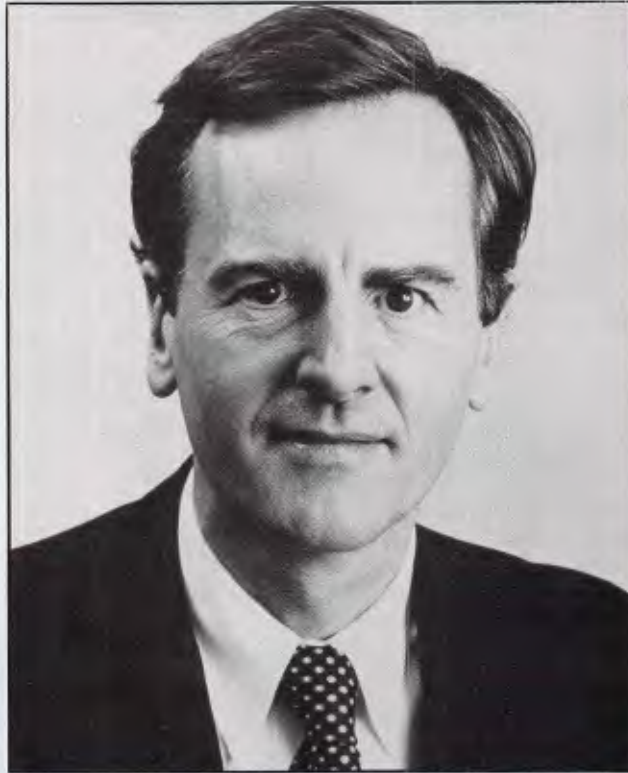
One direct result of ASPA's actions in Hong Kong is that software users have been given proof that legitimate software suppliers are willing to protect their products through the full weight of the law.

They have also shown that the level of support and training provided by legitimate software suppliers makes it worthwhile to invest in legitimate software. Imagineering's software sales have trebled in Hong Kong, indicating that corporate and government software users are willing to back ASPA's actions.

I wish to make it quite clear that ASPA will continue mounting raids, and taking legal and court action against proven software pirates — both here in Australia and throughout South-East Asia.

In the case of Down Under Software, the subject of several stories in both publications previously mentioned, a written undertaking was made not to pirate software. ASPA has accepted that undertaking, and no further legal action will be taken unless there is further evidence of software piracy.

I would also like to point out that ASPA's commitment to anti-software piracy goes beyond taking punitive



Work on the next wave of innovative computers is under way at Apple using a \$15 million Cray super-computer to speed a \$125 million development program this year, Apple's boss, John Sculley, revealed in Sydney last month.

Sculley, who took over from Steve Jobs last year, was in Australia for two days to attend the Australian Computer Society's PC86 Conference.

Planned new products include an IBM-compatible Macintosh and, as often promised, opening the Macintosh's architecture to make possible third party hardware enhancements.

The Apple II line will continue to have Macintosh-like products added to it, and the company aims to make it easier for users to migrate to the Macintosh.

But Apple isn't spending a massive \$125 million just to enhance existing products. It's working on a new line that will be as significant as that first Apple back when Steve Jobs and Steve Wozniak hurled the microcomputer industry from its embryonic days.

Sculley said Apple was on the verge of a new wave of personal computers that would take the industry beyond people's imagination.

"It's actually going to give us the most exciting growth years of the PC industry. The first wave got us started, but it's the next wave that's going to be important for the future," Sculley said.

The new products remain a tightly guarded secret, but Sculley confirmed that the essential focus for Apple and, he believed, for any PC company that wanted to last, was simpler user interfaces and powerful graphics.

To achieve Apple's dream of the next wave, PCs would have to be as easy to use as telephones. Only then could Apple move past the enthusiast and busi-

action against individuals or organisations found to be pirating legitimate software. ASPA has already succeeded in coming together with the Australian Government to introduce meaningful software copyright legislation, where none previously existed.

ASPA originally consisted of Lotus Development Corporation, Ashton-Tate and Imagineering. MicroPro and Broderbund, two of the largest software developers in the US, have thrown their weight behind the association, believing it to have the best interests of legitimate software developers at heart.

The easy way to crash

My colleague Menno Aartsen says in an, as yet, unpublished review that he found it almost impossible to crash the Tandy 100 lap-held by using the new \$350 portable disk. Menno obviously doesn't have what it takes to *really* crash a system.

His report on the 100k storage system bragged about lightning storms, humidity, and other illustrations of how hard Florida (where he lives) can be on hardware.

I don't need Florida; all I have to do is plug in the thing.

Tandy recently lent me a drive which I used with my Tandy 100 for an interview with one of my heroes, Chuck Peddle. He invented the 6502 chip (Apple, Commodore, etc.) and the Sirius, and he's now running Tandon Computer. The very next day, I had to fly off to the US with the machine, and I thought it would be nice to test the beast by saving my Peddle interview to disk, and get on with other work during the flight.

To understand the problem, you have to count bytes. The Tandy 100

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without expansion, can hold a measly 32k of memory. My Peddle interview took up about 11k, and my own Tandy 100 only has 24k anyway.

The software Tandy supplies is on the disk. There is a snag: if the disk software that reads the disk is on the disk, how do you read it off?

Answer: to use the thing you have to type in a Basic program of only four lines, but of nonetheless unbelievable impenetrability. It's a string of commands to the disk, telling it to send data from track x and load it into memory starting at point y, but it looks just like gibberish. You have to type it exactly right.

I'm fairly sure I got it right, because the message saying 'loading, please wait' came up on the screen. And the red light on the disk turned on and off, just like the manual said. Then it turned on, then off, and this time, it stayed off. I waited, and chatted to my neighbour in the plane.

After a few minutes of chat, I began to have a sinking feeling about my interview. All the 'stop' buttons were pressed, and eventually, I found a way of getting the computer to watch me again. The interview, every byte of it, was still there, but the 8k worth of disk filing system was not. Instead, there was a missing 4k of memory. Add all the files together, and it comes to 4k less than the 24k in the machine. Why?

There was still room for that 8k of filing system software, so, foolishly, I suppose, I tried again. Any rational human would have let well alone, but I did want the interview to be turned into an article, and (let's face it, I had good reason) I was anxious that the machine was going to swallow it if I didn't get it onto disk.

Again, I typed in the Basic. My colleague Peter Bright who happened to be sharing the journey to San Francisco,

ness user to the far vaster, virgin frontier.

One of the most important goals, Sculley believed, would be to overcome the tyranny of operating systems restricting users from accessing other systems.

Standards would need to be at the data level, allowing conductivity of data from machine to machine regardless of what operating system was in use. As users rapidly move more and more to multi-user, multi-vendor environments, the need for such standards will become more urgent.

Not only will PCs be networked in future, but users will want to use the peripherals and even free internal memory on each other's machines.

"What does this mean to our one person, one computer philosophy?" Sculley asked, "Simply, this philosophy is expanded to one person, one computer effortlessly connected to the world through transparent data avenues.

"Such access becomes critical in view of the information explosion which continues to surround us. The amount of information in the world is doubling every three years. By the end of the century we are going to have either learned to cope with it or be overwhelmed by it."



On first meeting Bill Gates of Microsoft, it's hard to believe the guy is worth in the vicinity of \$300 million.

Sure he is wearing a suit and tie, but as he prances around his hotel room high above Sydney harbour espousing the virtues of CD ROM and Microsoft's recent public float, the impression is more of an excited kid fresh out of high school rather than an established hi-tech hero.

Later, at a Microsoft function, he appeared in the traditional uniform of the Silicon Valley hacker, a T-shirt and slacks — looking like the 13 year old "computer nerd" who once played around with DEC minicomputers after school.

Gates was in Sydney recently checking out the progress of his company's far flung Australian subsidiary.

Much on his mind was Microsoft's recent public share issue.

checked it. We agreed that it was right.

We were wrong. This time, after two false starts, the system became serious. It stopped — totally and unrecoverably. Nothing could make anything happen — except an emergency full reset. That clears out everything from the memory.

At that point, there was one bright spot: at least we didn't have to worry about what else might be in memory. We had 24k free. We tried again, and the sequence repeated itself pretty well — apart from the fact that this time, we didn't wipe out an interview with Chuck Peddle, because there wasn't one there.

So now you know why I don't have an interview with Chuck Peddle, and can't give you a report on the Tandy filing system.

This will change, I'm certain. Tandy folk seemed (when I borrowed the disk) so anxious to please, I'm sure that soon, one of them will return at least one of the rather red-hot phone calls I've made to them, and I'll have another chance to make it work.

Or at least, I'll find out how many articles can be stored on a 100k disk and how long it takes to read them in and out.

What I *hope* happens, is that someone clever puts this wretched filing system software in a plug-in ROM chip, and we don't have to rely on writing Basic PEEK-and-POKE programs which load filing system software off a faulty disk. It is 1986, after all, and I've heard tell of 64k ROMs which really don't cost all that much, compared with what they cost when the Tandy was launched.

Guy Kewney

Were we wrong?

Last month's mention of a price disparity between

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"Going public has some overhead in terms of reporting — we have been required to report profits that we never had reported until this point," he said.

"People have been rather stunned to see our financial history. When we incorporated four years ago we started to spread the ownership around among our employees.

"So far we have been able to fund the company internally and that has been really great for us. Going public allows us to provide liquidity for the employees' shares, of course it also allows us to raise more cash which means we can be more aggressive in terms of acquisitions."

The microcomputing industry ideal of a machine on every desk was fait accompli according to Gates with no room for a revolutionary new architecture.

"There is no quantum leap needed there, what is needed is a gradual shift to more networking, more 80286 machines and more hi-resolution screens.

"We will get to our vision of a machine on every desk — that's really exciting growth and great business.

"We have a vast amount of development going on with the 80386 based PC. That machine is so powerful that it will capture a large part of the technical workstation market."

New developments in the works at Microsoft included an IBM PC version of the Macintosh Excel software package and a more powerful version of Microsoft Word for the Mac, but Gate's passion of the moment is CD ROM.

Gates has set up a CD ROM development group within the company.

"CD is peripheral to existing PCs, it allows you to do large vertical databases, distribute a lot of reference material and do fonts for laser printers — it will have a great impact on the PC space.

"Today CD costs \$1000 — but it will come way down from that," he said.

"The use of CD to store not only data and code but also video and audio information will allow us to create a new multi-media software which could have a great impact on the consumer market.

"That could allow us to build a home computer that actually has some relevance to a lot of people."



From the man who designed "printer buffers to give Macs back to their users" comes the Mac Bytebuffer. Three models are available, from 64k up to 512k; all are compatible with a wide range of printers for the Macintosh including the LaserWriter and the ImageWriter II. Prices start from \$325; details on (045) 77 6023.

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P.S. Our deepest apologies for the long delays to the many, many hundreds of inquirers for our 64/80E (Apple IIe compatible) computer, we had a few technical bugs to iron out. Both software and hardware have been totally redesigned and USA registration has been applied for. If we proceed with it, it will be a detachable unit with dual CPU, 2 d/drives, colour card, 128k, 80 column and monitor for under \$1400.00 for non-members and under \$1000.00 for HOME-SHOP member, we'll keep you posted on it.

N.B. Due to Aussie \$ slump against Japan yen, prices subject to change with new shipments, AVOID DISAPPOINTMENT AND ORDER NOW. (If you do not wish to damage your magazine, use photocopy or PRINT/TYPED your order on a plain sheet of paper (please PRINT as below).

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virtually the same PC/AT-compatible machines being sold by Pantek and Osborne has indeed prompted "pricing shuffles". At least, that's according to us. Osborne's Stanley Falinski reckons we're not too bright and incorrectly stated the price of his machine.

Whatever, Osborne's current price is \$4950 which includes 1Mbyte of RAM, and serial and parallel ports. Pantek's price for a 512k RAM machine, with serial and parallel ports is \$4895 (an extra 512k of RAM costs \$180).

AT portable

You know a company is going well when every time a press release is received it is accompanied by a statement of the company's financial position.

Such is the case in Compaq's opinion: the announcement of the

80286-based Compaq II was attached to Compaq's 'Consolidated Statement of Income'. For your information: in 1984, Compaq's revenue was \$US329 million and in 1985 \$US503 million.

Its profit for the two years was \$US16 million and \$US43 million respectively. Other snippets include an expenditure of \$US16 million last year on research and development; and a whopping \$US17 million provision for income tax in the same period.

Call (02) 660 0077 for details of the Compaq II.

Briefs

Microsoft's Windows has received a shot in the arm with the announcement that future applications from Lotus will utilize Windows' features.

"We are already developing entire new families of

STOP PRESS

Since Futurtronics' demise, Atari's computers have not been officially distributed in Australia. Now Mobex has taken up the challenge.

According to Atari's newly appointed national sales manager, Bordan Tkachuk: "Atari has a new flagship computer and new impetus that will drive a giant wedge into the marketplace".

And to the Atari 520ST's impact on the Commodore Amiga's sales: "The 520ST will probably assist the Amiga. The two machines together will create a bigger market and market awareness for this sort of computer."

Initially Atari will have the market to itself — having PAL machines already in Australia as this issue went to press.

Pricing has also been announced: the basic machine with 512k of RAM, GEM and TOS in ROM, Basic and Logo on disk and word processor and graphics packages retails for \$1499. This unit can plug into a domestic TV. A package which includes this basic machine with a monochrome monitor and 360k 3.5 inch floppy disk drive retails for \$2399 (or with colour monitor for \$2999). The disk drive on its own retails for \$699; and a 20Mbyte hard disk will sell for \$2999.

products which take advantage of Windows," said Mitch Kapor of Lotus... According to Ashton-Tate it would only take a couple of hours for a Cray II super-computer to break the encryption system used on its dBase III Plus database. This is not by design, but a restriction of the US Government which wants any products exported from the US to have encryption techniques that can be smashed by a Cray II within two hours. Any longer and such products could damage US Government moves to "retain the secrecy of its high technology from Eastern block countries"... Something that strikes us as being very useful is a product which keeps track of individuals' or small businesses' income and expenditure. Its reporting feature aids in the preparation of tax returns as expenditure is summarised into categories. Also, payments to credit cards can be divided into various expenditure categories.

Up to 120 categories can be handled by Cross-Cheque, with each having a

three character abbreviation and a 20 character description. Income and expenditure data can be searched by category, payee, date, cheque number or amount. Cross-Cheque runs under both MS-DOS and CP/M-80. Call (02) 399 8520 for more details...

The Kurzweil Voice System 3000 is a voice recognition system for the IBM PC which employs artificial intelligence techniques and includes "sophisticated speech normalisation, high level pattern recognition and feature extraction." Details from Software Corporation of Australia on (03) 699 7255... Prolog, a favourite language among AI aficionados, is now available for the BBC. Scott Brownell of Barson Computers says that: "Acornsoft's micro-Prolog is a full implementation, and comes with a friendly front end interface to make the language's syntax easier for the inexperienced user."

It sells for \$170; call (03) 419 3033 for more details...

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- High specification and speed loading capability for programmes.
- 3-voice, 7 octave stereo output.
- Wide range of software available. Subjects include entertainment, brain power, education and business.
- Colour screen package available from around \$629, complete with monitor and built-in data recorder.



Amstrad CPC6128 Computer with Monitor and Disk Drive

This ultra-efficient business and home computer comes with its own green screen monitor and built-in disc drive from around \$699.

It can play games, or do more serious things such as spreadsheet analysis, budget calculations, debit and credit analysis, cost control, cashflow projections, sales forecasts, and many other accounting and business functions.

For the money you pay, there isn't a better business and home entertainment computer available.

- Incorporates both AMSDOS and CP/M operating systems.
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- Monitor with 80 column text display.
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- Rapid loading. Instant cataloguing.
- 3 voice, 7 octave stereo output.
- Wide range of software available. Subjects include entertainment, brain power, education and business.
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Life after the show

*PC86 has been and gone and left its mark on many well worn legs.
Richard Rydge reports on the aftermath.*



IBM: more like poker machines at the local RSL club.

Last month's PC86 Show was exhausting for exhibitors, alluring for visitors, and the best opportunity this year for just about everyone to learn about the latest products.

Australian Exhibition Services, which organised the show with *Australian Personal Computer*, estimated that attendance exceeded last year's staggering 25,000 people.

The Sixth Australian Personal Computer Show took all the available exhibition space, four floors,

at Sydney's Centrepont to host 72 leading suppliers. These included companies such as IBM, Apple, Commodore, Hewlett-Packard, Barson Computers, Sperry, Imagineering, Tandy, Arcom Pacific, Microsoft, Canon, Olivetti, Microbee, Memorex, and Sanyo.

The NSW Minister for Industry, Small Business, Energy, and Technology, Peter Cox, opened the show at a breakfast launch. Cox stressed his strong support for high technology, and said the government planned to

soon announce several new research and development initiatives.

At the nearby Masonic Centre, the Australian Computer Society held a special conference to coincide with the Show. Guest speakers included the chief executive officer and chairman of Apple, John Sculley, and the young founder of Microsoft, Bill Gates.

Delegates at the conference left free their first afternoon, the opening day of the Show, to roam the stands.

C64, and everything that runs under CP/M.

Apple had its sleek new boy on the blocks, the Macintosh Plus, with a hefty 1 Mbyte of internal memory, speedy 800k internal disk, expanded keyboard, and enhanced operating system and communications ports.

Flying the Aussie flag was our very own Microbee Systems, with its new Premium Series, designed for home, office, and school use.

The newest of its line, the Gamma, has already caused



John Sculley, chairman of Apple Computer, with Australian PR Manager, Inge Fuglestad and General Manager, David Strong. (right)

The Show itself had all the hectic excitement of an Arabian bazaar. People jostled each other to glimpse the amazing Commodore Amiga perform dazzling computer graphics. The Amiga was easily the star attraction, with no shortage of admirers.

Also on display at the Commodore stand were the C128 and 128D, a desktop version of the C128. These are the machines that have three resident processors, and can run probably the world's largest collection of software, everything for the

a strong stir of renewed interest in Microbee. The machine features 32/16 bit technology based on the Motorola 68000 chip, the same as Apple's Macintosh, Commodore's Amiga, and Atari's 520ST. And soon it will have an optional co-processor card to provide IBM-compatibility.

The Gamma undercuts just about everybody and seems certain to blaze a trail across our sunburnt land once the marketing gets fully wound up.

Down again among the thick of it, any keen eyed



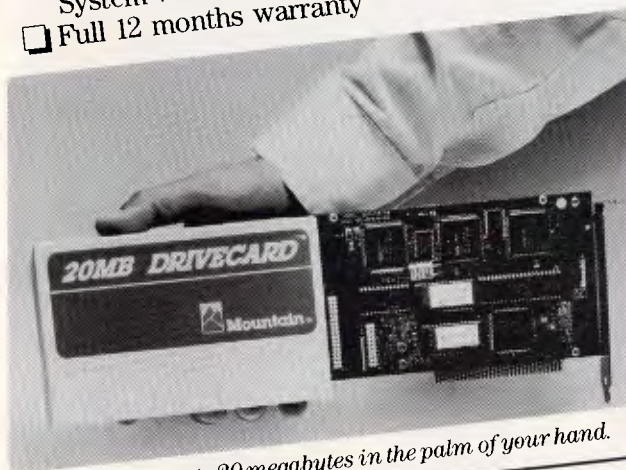
Commodore's Amiga: a rare quiet moment

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Microbee's new Premium Series range of computers.

person who stumbled into Olivetti's grey, tram-like stand could have spotted the still hush-hush Unix PC, or as Olivetti likes to call it, the 3B1, full details of which is our cover story this month.

Hewlett-Packard had its Vectra PC on display. Despite being smaller, faster, and cheaper than its IBM counterpart, it looked pretty much abandoned when I passed it by. Possibly, though, a simple enquiry might have sparked some enthusiastic salesman to sally forth its wonders, including its touch sensitive screen.

Apricot's Xen, distributed by Barson Computers, was on show with claims that soared the mountain tops. In an industry that knows no bounds for its advertising hype, the Xen is claimed to be the fastest, most sophisticated microcomputer on the market. Curiously, it

caught none of the attention of the Amiga, and seems to hold none of the promise of the Macintosh Plus.

Epson not only had three new desktop MS-DOS PCs on show, adding to their three laptops, but also boasted two brand new printers.

The HS-80 is a portable ink-jet 80 column NLQ printer that whizzes along at 160 cps. And the LQ-800/1000 series is Epson's 24-pin show stopper. It includes a choice of six font cartridges, and runs at 180 cps in either IBM 5152 or Diablo emulation.

No reputable show would be, well, reputable without IBM. And Big Blue was there wowling folks with its new JX, plus the full range of IBM PCs. But it was the JX, aimed at first-time home and business users, that was catching everybody's eye.

Included in IBM's line up



The new BBC Master at the Barson stand.

INTRODUCING IBM Compatible Hi-Res Monitors from **QUBIE'**

The HR 39 and HR 134 Monochrome Monitors are direct replacements for the IBM Model 5151 Monochrome Display. The HR 39 features a GREEN phosphor screen, while the HR 134 an AMBER screen. Both monitors plug into the IBM Monochrome Display and Printer Adaptor (or compatible) card.

The HR31 200 Colour Monitor is a direct replacement for the IBM Colour Display. It plugs into the IBM Colour/Graphics Adaptor (or compatible) card. The HR31 200 features **0.31mm dot pitch and a black matrix picture tube**. This special tube reduces glare and enhances RGB colour to ensure superb picture quality.

All three monitors include a tilt and swivel base. Use your Qubie' monitor as you would the IBM ; it will in no way affect the normal use or function of your Personal Computer.

Technical Data - HR31 200

CRT Size:	14" Diagonal (34cm)
Tube:	Black Matrix
Sync-H. Scan Frequency:	15.7kHz
V. Scan Frequency:	60Hz
Signal Type:	RGB I: TTL Level Positive Sync H/V: TTL Level Positive
Display Size (H x V):	245mm x 170mm
Retrace Time (H x V):	0.5Ms x 0.4msec
Resolution:	640 x 200 lines
Input Terminals:	9 pin "D" type connector
Dimensions:	11"(H) x 15"(W) x 13"(D)
Shipping Weight:	266(H) x 367(W) x 318(D)mm 15.9kg



Model HR31 200



Models HR 39 & HR 134

Technical Data - HR 39 & HR 134

CRT Size:	12" Diagonal (29cm)
Phosphor:	HR 39 (Green); HR 134 (Amber)
Sync-H. Scan Frequency:	18.432kHz
V. Scan Frequency:	50/60Hz
Signal Input:	Video - TTL Level Positive Sync. H - TTL Level Positive Sync. V - TTL Level Negative
Video Response:	20MHz
Display Size (H x V):	203mm x 135mm
Display Time (H x V):	44Ms x 18.99msec
Resolution:	Centre 1,000 lines Corner 800 lines
Display Formats:	9 x 14 matrix, 2000 characters in 80 x 25 format
Input Terminals:	9 pin "D" type connector
Dimensions:	10.5"(H) x 15"(W) x 12"(D)
Shipping Weight:	257(H) x 367(W) x 294(D)mm 11.36kg

All models: 240V AC/50Hz

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SHOW REPORT

were the ColorJetprinter, the Proprietary, the Wheelprinter, and the whisper quiet and aptly named Quietprinter.

Lots of suppliers were running competitions for lucky visitors to win computers and software. Memorex, which makes disks and other magnetic storage, caught the festive atmosphere with a magician performing tricks, a real crowd puller, give away beach balls and card tricks, and chances to win packs of disks.

One of the most unusual prizes would have to have been the Movit line of robots, which come as kits, and are distributed by Thinking Systems. These cute little toys can be voice controlled, infra red controlled, and yes, even computer controlled.

One Movit can follow lines drawn on paper, another can be programmed with

the user groups. Here could be found the last of the home brew hobbyists, with enticing offers for like minded devotees.

SMUG, the Sydney Micro-bee Users' Group, had some slightly podgy representatives staffing their stall, suggesting perhaps that sitting behind a keyboard every spare moment is as bad as Norm watching telly all day.

TISHUG, the Texas Instruments Home Users' Association, had people of a leaner, more earnest sort. One member was spotted toying with an algorithm while another tried to perfect a 3-D triangle complete with arcane notation.

AUG, the Apple Users' Group, was well organised with sample bags just like the Royal Easter Show. Delighted Apple II and Macintosh owners could score a disk of public



Online with Telecom's Viatel service.

punched cards, and the top of the line machine performs turtle graphics, and accepts 256 bytes of instructions from its own control panel or through an RS232C port.

Up on the top floor of the Show visitors could seek refuge, have a cup of coffee, maybe something to eat, and browse through some of the more interesting brochures they had picked up, while possibly preparing a plan of attack for the next descent.

Next to the food stall, in what seemed a strange time warp to the golden days, hid

domain software, a key ring, magazine articles, and one of Mother Nature's edible apples for \$12 and \$15 respectively.

Sadly, there are just too many products to write about. There would have been hundreds, a lot of them very good. And that's the pity of missing the Show.

Unfortunately, it doesn't return to Sydney for another year. But from June 1 to 4, you can see it all again at Melbourne's Royal Exhibition Building.

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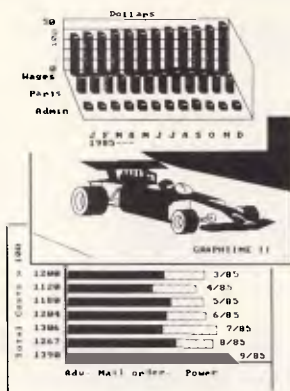
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Amazing Business Graphics for only \$99. Graphtime II is an easy to use Business Graphics System combining data presentation (on screen or printer), business statistics, diagram drawing and slide show presentation. The system is menu driven and incorporates a macro facility allowing you to group sequences of commonly used key strokes.

Graphtime II provides multiple graph types... Line, Dot, Area, Pie, Step, Stick, High-low line, High-low area, Horizontal Bar and Column (single, multiple, stacked or blocks). Automatic labels and scales are initially generated for fast display and all details can be quickly amended by the editor if required. Data is entered directly into Graphtime II or as ASCII files (from Lotus 1-2-3, dBaseIII, Statpak etc.) or SYLK files (Multiplan). Business Statistics are available for all graphs.



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The excellent thirty six page tutorial takes about ninety minutes for a novice to complete and illustrates most of

Graphtime II's features and facilities. Create your own sophisticated business graphics on your IBM PC or compatible by ordering Graphtime II today for only \$99.

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A Notebook II database is endlessly flexible. It can have an unlimited number of records, with up to 30,000 characters (about 10 pages of text) and 50 fields in each record. Each field can hold unlimited text — up to the maximum record size. And you don't have to reserve space in advance, because fields and records expand dynamically as you add text. You can even add new fields to existing records.

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Notebook II lets you print information exactly as it appears in the database. Of you can use its full-screen custom report editor to print in any format you choose. You can send output directly to your printer. Or you can write it to a diskfile to incorporate it in documents prepared with your word processor.

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END USER

filePro 16 can be used directly by end users. Just look at the conceptual differences between filePro 16 and other packages. Many data bases are infact programming languages... fine if you are a programmer or have a technical background.

DESIGN

filePro 16 has two goals. Firstly, it enables you to set up and maintain a personal data base easily and quickly with either automatically created or custom designed screens, indexes and reports. Secondly, filePro 16 is designed to manage accounting type applications. A relational capability is available to move data between files automatically, allowing the posting of entries for a complete accounting system. In fact each filePro 16 package includes a basic Invoicing, Debtors and Stock Control System.

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Editor's Note: APC's deadlines are always fine — in an attempt to bring readers the very latest news — but this time just a little too fine. The dBase III Plus test will appear next issue; in the meantime...

Smart II

Smart, from American software house Innovative, combines word processor, spreadsheet with graphics and data management at a level which provides adequate facilities for the needs of the beginner and the experienced user.

Kathy Lang takes a closer look.

People who need a data management system can choose either to buy a package designed just for that purpose, such as dBaseIII, or they can go for a so-called integrated package in which data management is one capability among others, usually including spreadsheet, word processing and graphics. In most cases, the data management option in integrated packages is less powerful than a corresponding specialist package. There are, however, exceptions; among them the latest version of Smart from the American software house Innovative, distributed in Australia by Sourceware. Rumour has it that a networked version of the package will shortly be announced, so it is worth keeping your ears open if you are likely to need to share your database information among several users.

Smart consists of three modules: word processor, spreadsheet with graphics, and data management, in addition to basic system facilities which include communications. Each of the three modules can be purchased and used separately; Smart could be termed a loosely integrated package, in contrast to the closer integration of packages such as Symphony and Framework. (In practice, the plus point is that Smart does not require you to be able to store all your data in memory, so you can have much larger data files; the disadvantage is that it requires a file translation to move information between modules.)

In this review I'll be looking at Smart's data management capabilities, using the same categories of analysis as the software Benchmark, though in a little less detail than usual since the first version of the Smart package has already been covered in APC (May 1985).

Smart is initially a menu-driven package: the first screen shows a menu of the three main modules, and you choose one by moving a highlighted bar to the appropriate module name. Thereafter, Smart can be used either through menu options or keyboard commands, or through a 'project file' into which these and other commands can be stored for execution by less experienced users (or to automate regular tasks). Unusually, Smart allows you to choose between storing records in fixed-length form (in which every record takes up the same amount of space, regardless of the amount of information it holds) or variable-length (in which records occupy only the actual space they need). However, the manual recommends using fixed-length form unless disk space is short, as variable-length files take longer to process.

File creation & indexing

The first step is to create a record definition for each file in the database. Fields may be of several types, including text (up to 1000 characters), numeric (18 digits), date (DD/MM/YY format is available) and, unusually, time. Fields may be the result of calculations within a record, or of looking up a corresponding value in a reference file; such fields can be 'read only' to prevent users entering invalid codes. Entry fields can be made mandatory. You can also keep running totals of values in numeric fields.

Smart allows up to 15 keys to any one file, and these can either be kept up-to-date automatically, or updated on request (in some circumstances, the latter would be better, to speed data

entry). Any key can consist of a major key field plus up to 15 minor key fields, and the whole or the first few characters of each field involved may be specified. Such flexibility is rare among data management systems, and should satisfy the majority of requirements.

Data entry & updating

When you initially create a file, Smart sets up a default screen display format for data entry. In addition, you can set up your own formats (maximum — nine per data file) which need not contain all the fields in the file, so you can allow other users access to parts of a file which contains some confidential information. Screen formats are constructed by a combination of paint-a-screen and row/column definition. In addition to the validation checks provided by look-up files, you can ensure that fields fall within a specified range of values. Each screen format may allow for up to 15 'pages' (display screens) of information.

These display formats, showing one record per screen or a record spread over several screens, can also be used to scroll through the records, in order by any key or in other orders if you have used the sort feature. You can also find individual records directly. Records may be updated in this mode, or through an automatic Replace mode if you want to make the same change to many records.

As an alternative to showing one record per screen or screens, there is a Browse mode in which Smart displays data in columnar fashion, one record per line. You can select individual fields for display, and show them either full width

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or just the first 14 characters.

Smart has two printing modes: columnar, showing one record per line; and form, showing one record per page. Columnar reports provide for up to 10 levels of sub-totals, as well as grand totals and statistics such as average and count. You can also construct summary tables, which provide a form of cross-tabulation.

Selection & sorting

In addition to selecting individual records with the Find command, Smart allows you to set up selection criteria to select groups of records. Such definitions may be acted upon at once, or stored in a file for later execution. The package provides the usual range of comparison operators (equals, less than, greater than, and so on), together with some character field operators such as 'contained within' and 'not contained in'; case may be ignored or taken into account as you wish.

Complete files or selected subsets may be viewed in entry order, in order by any key, or in another order specified through the Sort command. Smart never physically sorts files, but sets up a temporary index to the file or subset according to the sort specification. As with keys, the total length of all sort fields in any one sort command may not exceed 500 characters, but that is a generous allowance — time is likely to be more of a limiting factor than length of sort key.

Sorted order, unlike key order, is not maintained when records are updated; this feature is intended to cater for the need to have records in a particular order for reports, and so on, without incurring the overhead of updating a key field for each such requirement.

Multiple files & tailoring

Smart allows you to link two files together through the Transaction command; a field which will link the two files must be specified, and in the target file this must be a key field. Both the source and the target file can be updated by this process, so it should be possible to construct 'many to many' relationships, as well as the 'one to one' and 'one to many' relations usually allowed in transaction processing. However, for some, the limit to two files linked in this way will be insufficient. The other file-linking feature allows you to merge two files into a third, with several options for combining records.

You can redefine any of the keys on the

keyboard, including the function keys; such definitions can include Control and Alt key combinations, as well as ordinary keyboard sequences including Smart commands, up to a maximum of 160 characters. Limited control over colour is provided: you can change the foreground and background colours of parts of the screen, but, for example, all data values must be displayed in the same colour. You can also alter a number of Smart system parameters, including the confidence levels which control the amount of prompting given and the extent of the system to which one has access.

The basic features of Smart are invoked from the keyboard, through interactive commands. In addition, Smart has some programming-like features called 'project processing'. Keyboard commands may be stored in a file, along with additional commands, such as Input a variable from the keyboard, Jump to a label and If-Then-Else conditional statements, when constructing a tailored system for specific applications. Smart allows you to set up menus of these sets of commands, and such an approach should allow the development of quite powerful and complex applications.

Security & housekeeping

Smart allows you to access files in any directory, and to delete, rename and copy files within the package. Files and screens may be protected by password from unauthorised alteration.

If you want to use your Smart database information in a spreadsheet or word processor, or to import spreadsheet data, you have several choices. The Smart suite uses a data interchange format of its own, and utilities are provided to swap information among the three modules. This makes it a straightforward task to, say, produce graphs from database information, but it does involve a file translation. (This is, of course, the reverse of the coin that Smart does not require you, as do closely integrated packages such as Symphony, to keep all your records in memory.) To swap information with other programs, Smart provides several data formats, including DIF (used by many spreadsheets), SYLK (used by Chart and Multiplan from Microsoft), and ASCII text files which can be read and written by packages such as the dBase family.

In use

The Smart range takes an interesting

approach to the problem of providing for the needs of both novices and experienced users. Commands may be invoked through menus, with full prompting for all parameters; in addition, there are three 'confidence levels' of commands, so that a novice can start by using a few basic commands such as Create, Enter, Update and Browse, and then expand usage to cover more commands as experience is gained. When you are familiar with all the

Command list one

Autohelp: turns auto help line on or off (toggle)
Browse: puts current window in columnar mode
Create: creates a new file or new screen
Delete: deletes or activates the current record (toggle)
Enter: append new records to the file
Find: will find a record based on given criteria
Goto: go to a file, window or record
Help: detailed help information
Print: print the current record or file
Query: selects specific information from a file based on criteria
Report: definition and printing of a report
Scroll: scroll through a data file
Update: update previously entered records

Command list two

File-Specs: lists specifications of a current file
Key: add, delete, organise or update keyfields
Look-up: define, load, or unload a look-up
Order: change the order (sequence) in which the file is being accessed (sequential, index or key)
Relate: establish a relationship between two files
Sort: sort the current file and create an index
Transaction: perform file transaction between two files
Utilities: file utilities

Command list three

Border: sets border on or off (toggle)
Close: close current window
Link: link windows to scroll together with matching information
Paint: set colours of border, data, graphics, titles or window
Split: split window into two windows
Unlink: unlink two linked windows
Zoom: expands current window (toggle)

Command list four

Activate: activate a data file but do not put in the window
Directory: list the files on a disk drive
File: copy, erase or rename a file
Index: lists the currently active data files
Load: opens a data file and displays it in a window
Read: read ASCII, fixed or Smart files
Save: save recent changes but do not unload the file
Unload: deactivates a data file
Write: write data in ASCII, DIF, SYLK or Smart

Command list five

Beep: sets error beeper on or off (toggle)
Confidence: sets confidence level
Display: alter display mode to B/W or colour
Execute: execute a project file created in the Remember mode
F-Calculator: formula calculator
Input-Screen: define, modify, load or erase a screen for data input
Macro: define, remove, load or store keyboard macros
Parameters: set/change system parameters
Remember: create or modify a project file
Send: send information to the Smart spreadsheet, the Smart word processor or Smart communications
Text-Editor: edit a text file

SCREENTEST

commands you can increase your confidence level further, to reduce the amount of prompting virtually to nil if you wish. At any confidence level, commands may be invoked either by moving a highlighted bar or by typing the first character of the command name. In addition, the most frequently-used command/option combinations are set up on function keys (used with Ctrl or Alt in some cases); other function keys carry out tasks such as moving the cursor or scrolling. This seems a pretty good compromise approach, and should satisfy both types of user.

At any time, you can open extra windows onto your data, which may view either records within the same database or information in another. Smart allows up to 25 windows to be open at once, though there would hardly be room for anything like that number on the screen!

Documentation

The Smart package includes a *Reference Manual*, a *User Guide/Tutorial Manual*, and a *Reference Summary* which covers the whole suite of Smart programs. On the whole, I

found the standard to be high; in particular, the index is reasonably comprehensive, and the *Reference Summary* should be a sufficient memory jogger for most circumstances, though it does not, unfortunately, include a full syntax definition of each command. This is provided through onscreen help, which is available through a function key at any stage during the use of the package.

Conclusion

Smart provides a good range of data

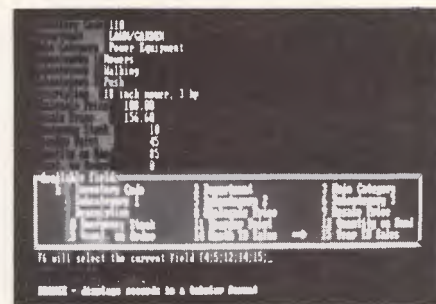
management features at a competitive price (\$1095). Its method of use provides a helpful progression from the needs of the beginner to those of the more experienced user, and the programming-like commands should allow the development of quite complex and powerful systems.

The constraints on linking files together will prove a limitation in some types of application. On the other hand, the ability to link straightforwardly to a spreadsheet and word processor, each well worth considering in their own right, is a distinct advantage.

END



The help index with topics



A pop-up window showing fields

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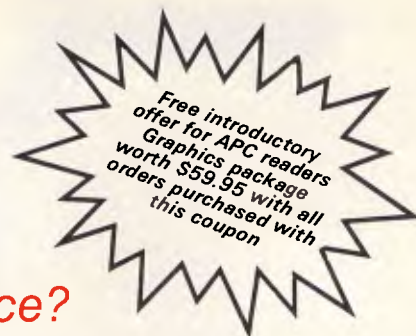
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    IF NAM' ?2.A1" , "1A.E WRITE "PLEASE ENTER AS LAST, FIRST MI" , ! GO RD
TEL  READ "TEL # ", TEL, ! IF TEL' ?3N1" - "4N WRITE " NNN-NNNN PLEASE" , ! GO TEL
    SET ^DATA(NAM) = TEL GO RD
PRT  WRITE "      NAME", ?20, "TELEPHONE #", ! SET NAM= " "
LP   SET NAM=$ORDER(^DATA(NAM)) QUIT: NAM= " "  WRITE NAM, ?20, ^DATA(NAM), ! GO LP
```

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A vintage Commodore 64 computer setup, including the monitor, keyboard, and joystick, resting on a bed of crumpled, shiny metallic fabric. The monitor displays a green-on-black graphical user interface with a menu structure. The keyboard is beige, and the joystick is a light-colored joystick with three buttons.

I'm not normally affected by a person's appearance, or at least that's what I used to believe, it was back in 1981 that I met my first guru of the Unix operating system, and contrary to Unix folklore he wasn't the beer-drinking, unshaven student type complete with runners and tee-shirt, but a well dressed businessman.

Over the following two days I became very impressed with Unix, and possibly because he wasn't the hippy programming fanatic I had expected, I joined my colleague in his view that Unix was poised to take the business computing market by storm at any time. Since then I've met numerous people, businessmen and fanatical programmers, all convinced of the imminent onslaught of Unix.

So why hasn't Unix taken off? Since 1981, IBM has grown, and now dominates the business micro market with a machine that would collapse under the strain if it tried to run Unix — the IBM PC. However, the latest offering from IBM, the PC/AT, has meant an increase in interest for multi-user, multi-tasking systems, which is very much the Unix domain. But there's one fault which has caused many people to question whether Unix can succeed in a commercial environment — it uses the most cryptic commands of any operating system; examples being 'mv' to rename a file, or 'ls' to obtain a directory.

The latest batch of low-cost Unix micros has attempted to overcome this failing by adding some or all of the WIMPs (Windows, Icons, Mice and Pull-down menus) environment. One machine employing this combination of WIMPs and Unix has already been Benchtested in APC — the Hewlett-Packard Integral (July 1985). However the machine reviewed here, the Olivetti-AT&T Unix PC, is possibly the most significant due to its origins in the American telecommunications giant AT&T, making it a more direct competitor for IBM's PC/AT.

Previously, AT&T products have never found their way to Australia despite their success in the US. The Unix PC is one of many AT&T products becoming available in this country due to the recent purchase by AT&T of 25 per cent of Olivetti. The deal also means that Olivetti's excellent PC clone, the M24, will be sold in the US under the AT&T label.

Hardware

When the Unix PC arrived on my desk, it immediately struck me that the machine



The side view of the Unix PC shows its 'toboggan'-like appearance to good effect

didn't look quite right: there was something decidedly odd about its design, and yet I couldn't figure out what it was. On closer examination I put the blame on three things: the shape of the main system box; the seemingly integral keyboard; and the apparent lack of a floppy disk drive. It doesn't look bad at all — it's just different from the usual three-box design.

The Unix PC contains a complete implementation of Unix System V, Revision Two, which is the latest version of Unix.

The system box is finished in a strong cream plastic and is shaped like a large wedge of cheese, with the sharp end at the front. The wedge is mounted on a smaller square area which makes up the machine's footprint. The overall effect makes the machine look as though it's floating two inches above your desk.

The system is, however, pleasingly small for a Unix system. The main unit is just 47cm square and 13cm high (47cm

high if you include the unremovable monitor) which makes it very much a desk-top machine, more so than IBM's obscenely large offerings.

The front and sides of the system are absolutely bare, leaving the rear as the only possible place for I/O ports. Along the back there is: an RS232C port configured as DTE (data terminal equipment); a Centronics parallel port; and three telephone jack sockets. The legends for all the I/O connections are embossed on the casing for easy recognition.

The three telephone connections comprise two inputs and one output. The two inputs enable the machine to handle two telephone lines — one for data and one for voice. This is a boon for the user who regularly accesses electronic mail systems or for anyone connected to a switchboard similar to the one in the APC office, where just checking to see if a line is busy will destroy any telecomms taking place. An ordinary telephone handset is connected to the output.

It should be noted that currently, the Unix PC is supplied with an American-style telephone jack connected to an American 300/1200bps 212A-compatible modem. While it is possible to connect this to the Australian phone

system, without Telecom approval it is illegal. According to Olivetti's representatives at the recent Sixth *Australian Personal Computer Show*, plans are afoot to fit a Telecom approved 300/1200 bps Australian standard modem; and Olivetti intends to delay the machine's release until this modem is installed, probably in June. (It seems strange that Olivetti went to so much trouble to conceal its new range of MS-DOS machines — four in all — behind closed doors at the Show, and yet happily displayed its Unix PC which it admits is still a couple of months away from being on sale).

Careful examination of the keyboard revealed that it isn't the integral affair I first suspected it to be. A little tug, and the keyboard pulls away from the main unit, to which it is attached by a coiled cable. Revealed in the keyboard recess is the missing floppy disk drive that is obviously necessary, if only for backup and the installation of new software. Although I realise that the Unix philosophy is very much 'everything you need is on hard disk', I still find the placing of this disk drive very awkward, especially as the machine is otherwise quite usable with the keyboard in position.

Apart from its unusual position, there is nothing special about the disk drive; it's a standard 5¼in drive which is capable of reading IBM PC data and ASCII files such as source code. Interestingly, in IBM PC (MS-DOS) format, the disk offers more storage at 360k than in AT&T's own format at 320k.

The Unix PC's keyboard is reminiscent of the keyboards found on dedicated word processors consisting of 103 keys; the standard qwerty layout being supplemented with a mass of hard and soft defined function keys. To the right of the qwerty section is a numeric keypad; at either end of the keyboard is a cluster of hard defined function keys; and at the very top of the keyboard is a row of eight standard soft function keys. Overall I found the layout excellent, given the number of keys; my only criticism being the feel of the keys which is soft and spongy — this will be particularly disliked by touch-typists.

The monitor is physically attached to the system box so all the cabling runs up the centre of the monitor, making it a very neat-looking system. The monitor is a high-resolution green on black 12in affair. Resolution is 720 x 348, which gives a very clear text display but is a little disappointing when displaying graphics, possibly because there is insufficient shading in the green area.

Getting inside the Unix PC involves



The 103-key keyboard features hard and soft defined function keys

removing four screws and taking off the lid, and AT&T has a reason for making it so easy. Firstly, the inside is designed so that it can be easily upgraded by the user; and secondly, the inside is so nicely designed that it's worth opening it up just to have a look.

The Unix PC consists of removable modules which can be replaced by the user. The first thing you see is a pan assembly which houses the floppy disk, the hard disk and the power supply. This assembly hinges forward to reveal the motherboard. Three expansion boards each slide underneath the motherboard from the rear of the machine, and

Overall I found the layout excellent, given the number of keys; my only criticism being the feel of the keys.

connect to each other through a narrow backplane that runs along the front of the machine. These horizontally-mounted expansion cards have a 21-bit address bus and a 16-bit data bus, and are what gives the system such a low profile when compared with similar architecture.

Due to the use of three custom gate arrays, the motherboard is well laid out and uses surprisingly few chips, given the complexity of the machine. The basic Unix PC comes with 1Mbyte of RAM made up of 256k by 1-bit dynamic RAM chips with parity. The system can take 2Mbytes of RAM on the motherboard, with a further 2Mbytes available on expansion cards. The bit-mapped video display is driven by 32k of available RAM. The system contains only 16k of ROM which contains the bootstrap loader and diagnostic code for power-up.

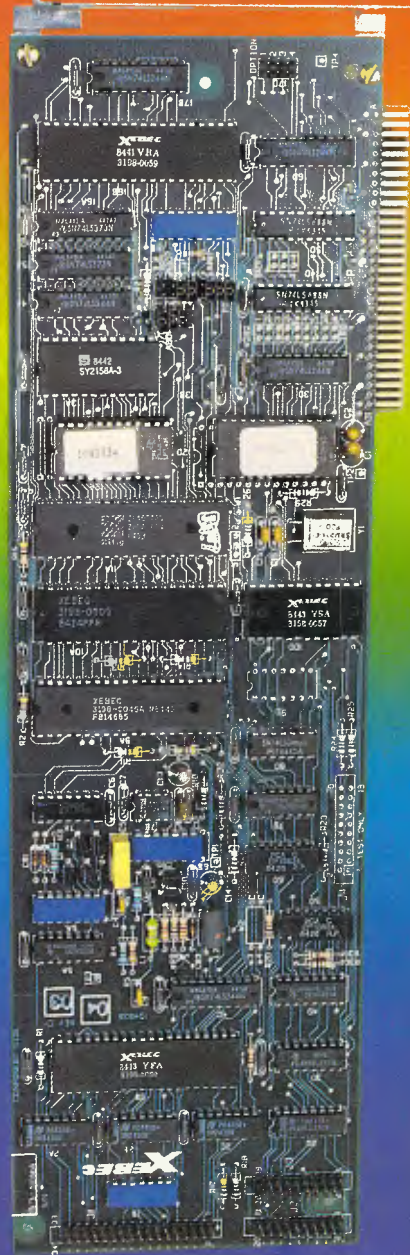
This 16k ROM also contains code to ensure that the telephone works as a standard phone when the system is switched off.

By far the most dominant chip on this board is the microprocessor, a 68010 running at 10MHz. This processor is a derivative of the popular 68000 found in the Apple Macintosh and many other 16-bit computers. The main difference between this and the 68000 is that the 68010 incorporates virtual memory management on the same chip, which enables programmers and applications to act as though there is considerably more RAM than there actually is, by effectively extending the RAM onto the hard disk. This is fully utilised on the Unix PC, giving a virtual address space of 4Mbytes regardless of actual RAM. (The machine is sold in the US with 512k of RAM.)

It should be stressed, however, that the memory management within the 68010 is not sufficient to completely implement a memory management system. The usual method of dealing with this is to add a custom chip that provides the extra functions, but on the Unix PC, the extra functions have been added in discrete logic and a high-speed RAM table, supposedly in an effort to speed up the system. It is claimed that this hardware gives sufficient power to support up to five users. This may be the case if the users are only light users, but when talking to existing installations it seems that three users is nearer the mark.

The hard disk contained within the pan assembly is a 20Mbyte Winchester built by a US company, Miniscribe; also available are 40- and 67Mbyte internal disks. The machine uses an interesting variation on the standard DMA (direct memory access) method of moving data from the hard disk to RAM. Most micros

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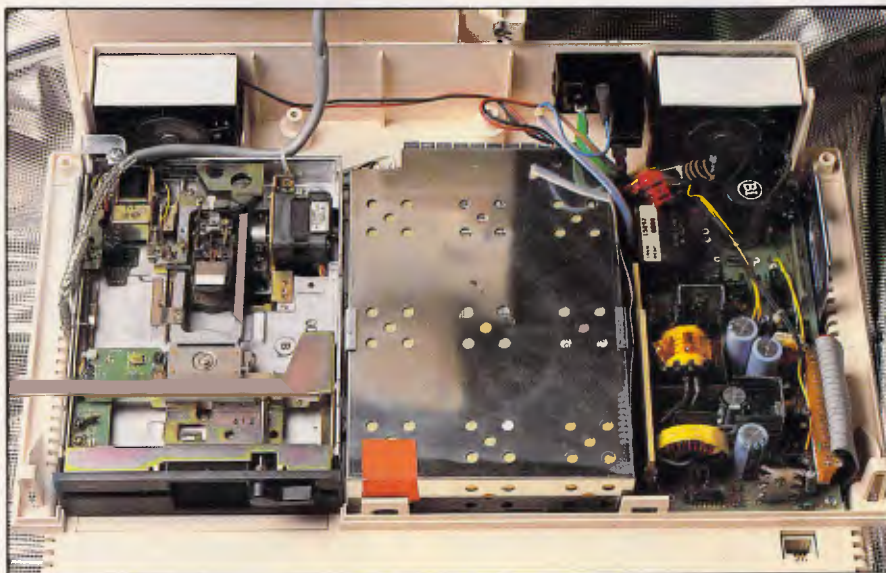
transfer control of the address and data buses to a piece of specialised hardware that first moves the data from the disk to a buffer area; control of the buses is then given back to the processor which moves the data to its final destination. The Unix PC differs in that it captures the buses many times, each time only long enough to transfer a word of data from disk to its final destination. By not holding the buses while the disk is forming its next word, the 68010 has more time for other work.

I'm assured that this method results in a noticeable increase in hard disk operation, though it's hard to tell with a machine that is so hard disk dependent due to its running Unix.

A three-button mouse plugs into the keyboard, and as on the Macintosh, this mouse is based around a rubber ball. If I were to be awkward, this mouse could be criticised for not being as smooth to use as that found on the Mac. The three buttons correspond exactly with three keys on the keyboard — Enter, Cmd (Command) and Mark.

System software

The Unix PC contains a complete implementation of Unix System V, Revision Two, which is the latest version of Unix (this isn't surprising, as AT&T has set the standard for versions of Unix). To this standard there has been added a number of significant enhancements to provide facilities suited to business computing environments. Most important is the base-level record locking, which will enable the system to support a multi-user database without the convoluted programming techniques that were previously needed with Unix when two users were simultaneously trying to update the same record. Other enhancements include: a paged virtual memory system; onscreen windows defined as Unix character devices; and shared function and source libraries. Unlike the rest of Unix System V these extensions will not be made available to outside developers, so only expect them on AT&T's own machines.



The well designed internal modules are removable and replaceable

As a confirmed Unix hacker, I was more than a little disappointed to find that although the basic system contains a full implementation of Unix System V, it does not contain many of the utilities usually found on Unix systems. Admittedly the utilities which remain on the system are the ones that would be most useful to a business user, but if you are familiar with Unix it can be quite disturbing to find that a utility you require is in one of three additional packages expected to sell for around \$700 each.

Unix may be fine as a programmer operating system, but its drawback as a business tool is that it has never been particularly easy to use. AT&T has made some effort to overcome this problem by grafting on a user-friendly front-end called the Office program, and it is through this mechanism that most users will interact with the Unix PC. In line with current fashion this is a windowing environment, although within windows it is really menu-driven rather than a complete WIMPs system.

When the Office window has been made active, you can execute an item from its menu by highlighting it with the cursor keys and pressing Return; pointing with the mouse cursor and hitting the left-most mouse button; or by typing sufficient characters of the item's name for the software to recognise it, and hitting Return. When the software needs more information, it opens up another window containing a further menu.

Twelve items are usually available from this Office window, which, for expert-level users, will include a window which acts as a standard Unix terminal. At the moment this defaults to the Bourne shell, though if other shells are available, a further menu will enable you to select the one you require.

The Administration option leads through a series of menus to a collection of system maintenance utilities which includes everything from setting date and time, backing-up the hard disk and changing passwords. A measure of how successful this front-end is can be gauged from the ease with which you can add, delete and change users on the system (assuming you are sufficiently authorised). Usually this requires a specially written C program and is still a complex operation.

Another item of interest is the File Cabinet item which opens to a window that contains all the files and folders in your particular user area. Creation of data files from within this window will give you the option of creating not only standard data files, but also modem data and RS232 profiles. A Waste-basket

option contains all the files you have deleted in the current session, and expanding this item gives you a chance

to retrieve any cast-off item, providing it's within the current session. In true multi-user tradition, all items

for printing are queued up and printed as a background task. The Printer Queue item expands into a window which lists all items awaiting printing, and you can cancel or change the order of these items.

While there is no doubt that the windowing environment on the Unix PC makes the system considerably easier to use than using Unix direct, the system doesn't compare favourably with similar systems, even those found on other Unix micros such as the aforementioned Hewlett-Packard Integral. In particular I found the windowing operations annoyingly slow, quite often taking a couple of seconds between expanding a window and taking its final size. This is a shame, as the system otherwise seems reasonably fast. In its favour, however, is the fact that this interface can be used perfectly without a mouse.

Little use is made of icons in this system; the only icons being those found in the four corners of a window to control window manipulation, and two arrows on the side of any window which can't display all its information. The corner icons, starting at the upper left-hand corner and moving clockwise, are: Move Window, Help, Grow Window and Close Window.

Technical specifications

Processor:	Motorola 68010 running at 10MHz
ROM:	16k containing bootstrap loader
RAM:	1Mbyte expandable to 2Mbytes internally, or 4Mbytes in total
Keyboard:	Detachable 103-key full-stroke
Display:	12in green-on-black display; 720 by 348 pixels resolution
Size:	470mm x 470mm x 470mm including monitor
I/O:	RS232C, Centronics, three modular telecom jacks (two incoming, one outgoing)

In perspective

The market for Unix computers at a desk-top price has only really begun to be established. And at this stage there is very little direct competition for the Unix PC. Where it may, in time, find a competitor is in the Xenix marketplace. Technically, the Unix PC is way ahead of IBM's small multi-user system, the PC/AT. However, for a business buying its first multi-user machine, I have to recommend it takes a look at the vast range of applications software available for PC/AT-compatible machines. (Interestingly, Olivetti is about to announce its own PC/AT-compatible).

There are many other multi-user systems from various companies such as ICL and North Star. These usually run Concurrent DOS and Concurrent CP/M, which have rather more applications available, but little is being done to develop new applications for these systems.

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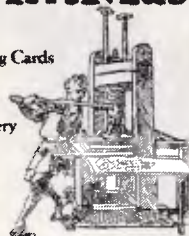
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BENCHTEST

One of the nicest features of the Unix PC is the copious amount of help available through the Help icon. Whatever the operation you are performing, help is always available — quite often numerous screens' full. An index of all the help is available at any time.

Applications software

Any machine which departs from the IBM standard, even if it is to Unix, needs to advertise the available applications software. To this end, Olivetti-AT&T has published a 14-page catalogue of software which lists approximately 200 packages. The trouble is that the majority of this software is either development software or versions of the large, hefty applications found on mainframe computers.

A number of the far more friendly micro-like packages have made their way over to the Unix system (and they are so much more easier to use than those horrible Unix-specific applications), among them WordStar 2000, Multiplan and dBasell. The most (supposedly) popular package supplied with the Unix PC is an integrated package called Qoffice, but whatever you do, don't show potential users of this package a similar integrated package running on a Macintosh or even an IBM PC — they would never touch Qoffice again. To my micro-orientated outlook, it really is that bad!

I had my doubts whether to include the Telephone Manager in 'Applications software' — it's so integral that it could be considered as part of the system. Until an Australian-approved modem is installed, there is nothing you can do with it apart from look at it. However, the telephone functions distinguish the machine from the competition, and in all respects it looks like a bundled application.

The telephone functions are accessed by opening the Telephone item from the Office menu. This leads you into a list of names and numbers from which you can dial people and online computers. Functions available from here include: timing a call; automatic redialling; single-key dialling; and putting a call on hold.

In addition to these 'standard' telephone functions, there are others that go beyond what you would normally expect and which make the machine potentially very useful for anyone who frequently uses the telephone. The Unix PC automatically maintains a log of all incoming and outgoing calls, complete with duration and phone numbers. A second window can be opened, into



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which you can copy any text that's coming in from an online system, and an optional Electronic Mail option allows you to control electronic mail from this window.

One of the biggest advantages of the Unix PC as far as applications software is concerned is that any software you purchase for it will be compatible with any of the larger machines in the Olivetti AT&T Unix range.

Documentation

Users used to joke about the manuals for the IBM 370 mainframe outweighing the machine itself. With the Unix PC it's no joke — a complete set consists of eight hefty manuals. Combine this with the three manuals which accompany the Qoffice application, and you have a pile of documentation which easily outweighs the machine.

To be fair, you only initially receive three manuals: the *Telecommunications Guide*, the *Unix Guide* and the machine's own guide. Also included is a thin introductory guide which I used extensively throughout this Benchtest. If you were to seriously consider programming the Unix PC, you would need at least the further five *Programmer's Guides* — possibly more.

On the whole the documentation is very thorough but more than a little staid in style, and is certainly not suitable for inexperienced users.

Prices

At the time of writing Olivetti had not set prices for the Unix PC. However a

reasoned estimate, based on US and European prices, would indicate a retail price of under \$10,000 for a 1Mbyte RAM, 20 Mbyte hard disk machine, which makes it a competitive entry into the small multi-user business micro field. There will be many peripherals available for the Unix PC when it is released, including tape streamers, expansion boxes and external hard disks; again, no prices are currently available for these. Olivetti is treating the machine very much as an entry point for an entire range of Unix machines, all the way up to a \$200,000 64-user mini.

Conclusion

My views of Unix have changed during the course of this review. Originally I thought that it was the best thing since sliced bread in all respects; now I think it has the potential, but that awful user interface must be concealed from the user. AT&T has tried to do this with the Office windowing system, but it hasn't gone far enough in making it a true, easy-to-use desk-top PC.

Technically, I was impressed with the Unix PC's hardware. It uses a beefed-up version of my favourite processor, the 68010; it operates a virtual memory system and is generally well designed and put together. As a communications tool it has a lot to offer, with two phone lines, an internal modem and some well produced telecommunications.

But, overall, I was left with a feeling of disappointment. The Unix PC doesn't quite attain the level I expected after reading the specification. If you require a small office machine, I would strongly recommend a close look at the more traditional MS-DOS machines, such as the Olivetti M24. However, if you are a dedicated Unix user who occasionally requires a less knowledgeable user to use the system, it may be suitable, or if a larger Unix system is already installed, it may be just the machine for, say, a reasonably sized office.

No Benchmarks are available for the Unix PC due to the system's lack of Basic. **END**



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Man or mouse?

Keyboard or mouse? An inability to type or an unwillingness to be seen using the keyboard may be just some of the reasons why executives opt for the mouse in their computerised offices. Dennis Freeman has his doubts, however, about the mouse's efficacy, and here pits it against the keyboard in a simple word processing application.

Until recently, experienced computer users would react to a mouse in the office in the same way women did in all the old comic strips: they'd stand on their chairs and scream. The feeling was that the mouse was fine for novices who had to be coaxed into using the computer with comforting screen pictures of wastepaper baskets and file cabinets. For the sophisticated user, however, the graphics-based interface just got in the way.

Apple's Lisa — aimed squarely at the corporate market — was striking in its failure. However, its mouse survived. Apple's more downmarket Macintosh has had reasonable success and now Microsoft, Digital Research and Epson have all brought out operating environments which bring the so-called WIMP (windows, icons, mice and pull-down menus) technology to the IBM PC and compatibles market.

Products such as Windows, which includes useful features such as multi-tasking and data between non-integrated packages, can't help but confer respectability to mouse-driven software. The question is: should professional computer users succumb to the charms of the rodent? Or should they trust their first instincts, that pointers might be more trouble than they're worth?

I decided to test the value of the mouse in word processing, which is generally agreed to be the most widely-used application for micros.

My task was to determine:

(1) How long does it take to learn to use a mouse; and

(2) Does it improve the efficiency of word processing?

Remember, user-friendliness is not the issue here. This article is for people who are not scared of MS-DOS, who positively welcome the sight of an A> and who have already mastered a keyboard-controlled word processing package. The question is: what can WIMP technology offer them?

My approach was simply to compare the time it takes to complete various tasks using a mouse with the time taken to perform the same tasks using commands entered at the keyboard. I chose a word processor with which I was unfamiliar — Microsoft Word 2 running on an Apricot Xi — to ensure that neither method started an advantage.

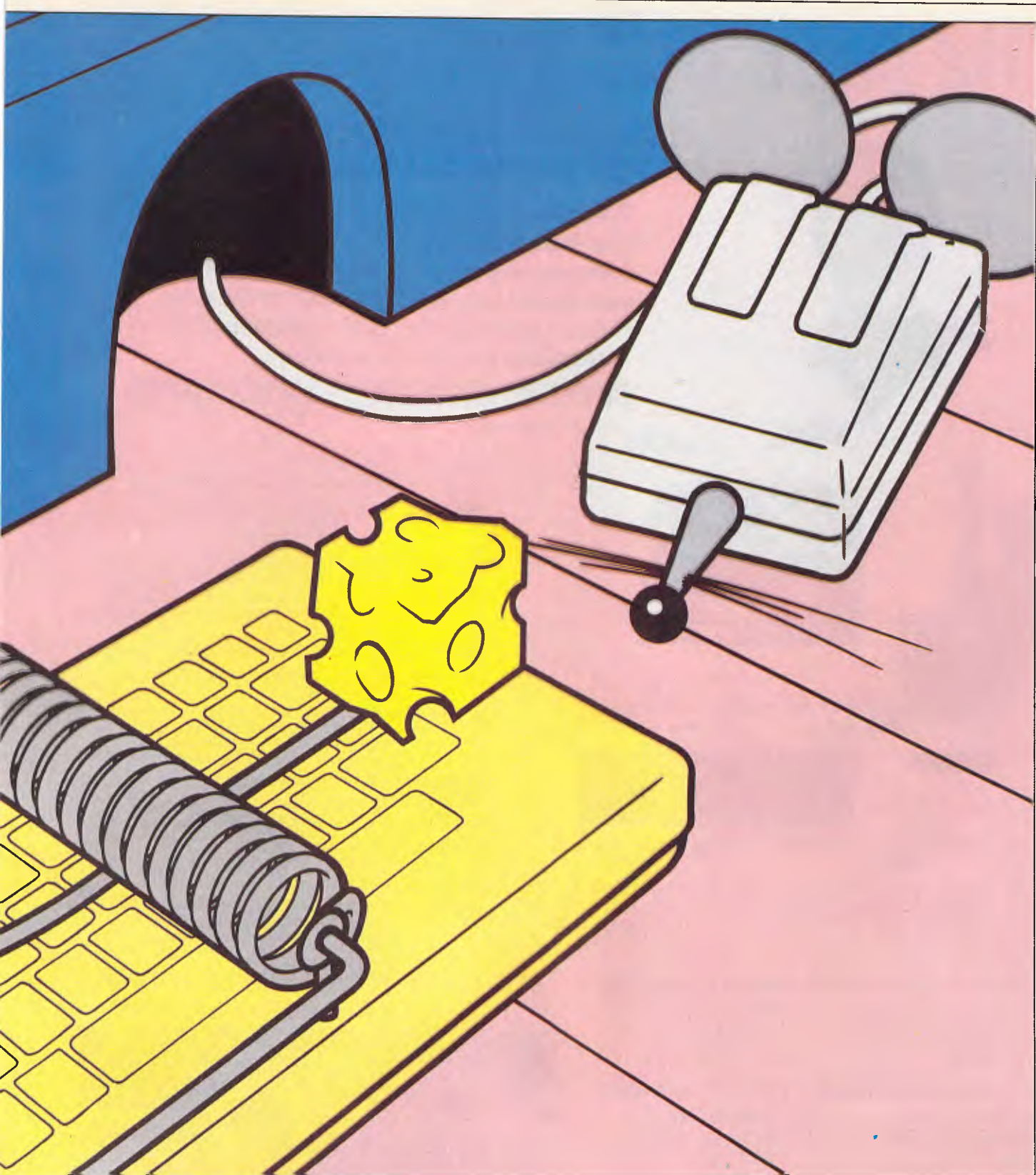
Learning Word

The first job was to learn Word with the mouse switched off. Like most modern word processors, Word is very easy to learn. The command options are arrayed in the bottom three lines and are accessed by pressing ESC, then the first letter of the command — for example, ESC S to search the text or ESC D to delete it. Sometimes a second menu of commands comes up. Pressing ESC T, for example (for Transfer), brings up a new set of options: Save, Load, Merge. Typing another letter completes the command.

It took me three hours and six minutes to feel comfortable with Word. By this I mean I had worked through the first 15 chapters of the manual and was able to do everything you would expect of a



word processor: search and replace, carry out direct formatting and move text around a document. I also worked out how Word could create up to eight windows on the screen, with different files in each, and transfer data from one window to the next. I didn't bother with the more advanced functions such as



style sheets, the Glossary feature, mailmerge, and so on. (For a proper review of Word see *APC*, June 1985).

At this point I turned to the mouse, which was of the Microsoft species, with two little buttons on its nose. Be careful — the pointer is not *that* easy to control, and I had a tendency to knock over my

coffee with it.

You move the pointer across the screen by rolling the mouse around the table; with a combination of button-clicks and logical movements you highlight the required character, word, paragraph or chunk of text. You then move the pointer to the command menu,

click on the appropriate word — Delete, Copy, Format, and so on — and the highlighted text is dealt with accordingly.

It sounds, and indeed is, straightforward. What the novice mouse user must allow for, however, is the time taken to get the hang of highlighting text:

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Say you want to delete a three-word phrase, you click at the start of the first word and — still holding down the left button — drag the pointer across to the end of the phrase. Oops! Let the pointer slip down onto the next line and suddenly a dozen words light up; your instinct is to let go of the button. Now you're stuck with the highlighted text and have to go back to the beginning of the phrase. What you have to learn is to keep holding down the button until your pointer is securely on the last character. Now release the button and move the pointer down to Delete. Oh, dear. If you move the pointer a millisecond before you release the button, you'll highlight too much text again.

It's possible to highlight complete sentences by pointing to any word and clicking both buttons. Pointing in the left margin and clicking the right button selects the whole paragraph. You can achieve the same effect from the keyboard by typing F8 S (for sentence) or F8 P (for paragraph).

The keyboard commands quickly became second nature while, after several hours using the mouse, I still had to think about which button to push in order to carry out my tasks.

The manual's mouse section contains six pages of commands for opening and moving windows, scrolling, and so on. In all it took me three hours 35 minutes to feel I could do everything I wanted using

'By the end of the last trial, I was grudgingly admitting that the mouse wasn't as bad as it had originally seemed. It does simplify operations which involve jumping around the screen or between windows...'

the pointer, about half an hour longer than it took to learn the keyboard controls.

If someone tells you that a mouse-driven word processor is easier to learn than a conventional package, I would say it simply is not true. And that would seem to wipe out the major benefit claimed for mouse-driven software. However, 30 minutes one way or the other is not worth carping about...

Let's turn now to the more interesting question: is to know the mouse to love

the mouse? Or put another way, does it improve word processing efficiency?

The Mouse Trials

To test this, I set up a series of contests — we'll call them The Mouse Trials — which pitted me on the mouse against me on the keyboard.

Trial 1. Starting with Word already running, the task was to load a document from disk, split the screen and load a second document into the new window, then return to the operating system prompt by exiting from the program.

Result. In six attempts, I couldn't run the mouse through the course in under 74 seconds. On the keyboard, I averaged 52 seconds — and could shave a full 10 seconds off that time when I typed in the name of each document rather than highlighting the required file on the directory. The keyboard is so much faster because you can type in ESC T L <filename> at speed without waiting for the computer to prompt you. With the mouse, you have to click on Transfer and wait for the Load option to appear. You click on Load and wait for the directory to appear, before finally clicking on the required filename.

One to the keyboard.

Trial 2. The Word diskette contains a document called Typos, which is designed to let you practise editing. It contains about 20 mistakes which need correcting, mainly adding and deleting single letters. I gave the mouse a fighting chance here, allowing myself to delete characters with the dedicated DELETE key, rather than by having to move the pointer back and forth between the text

and the command line. It seemed to me that even the most ardent mouse fan would use this method.

Result. The mouse's best attempt came within 20 seconds of the keyboard (two mins 45 secs vs two mins 25 secs). Generally the gap was wider. Although the pointer certainly flies from typo to typo more quickly than the cursor, you lose time positioning it on exactly the right character. It's quite probably that readers with better hand/eye co-ordination than me could improve on my time. But be warned: moving the mouse too quickly after a click may result in the computer not registering the command.

Two to the keyboard.

Trial 3. I created a document containing four four-line paragraphs. The task was to reorder the paragraphs so that the first paragraph became the last, the second became the third, and so on.

Result. No contest, I'm afraid. Using the F8 P command to highlight paragraphs and the HOME button to speed up the cursor's movement, the keyboard could complete the course in 25 seconds flat. The mouse came limping in at 40 seconds or more.

Three to the keyboard.

Trial 4. Using the same document, the next test was to transpose two words in each paragraph (which you often need to do if your brain is working faster than your fingers). This is done on the keyboard by highlighting the first word (SHIFT-CURSOR RIGHT), pressing DELETE, moving the cursor to the end of the next word, and pressing INSERT to bring back the first word to the correct



'My computer dating agency doesn't understand me, Miss Ponsonby.'

position. The mouse requires the same procedures. As in trial two, it's far too slow to delete and insert by pointing to the appropriate functions on the command line; you have to use the dedicated keys.

Result. The mouse finally won one. My average timings were 15 secs for the mouse, compared with 18 secs for the keyboard. The extra speed comes because you don't have to position the pointer so precisely to highlight a word: clicking the right button anywhere in the word does the trick. But note that the mouse's victory is only possible with the above-mentioned help from the keyboard — and that you have to use your left hand to push INSERT and DELETE, while the right hand controls the mouse. This feels most unnatural, as these keys are at the far right of the keyboard.

Keyboard 3, Mouse 1.

Trial 5. Moving Text Between Windows. Imagine you're a PR person trying to make the best of a bad product review. The reviewer writes: 'I'd say this was a great computer — if I hadn't already seen a hundred just like it. God knows why we need another clone... So, in conclusion, I'd recommend this micro only if you could get it at

a substantial discount and don't need much support.'

That's good enough for PR. You type the review into one window, then opening up a second window, you type: 'The product has been favourably received.' John Expert writes in *Computing for all*. 'I'd recommend this micro,' he concludes.

For the purposes of this trial, I required that both the direct quotes be copied from one window to the next. This is particularly easy on the mouse. You highlight the required text, press F4, then move the pointer to the correct spot in the next window and click. The text immediately appears. Without the mouse, you highlight the text, then punch in ESC C RETURN to copy, CTRL-TAB to go to the next window, then you position the cursor and press INSERT.

Result. The mouse turned out to be an average of five seconds faster (40 secs vs 45 secs). An important victory, as transferring data between windows is very useful to anyone who keeps notes in one file while writing a draft document in another.

The keyboard, incidentally, reasserts its supremacy if in Trial 5, you *move*, rather than *copy* John Expert's quotes to

the next window. The mouse now requires an extra keystroke, SHIFT-F4, before pointing to the next window. This is an awkward, finger-stretching movement on the Apricot. With the keyboard, by contrast, you save two keystrokes by pressing DELETE instead of the ESC C RETURN combination needed when copying.

Keyboard 3, Mouse 2.

Conclusion

By the end of the last trial, I was grudgingly admitting that the mouse wasn't as bad as it had initially seemed. It does simplify operations which involve jumping around the screen or between windows, but, on balance, I proved (to my own satisfaction at least) that it was quicker to keep my hands on the keyboard and not live in fear of knocking over my coffee. Thank goodness that Apricot — unlike the Apple Macintosh — gives you the option of using cursor keys.

A final note: as I was learning Word, I found it very tempting to reach for the mouse and point to the commands — even though I knew it would be quicker to use the keyboard. The mouse requires less concentration, but then it's human nature to go for the easier option... **END**

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There are changes afoot at Atari, plus exciting news of built-it-yourself robots. David Ahl has the gossip.



Atari back in gear

Atari recently announced that it will sell its 520ST personal computer through mass market outlets. Specialty computer shops, which had been the company's channel for the product, will get a new model, the 1040ST with 1Mbyte of memory. Concurrent with this move, Atari has added an RF modulator to the 520ST and dropped the price by \$US100 to \$US399 for an unbundled CPU. A system with a 3.5in disk drive, a mouse, and a black and white monitor will sell for \$US699 while a system with a colour monitor is priced at \$US899. All systems include Basic, Logo, a graphics package, and a word processing package.

The new 1040ST will be the same price as the original 520ST — that is, \$US1,200 for a complete system with a high-resolution colour monitor. Meanwhile, the 130ST has been quietly dropped along with the 800XL series.

On the other hand, the 65XE and 130XE are available in new, bundled packages. Complete with mouse, printer, disk drive, and five software titles the 65XE sells for \$US300 and the 130XE for \$US400.

Surprisingly, Atari announced that the company had sold over one million video game systems in 1985 and that it would dust off the year-old plans to introduce the 7800 high-end game system (an 800 computer in a different box); price \$US80. Also, a new compact version of the 2600 video game system has been introduced. Atari reasons that with a retail price of \$US39 to \$US49 for the new unit, the 2600 still has several good years of life.

Meanwhile INTV Corp,

which purchased the manufacturing and distribution rights to Mattel Electronics' Intellivision in 1984, is continuing to invest in the video games market. At CES the firm showed its System III unit, which features enhanced graphics and an LED on/off indicator, as well as three new games: Baseball, Karate Chap and Thunder Castle (a survival game).

Robot link-up

Multibotics has announced an interface which connects a Commodore 64 computer to Capsela, a popular line of build-it-yourself motorised toys. The Capsela toy kits consist of 2in transparent spheres, each one containing a different working part such as a motor, differential gear, transmission, right angle drive, and so on. While the models built with Capsela sets are interesting, there is no way to control them except by simply turning them off and on.

The Multibotics interface adds a new dimension of fun and challenge to a Capsela set by providing an input sensor (infra-red photo cell, audio responder, and so on) and output control signals to vary the speed and reverse the direction of up to three motors.

I built a robot crawler that executes a random walk on a large piece of white paper but will not go off the edge (sensed by the infra-red scanner). Joystick control lets me vary its speed, direction, and the 'randomness' of its walk. Multibotics kits are priced from \$US50 to \$US200 depending upon the number and type of sensors.

Meanwhile, Computer Magic which had announced an interface to three Tomy robots last June, is finally delivering the product. The interface works with the Verbot, Omnibot, and Omnibot 2000 robots and a Commodore 64. The software lets you control all the motions and sounds of the robot. It also saves batteries

since it provides power from the computer to the robot.

Japan's Kahomusan Company has developed prototype computer interfaces for three of the Movit robot kits, Circular, Mr Bootsman, and Memocon Crawler. No decision has been made at the time of writing as to whether these will be marketed.

Lights! Camera! Activision!

One of the most fascinating new software products I've seen lately is the not-quite-finished Director program from Activision. An extensive set of pull-down menus (similar to those in Garry Kitchen's GameMaker package) lets you take various figures (people, vehicles, animals) and combine them in animated sequences against varied scenic backgrounds, thus making your own movie. The beauty of the package is that you don't have to design your own figures — they're already built-in and they know how to walk, run, jump, dance, and even fly.

Director will be the fifth package in Activision's line of creativity software. Another dynamite package in this series is The Music Studio (for the C64, the Atari 800 and ST, the Amiga, and the PCjr). This package, complete with a MIDI Interface, will appeal to both amateur and professional musicians. Pull-down windows for composition and editing coupled with complete music notation make it easy to use and understand. Also, its colourful 'Paintbox Mode' is an ideal short-cut for fast, easy composition.

The other packages in the creativity series include GameMaker (an integrated set of five design tools for making your own games), The Designer's Pencil (a graphics and animation design tool) and The Complete Computer Fireworks Celebration Kit

(which makes electronic greetings cards).

Along a similar line as Director is PSI-5 Trading Company from Accolade, this package, designed by Mike Lorenzen, features detailed graphic depictions of 30 different characters who interact with the player through conversational text to produce a science-fiction 'mini-drama' whose plot and outcome is contingent on the player's relationship with the crew. PSI-5 Trading Company is available for the C64 and Apple.

Random bits

Colby has announced a transportable PC, the PC-5. It's compatible with the IBM XT and has an electro-luminescent display, a 20Mbyte hard disk, a 1200 baud modem, 3½in disk drive and 256k of memory for a mere \$US2,995 . . . Meanwhile IBM is going off in a different direction with a reduced instruction set computer (RISC) which uses a 32-bit proprietary MPU called the 801. The machine has three ports, 1Mbyte of RAM, a 5¼in floppy disk drive, and a 30Mbyte hard disk. An entry level configuration will cost around \$US6,000 . . . Berkeley Softworks has created a rather interesting graphic environment operating system, GEOS, for the C64 which has a meni/icon windowing interface similar to the Mac, multi-tasking capabilities and a disk transfer speed-up routine. It comes with a word processing and painting/charting program for only \$US59 complete . . . Another nifty package for the C64 (and IBM PC or CP/M computer) is PrintMaster, a package similar to Broderbund's Print Shop, but with a few more goodies built-in. It lets you make signs, stationery, calendars, greeting cards and banners. From Unison World . . . If you already own The Print Shop, a nice add-on is Graphics Expander for \$US39 from Springboard Software. **END**



Spectrum 128

The Spectrum 128 has many original features, but is sadly lacking in some of the 'basics', such as a screen and a disk, which might have been expected of a Spectrum upgrade. Guy Kewney finds out just what is offered in return for a high price tag.



The Spectrum 128 is so simple to describe that it hardly seems worth the bother of writing it down: It's a Spectrum with more memory and a few new features, none of which is remarkable, or first-of-its-kind, or even available at a new low price. Indeed, the price of the Spectrum 128 is \$499 (or is planned to be, at the time of writing) and to get the benefits of the new machine, you need the 'optional' editing keypad, which will probably sell for around \$55.

Logically, there is only one conclusion to draw: there are going to be lots of 'special offers' in the shops. Word has reached me of disks for the Spectrum,

using CP/M. I've heard reports that the 'optional' keypad will actually be offered free — and certainly, there's a space in the packaging where it would fit uncannily well.

I hope all these rumours and reports are true because, really, without these possible 'free' extras, the new Spectrum isn't much of a bargain for the money.

The Spanish Spectrum 128 is not the same machine, but is (although Clive will thank you not to mention this in Madrid) a test bed for this one. It has several little features which are not the same as on the 48k Spectrum, and you can't call it a disaster because word is that Sinclair has

sold 25,000 Spanish 128's. But it did annoy software producers.

System specification

Your first question will be: Why should I buy a Spectrum 128, instead of an ordinary Spectrum Plus? Answer: you get lots of extra goodies, which are: a RAM disk; no dot crawl on a television; sound on the television, no internal speaker; proper three-voice synthesised sound, not just *beep*; a space bar that works; a serial printer socket, usable for Midi synthesisers; a monitor plug with two types of output — RGB, and



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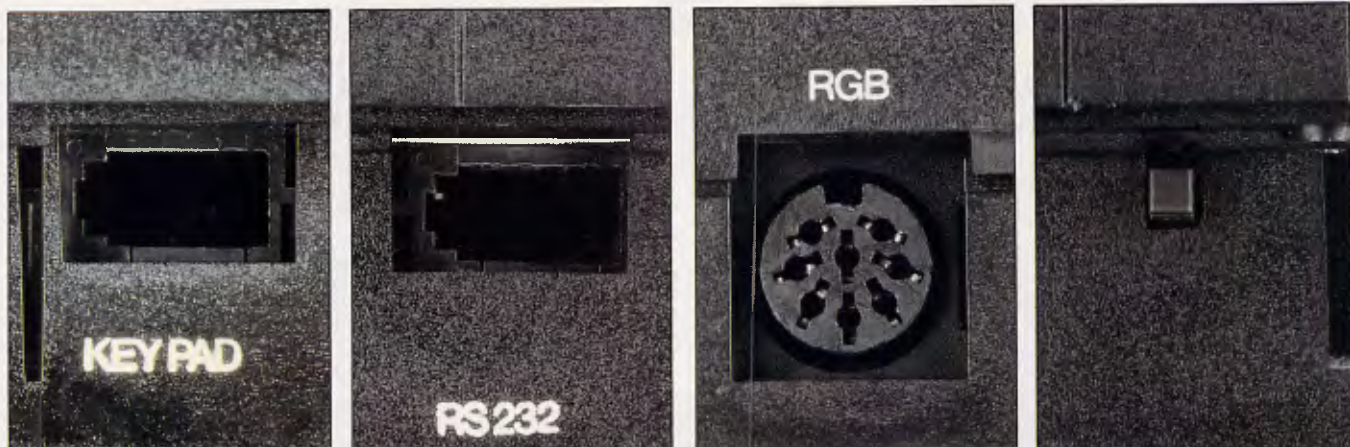
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The new external facilities include: a keypad port; an RS232 port; an RGB monitor port; and a reset button

composite video output; a handy calculator, if you're using Basic; no more complicated hunt-the-right-key Basic keyboard problems; absolute compatibility with the 48k Spectrum (bar a few POKes); a full-screen editor for Basic; a better Basic than Spectrum Basic, as well as the original; a big, solid lump of radiator fin — a heat sink — which should mean a more reliable machine; and the hope of bigger, faster, more reliable games.

That's the good news. What you might wish you were getting includes: a joystick port; the 'optional' \$55 keypad and editor box; a disk or even a microdrive interface; a display; a printer cable; a keyboard that you can read,

instead of the typographer's scrambled egg that this machine inherits from the Spectrum; and a keyboard that you can type on, instead of wobbly cushion covers in an arbitrary non-qwerty order.

All the grouches notwithstanding, there is no question that I'd rather have this than a 'real' Spectrum. It's a very noticeable improvement. The question that buyers will have to answer in their own minds is simple: in a world where the Amstrad 6128 is being sold complete with screen, disk and CP/M for \$949, isn't \$500 a lot to pay for a very ordinary games box?

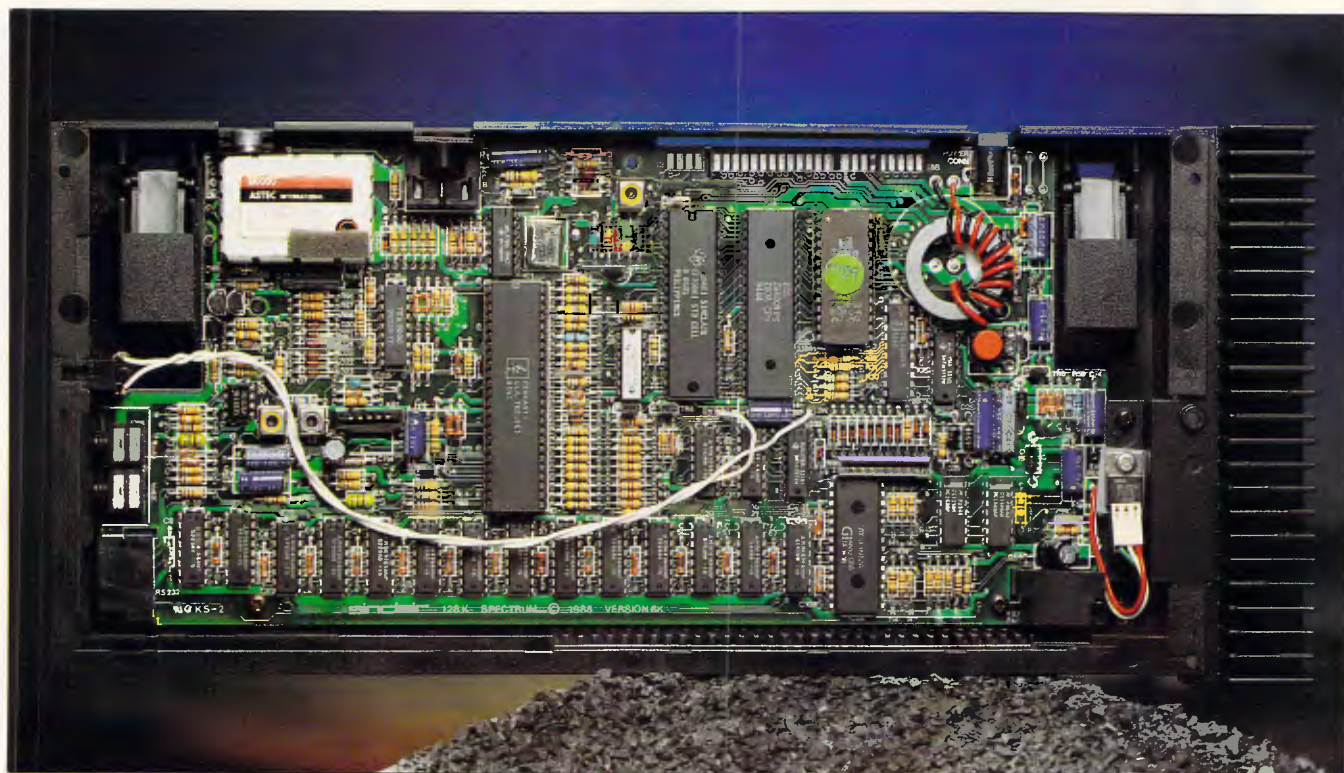
The three features which stand out are the RAM disk, the sound chip and its

serial output, and the total compatibility with the old machine. The total compatibility is really quite uncanny — I've never before known a micro manufacturer to produce Mk II that will really and truly run all the old programs written for Mk I. This one does. But will anyone write programs for Mk II?

Rather stupidly, I'll start by assessing the Basic; stupidly, because it doesn't really matter whether the new Basic is faster, slower, nicer, or whatever — no one judges a micro on its Basic any more.

Basic 128

The new Basic looks identical to the old



Inside: the new-format circuit board includes a sound chip, and lots of cheap diodes to prevent voltage spikes

Spectrum Basic and, indeed, will run the old Basic programs, apart from one or two PEEK and POKE commands which might have been left in by mistake. It is slower (around 7 per cent) on the identical programs, but faster on programs which take advantage of the Spectrum 128's new features.

The Basic includes a new full-page editor with an automatic Renumber command, and, for the first time, keywords are typed in letter by letter. If the Basic were an important part of the machine, you could happily spend hours debating the wisdom of this. If it's a good idea now, why did we have keys with four, or five different functions before? On the other hand, if we don't need to have those crazy multi-function keys, why can't we have a clean keyboard? For example, to type 'greater than' on the old 48k Spectrum, you hold down the Symbol Shift key and press R. On the new one, you do the same. But on the old machine, you have another single key for <> (meaning not-equal (greater than, or less than)). On this machine, the <> is there on the W key, just like the < and the >, but if you press Symbol Shift and the W key together, nothing happens. You have to type Symbol Shift R and then Symbol Shift T.

I suppose, after you've had the machine a month or so, you get used to it. Sinclair's logic is that it had to do it, to be compatible with the old machine. You either agree, or you don't.

New Basic commands

Spectrum: this is the simplest new command, and turns your 128k system into a 48k system. It will then run all your old tapes, I (almost) guarantee (I do know of one it won't, but I don't think you'll get excited about it) and behave exactly like a 48k Spectrum, even to the single-keystroke Basic.

Play: to make music, either connect your Spectrum 128 to the TV, plug in a cassette recorder and pop in a music tape — yes, the music will emerge from the TV loudspeaker — or use the Play command.

To set up a tune, you have to convert the notes into a Basic string. Codes decide how long the notes are, where the rests come, where it repeats, and so on. For example:

```
10 LET a$ = "T18008(CDEC)(5EF7G)
(3GAGF5EC)5Cg7C9CgC"
20 PLAY a$
```

Play three strings simultaneously, and they'll give you harmony. You can also specify eight strings (a\$ through h\$) to

drive eight Midi-based synthesisers or drum kits, plugged into the serial port.

The system is perfectly adequate and an improvement on the old system of buying add-on Midi interfaces for the 48k Spectrum. It makes you wonder why Sinclair didn't include a disk interface, too.

T: this is the magic fairy dust which transforms the normal tape loading and saving commands into lightning-fast RAM disk controls. **Load!** loads from RAM disk; it can be a program, a picture, data, or a data file. Similarly, **Save!** creates a file on RAM disk.

Here's the problem — Basic has no error-handling. If you try to create a file which already exists, Basic will die; if you try to load a file that doesn't exist, Basic will die. I haven't found a way (obviously, there must be one, using PEEK) to find out which files are in the RAM disk. **Cat!** is fine, because it tells you, but it doesn't tell Basic.

The speed of the RAM disk is, as you'd expect, phenomenal. I've used a little Benchmark of my own, in the past, to test RAM disks, but unfortunately that assumes a 16-bit computer which can PEEK and POKE numbers larger than 256. My Benchmark uses a thousand iterations, but the job of extrapolating from the eight seconds to run 256 iterations on this machine, to the 30-odd seconds on an IBM PC, involves too many unknowables. Consequently, I've left out the details, and anyway, comparing a 48k RAM disk with the 360k RAM disks on the IBM family is meaningless.

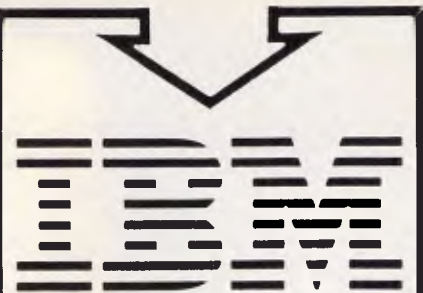
Benchmarks

Benchmark comparisons are in the melting pot, following the discovery of an error in back numbers of APC. Initially, I decided that the Spectrum 128 ran ordinary Spectrum Basic faster than the old machine. Then, getting suspicious, I dug out the old machine and re-ran the Benchmarks.

Aargh! We've been maligning the Spectrum! It goes faster than we said! Simple misprints, I think.

No, I'm *not* typing all eight Benchmarks into an old rubber-keyed Spectrum just to see if it really is slower. You do it, if it's that important to you. The Benchmarks otherwise appear to be identical from Spectrum 48 to Spectrum 128 — in 48k mode.

On the 128k Basic, they run slower because the interpreter has to stop every few microseconds to see if it has to change memory pages. However, that doesn't matter a tiny piece. If you look at the place where most time is wasted on



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CHECKOUT

the Spectrum, you'll quickly discover an audio tape cassette player occupying the space.

As a way of replacing the audio player, the RAM disk compensates for this slight slowdown more than a little. Examples include the programs that used to come on three tapes because there wasn't room in memory for them, but now come on one (admittedly, it takes 15 minutes to load) and can load all together.

Editor

The old Spectrum has a usable editor, where the top of the screen shows your listed program and you type in new lines at the bottom. I quite like it but it isn't a proper screen editor, where you change things on the screen and they change in Basic.

This one is. Wonderful! To use the full power of the page editor, you need the extra plug-in keypad/cursor keys. This will probably cost another \$55, which is a diabolical liberty.

Bundled kit

With the Spectrum 128 are two Ocean games: Daley Thomson Super Test, a sport simulation (re-written, I am assured, and *much* better than the 48k version) plus an adventure story, Never-Ending Story, based on the film. This game used to come in three parts, and now it all fits into the machine at once. There are plans to put it on microdrive cartridges.

A power supply, cables for connection to a tape recorder, and (possibly, it is undecided at press time) a monitor cable, with no plug on the display end, are bundled with the machine.

Conclusion

If you have to use a TV as a display, then

it's nice to lose the annoying shimmering effect which is caused by 'dot crawl' on the old Spectrum. On the other hand, Amstrad is offering a machine with its own monitor.

If you are fed up with 48k memory and want to run longer or over-laid programs, the 128k Spectrum is a really nice move forward on the old. On the other hand, just about everyone else (bar Acorn) includes a disk in the price these days. And even the BBC Micro has a disk operating system, though at the price you might expect a CD ROM...

A heat sink should eliminate many of the old 'catatonic' machines that turn themselves off after two hours. On the other hand, I leave most of my computers switched on for weeks (it's better for them!) — isn't this standard behaviour?

The sound output is a vast improvement on *beep*, and takes no time off the program in the way *beep* does. And the sound is almost as interesting as the old Commodore 64 sound (a bit simpler to program, admittedly).

In other words, the Spectrum 128 is very much nicer than the old Spectrum, but pretty damn ordinary compared with anything else. It's a calculated gamble, I suppose. Already, there is a good list of programs and products, specifically designed to work only on the 128k version, and so some software and hardware people are obviously convinced that it will sell. I just wouldn't like to predict how well.

Sinclair Research says that this is an 'evolutionary' product. I say the company had better get a screen and disk out for it, or it runs the risk of having produced just a better dinosaur.

Of course, Sinclair could always cut the price...

END

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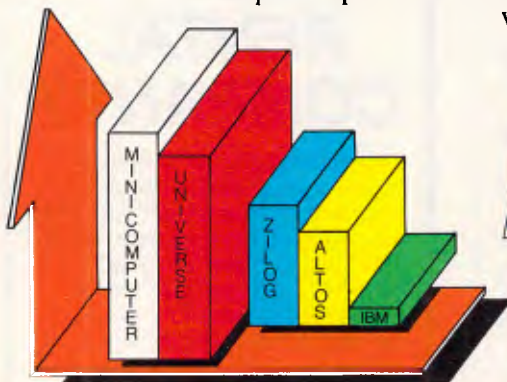
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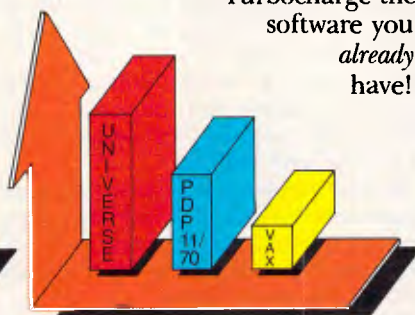
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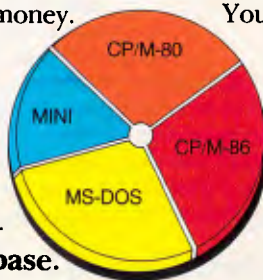


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Benchmark

The benchtest used was provided by BYTE magazine and is the Sieve of Erastosthenes prime-number program (10 iterations). Note that all performance is for a single user system only.

COMPUTER	PROCESSOR	OPERATING SYSTEM	LANG.	TIME (sec.)
AED UNIVERSE	80286/8	MP/M 8/16	C (D.R.I.)	1.8
ZILOG	Z8000	ZILOG	C	4.0
DATAMAX	80186	C-DOS	C (D.R.)	4.3
WICAT	68000	UNIX	C	4.7
ALTOS	8086	XENIX	C	6.0
LABTAM	8086	MC-DOS	Fortran 77	7.0
DEC	LSI-11/23	XENIX	C	9.3
IBM PC	8088	MS-DOS	C (D.R.)	12.4
OSBORNE	Z80A	CP/M	C (BDS)	15.2
DEC PDP-11/70		UNIX	C	1.5



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VIC Sales: AED Melbourne, 53 Waverley Road, East Malvern 3145 (03) 211 5542.

WA Sales: Computer Services of WA, 465 Canning H'way, Como 6152 (09)450 5888



Votalker IB Speech Synthesiser

A speech synthesiser to most people is seen as a pompous novelty to add to your PC. Peter Vernon looks at the Votalker IB Speech Synthesiser and its practical applications.

The Votalker IB is a plug-in board for the IBM PC and compatible computers which uses the SC-02 'phoneme-based' speech synthesiser integrated circuit — the latest product from Votrax Inc.

The board measures 137mm wide x 98mm high, and is easily installed in any vacant slot in the IBM or compatible PC.

On the board is a 75mm speaker, two 'mode' switches, a volume control, external speaker socket, IRQ jumper block and a connector for an auxilliary internal speaker. The system is supplied ready for installation, with a comprehensive user manual and a disk which contains the basic driving software and demonstration programs.

All controls are accessible from the rear panel of the computer when the board is installed and both mode switches can be changed without having to turn off or reset the computer. The volume control adjustment is also accessible from the rear of the PC, and is adjusted using a small screwdriver, although the volume of speech is more usually controlled by software.

The mode switches are used to specify the 'voice' and filter settings of the board. The voice mode switch allows you to choose between a smooth, natural sounding voice with a wide range of inflections and a deeper voice with less inflection. The output filter switch also has two modes of operation: normal and enhanced. The normal mode of operation accents the mid-range output of the audio section of the board, and the enhanced mode provides a more linear

tonal output. This mode can only be selected when an external speaker is attached, and is used to compensate somewhat for the characteristics of different loudspeakers.

Connection of an external loudspeaker automatically cuts out the on-board loudspeaker of the Votalker. The user manual recommends that you use a loudspeaker with a moderate high frequency response to minimise the

effects of digital switching noise which may be picked up by the amplifier. In practice, I experienced no problems with this aspect of the board's operation.

Installation of the Votalker is simply a matter of opening up the PC cabinet and plugging the board into a vacant slot. A jumper block on the board determines which interrupt line the Votalker will use, although some options are restricted if you have a hard disk system or a multi-



function card installed in your system. The user guide provides full details of the options available, and I have tested the Votalker on an IBM PC and a compatible clone with no problems.

Introduction to phonetic speech synthesis

Unlike other methods of speech synthesis such as Texas Instruments' Linear Predictive Coding (LPC), phonetic speech synthesisers do not extract speech from a human source. Instead, a set of 'building block' sounds, called phonemes, are electronically generated. Speech is created by combining these sounds in a sequence.

This method of speech synthesis means that the vocabulary of the synthesiser is unlimited. You are not restricted to words which have been digitised and stored in memory, and you are not restricted to the English language. Theoretically, phoneme based speech synthesisers can be made to talk in any language (although Swahili is a bit difficult to program).

The SC-02 chip which is at the heart of the Votalker provides 64 separate phoneme sounds. The average English speaker uses about 42 separate phonemes, depending on the accent and articulation of their speech. As with earlier Votrax products, the phonemes are associated with ASCII character codes which are used to select the sounds to be produced by the chip.

In addition to the basic 64 phonemes, the SC-02 chip can also produce hundreds of variations on these sounds, because the duration of each phoneme, the overall speech rate, inflection, amplitude and pitch can all be varied by software controls as speech is generated. In addition, you can control the transition between one phoneme and another, to duplicate the changing pronunciation of phonemes when they are combined in different sequences.

As a result, the speech produced by the SC-02 can be very life-like, pleasant to listen to and easily understood, even by people hearing synthesised speech for the first time.

In addition, the Votalker provides other options. By varying filter settings and pitch, it is possible to produce music (a singing computer), sound effects, and a wide range of alternative pronunciations (including Dalek voices, if you like).

Software

The Kernel is the centrepiece of the Votalker Speech Operating System. It

provides the software interface between the SC-02 chip and applications software, for tasks such as interrupt handling, phoneme buffer storage and the management of pre-defined vocabularies, (called lexicons). Programs that you write, and pre-written programs, can access the kernel routines to generate speech.

If you wish to write your own speech application software, it is strongly suggested that you use the Speech Operating System Kernel to interface to the chip. Not only does it provide powerful routines and remove much of the drudgery of programming, it also provides 'hardware independence'. According to the manual, it helps ensure that your software will be compatible with future versions of the Votalker.

The Phonetic Speech Editor (PSE) is a menu driven program that provides standard editing functions, (insert, delete etc) as well as editing functions specially designed for creating vocabularies of words from sequences of phonemes. The editor allows you to create lexicons which combine phoneme sequences with speech parameter assignments, and lets you insert, modify and save vocabularies in several different formats. Depending on the format used, you can store many different words with limited control over speech parameters, or store a smaller vocabulary combined with extensive instructions for varying speech rate, pitch and inflection.

Within the speech operating system, a lexicon file is a collection of vocabulary entries which contain phoneme sequences and speech parameter instructions. Any number of different lexicons can be created using the Phonetic Speech Editor, with each identified by a number and an optional 12 character file name.

Text to speech

The Votalker software also provides a resident text-to-speech (TTS), translation module, which works with the Speech Operating System to convert any ASCII text into phonetic speech. When the TTS module is loaded, programs can instantly generate unlimited speech using simple character strings. You can vary the rate of speech, the amplitude, inflection and filter settings of the voice output, either word by word or by using global parameters that apply to all speech output.

The TTS module can be used from BASIC (demonstration programs are included) and from other languages or the MS-DOS operating system. The user guide provides complete information to allow you to develop your own software,

for applications such as word processing (you can have your computer speak the contents of a file, for example) and for talking terminals (speech direct from the keyboard). Unlike programs that rely on predefined word sounds, the Votalker

'As a result, the speech produced by the SC-02 can be very life-like, pleasant to listen to and easily understood, even by people hearing synthesised speech for the first time.'

Speech Operating System and TTS allow the computer to pronounce any words or combinations of sounds.

The disk of software provided with the Votalker is not copy protected and can be backed up in the usual way.

Optional software

The Votalker user guide also describes a software option called PortTalk, which makes the Votalker board appear to be a parallel or serial peripheral device. By using this option, text sent to either LPT or COM ports is redirected to the Votalker board. In this way, you can have your computer speak the contents of a file by using standard print commands, including the Print Screen facility of the IBM PC, so speech output can be added to existing software quickly and easily.

Also available as options is the Sonix Toolbox set of programming utilities and the Sonix-Turbo Pascal Speech Interface program.

Performance

No matter what its capabilities, the worth of a voice synthesiser system must still be judged by the intelligibility of the speech it produces. Intelligibility is a subjective matter, and a person who is familiar with the speech system is not necessarily the best judge. Almost unconsciously the ear becomes accustomed to the mechanical inflection of ordinary synthesised speech so that after a very short time it is heard as perfectly clear and understandable. A person coming fresh to the system however, may only hear gibberish unless they know what the system is supposed to be saying.

This problem is overcome by the Votalker by the provision of extensive controls over the pitch and inflection of speech. Even for those unfamiliar with synthesised speech, the Votalker is clear

and easily understandable. A number of visually handicapped people are already using the system and have found it an invaluable aid, as it allows them to work with computers in ways that would otherwise be impossible.

Applications

Just what are speech synthesisers good for? Apart from its novelty value, Votrax systems have been applied by visually handicapped people, office workers and equipment operators who must review information while keeping their eyes on something else.

One businessman uses his PSS unit to check the contents of letters typed on a word processing system. The ability of the unit to accept input from a disk file and speak the text aloud allows the user to hear the letters spoken before they are printed. An accountant of my acquaintance is impressed by the possibilities of talking balance sheets, which allow a detailed display on the screen with essential information highlighted by being spoken by the computer.

A talking computer naturally attracts attention, and this characteristic of the



'Votrax systems have been applied by visually handicapped people, office workers and equipment operators who must review information while keeping their eyes on something else.'

Votalker could be put to good use by advertisers and shop-holders. Programmed with information on a product or service, the speech synthesiser is a proven attention-getter, and has proved ideal for advertising and a wide range of public relations work.

Of course, there is also the entertainment value of speech synthesis. When combined with the potential sound effects of the Votalker, speech can give a whole new dimension to games of all types.

Conclusion

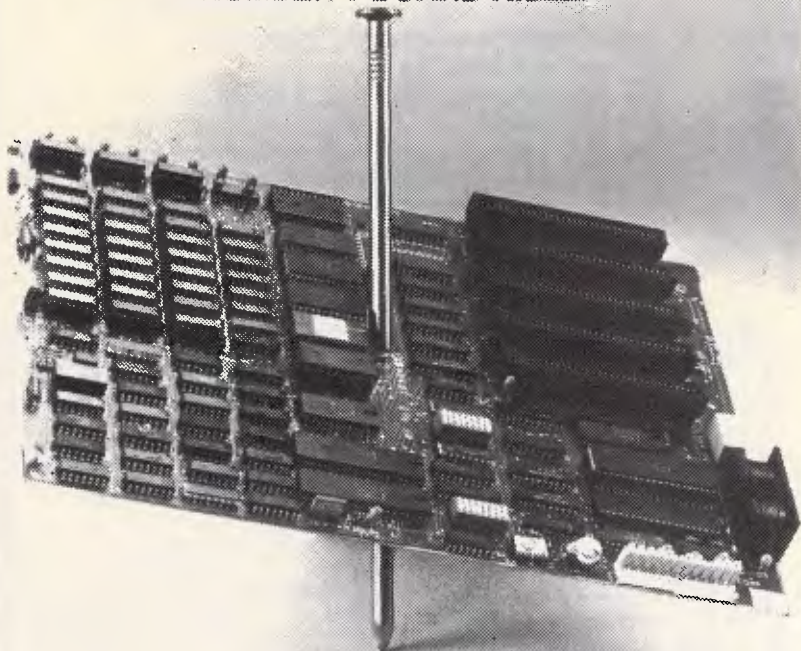
The Votrax Votalker IB is one of the most convenient and easy-to-use speech systems I have seen. The text-to-speech translation software is accurate in around 90% of cases, and difficult words can be programmed phonetically or added to an exception table to further increase the range of the system. Many other features of the system have only been touched on here, including the Phonetic Speech Editor, which would keep an enthusiastic user occupied for months. No doubt at the end of that time there would still be many avenues to explore. With a retail price of \$590, the Votrax Votalker speech synthesiser offers good value for money.

The Votrax PSS is available from Mike Bourne Electronics, 61A Hill St, Roseville, NSW, 2069. Phone (02) 46 3014.

END

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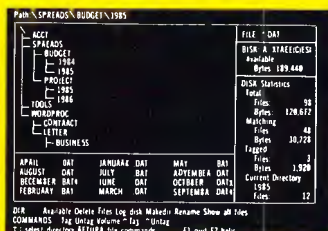
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APC 2-86

Viatel: one year later

Telecom's database service, Viatel recently celebrated its first anniversary. Steve Withers takes a look at the progress made after twelve months. And next month, Viatel's quarterly magazine will be given away with every copy of APC.

Viatel's birthday was a low-key affair; I saw a few congratulatory messages on Microtex 666's Blackboard, but that was about all. The system got off to a reasonably good start, and — as far as I have been able to find out — the growth in the number of subscribers and usage has at least matched Telecom's expectations.

In recent months the range of services offered by information providers has blossomed, and the volume of material in existing categories has increased. A fair proportion of it is of direct interest to the microcomputer user, but that's not surprising since some 75% of Viatel subscribers access the system with a personal computer rather than a dedicated terminal. This article is not intended to be a comprehensive guide to Viatel, and the mention of any particular company or other organisation should not be taken as a recommendation or endorsement.

Microtex 666

As this is APC, you'd be surprised if I didn't suggest that Microtex 666 was the premier service for micro users. The highlight is still the library of around 400 programs for the Commodore 64, IBM PC, BBC micro, and Apple II (with a collection for the Sega and MicroBee



waiting in the wings), but the range of other facilities has grown since the early days. Other information providers are starting to offer telesoftware, but they seem to be still at the experimental stage. One example is Tango, an 'umbrella' organisation that acts as a host for many smaller concerns. Tango offers three programs for downloading, and the promise of more to come has been made for some time.

Blackboard is Viatel's first (and only, I believe), automatically updated bulletin board. It actually consists of three separate boards: Debate 666 which is for discussions on specific topics, and two general purpose boards (one for Microtex 666 subscribers, the other for other Viatel users). Even though

Blackboard is updated in batches — at 15 minute intervals during peak times — some users seem to conduct 'conversations' in something approaching real time. Try doing that with your average single-user BBS! Other Microtex 666 features include technical information, news items (Newsprint and Yankee Doodles appear on Viatel before the corresponding issue of APC goes on sale), and a games department.

Trading Post is the 'small ads' section, covering a surprisingly wide range of goods, most of which have no connection with computers. Mind you, if you are in the market for some second-hand software, Trading Post is the place to look.

APC isn't the only computer magazine to become involved with Viatel. PC Australia has a small section, but at present it offers little more than an index to the magazine and a 'top ten' software chart. There are plans to expand the material, but it seems to be aimed solely at PC Australia readers, as it is not accessible from Viatel's microcomputing index.

Information providers

Some importers and manufacturers of personal computers have taken space on



Viatel, often with closed user groups to provide dealers with information. Commodore offers price lists, details of new items, and lists of dealers and user groups around the country. There are also response frames for sending messages to Commodore and for placing

In recent months the range of services offered by information providers has blossomed, and the volume of material in existing categories has increased.

orders or requesting information from certain dealers. Apple Computer Australia has a very similar set-up.

Barson Computers provides some information about the BBC and Apricot computers, and has dabbled in telesoftware with a typing tutor program for the BBC. MicroBee has a fairly extensive area that includes a magazine section that would be of interest to most 'Bee users. The company lists its stores and dealers, as well as providing an on-line catalogue. Other companies offering product information include Olivetti, Hewlett Packard, Sendata, and PC Extras (mainly software for the IBM PC).

Teleshopping

Talk of price lists and catalogues leads nicely into teleshopping. A wide variety of goods and services can be purchased from Viatel. As a matter of fact the first message to arrive in my mailbox was a note from a wine merchant offering a special deal on mixed dozens. I'm told that this junk mail is generated by programming a micro to repeatedly interrogate the Viatel Mailbox directory, until a comprehensive list is obtained. Another example of the misuse of technology?

Companies offering teleshopping facilities of direct interest to personal computer owners include Brainstorm, Micro-Educational, Discware (these three offer mainly IBM PC and Apple related items), Dick Smith Electronics, ABE Computers (various computer products), and Nashua (diskettes and related services).

After overloading your Bankcard, you might consider improving your education or getting some specialised training in the hope of convincing the boss that you deserve a pay rise — Viatel can help! Well, it can't actually provide the training, but it can point you in the

right direction. Deakin University and the University of New England are both information providers, as is the TAFE board of Western Australia. Other bodies offering courses include the Victorian Employers' Federation, and the Federation of Western Australian Industry.

It is possible that you could work more effectively with easier access to information relevant to your job. There's material about occupational health and safety, employment law, industrial gases, market research, leasing, and much more. If you're in business the database of tenders provided by the Department of Trade could provide some useful openings.

Entertainment

By now you are probably looking for some relaxation, so some fun and games wouldn't go amiss. First, a little background information. A Viatel database consists of a number of frames (screenfuls of information), with each frame linked to a maximum of 10 others. Users move from one screen to the next by pressing one of the numeric keys.

A wide variety of goods and services can be purchased from Viatel.

This means it is particularly easy to implement multiple choice quizzes and adventure games. In a quiz, pressing the number corresponding to the correct answer leads to the next question, while the remainder takes the user to a "sorry, wrong answer" frame, which links back to the question. I must admit that I've not yet tried any of the collection of adventures on Viatel, mainly because I

have yet to master Zork II on my trusty '64.

Some game designers have been a little more imaginative, and come up with things like the Flight Simulator. When someone's had a good idea it's often easy to see how it works, but my imagination boggles at the number of frames that must be involved.

Another novel game is the Viatel "race". What happens is that the race starts and finishes with response frames that record the time of day. Each intermediate frame offers three choices, but only one leads to the next page. Luck obviously plays some part, but nimble fingers and fast reactions still make a difference. If your idea of racing is the Sport of Kings, then TAB information from some states is available on Viatel.

So I still can't tempt you? How about a holiday? There are plenty of companies and government organisations just waiting to help you plan your next trip. Ansett, TAA, and Qantas are all there, with the Qantas database starting on the wonderfully mnemonic page 747. Tasmania's tourist bureau offers travel information and booking services, or if you are visiting Melbourne you might like to pick a restaurant from The Age's Good Food Guide. If you are like me and prefer touring holidays, there's always the Flag Inns section.

Of course, to go on holiday you need money, and that's a subject to which a large chunk of Viatel is devoted. Exchange rates, interest rates, market prices and reports, economic indicators, telebanking (access to bank services from your loungeroom), telebroking (buying and selling stocks and shares), the list goes on. If only you could have banknotes printed by your videotex terminal...

END



'I'm all for this new technology myself...'

Balancing books with IBM

Accountant Ian Robertson computerised his practice three years ago and has never looked back. Jan Smith takes a look inside.

The isolation of the sole practitioner is something accountancy practice development seminars love to discuss — the joys of freedom set against the fact that there are no colleagues around, and also, perhaps, that Hollywood has yet to bestow on them the nobler qualities we associate with hardpressed but dedicated doctors in the same situation.

Nevertheless, accountant Ian Robertson had no doubts when he literally went west at the age of 28, five years ago, leaving the six-partner firm of Norton and Faviell, in Phillip Street, to seek his fortune in the outer conurbation of Liverpool which he saw as a good growth area.

Today, with a successful practice in the leafy northwest suburb of Eastwood, Robertson marvels at his boldness. "I set up with no clients and a trusty Canon AX1, a baby computer rather like the Commodore," he recalls.

But it was a happy partnership and two years later, Robertson moved his growing practice to Eastwood, 11 minutes drive from his home in Beecroft. "We'd found a topfloor unit in a block which was scheduled for strata development, right in the middle of the shopping centre, which meant we had much more control of our overheads," he explains.

But the faithful Canon's days were numbered. "It did debtors, creditors and general ledger brilliantly, it was very clean and reliable for general practice work but it drove me mad because it didn't have the megabytes to handle the volume any more. It now has a good home with one of my clients."

The question of its successor was not all that difficult. "It sounds unbelievable but in those days (February 1983), there were only two accounting software houses with packages suitable for chartered accountants — Hartley and O'Reilly," he says.

It was also the year in which many PC firms were foundering, creating a shaky market and a great deal of nervousness in buyers trying to evolve a medium-to-longterm computerisation plan.

Upgrading

The launch of the IBM PC XT that year made Robertson's choice easy. O'Reilly not only sold IBMs, but had the FAMAS software to go with it.

Robertson doesn't think the accountancy world was using any particular brand of computer more than another in those hectic days. "We wanted one which wouldn't disappear, that would grow along with us. We'd sussed out the market by ourselves and seen O'Reilly's

The choice of IBM meant Robertson had access to an enormous range of software and could afford to develop a strategy at his own speed.

advertisements in computer journals," he explains, adding that "we" means himself and his full time staff of three, accountant John Che from Hong Kong, property manager John Fry and his secretary, Vesna Cuneo.

The choice of IBM meant Robertson had access to an enormous range of software and could afford to develop a strategy at his own speed. This is a vital factor for the small-to-medium accounting practice, which can't afford to switch from one brand of computer to another. For Robertson, too, it offered flexibility, very necessary for someone running what he calls "a general practitioner's boutique."

Robertson's practice embraces the

whole spectrum. "We do Trinity Properties Limited (a company listed on the Sydney Stock Exchange), small businesses, large corporations, everything from butchers to entrepreneurs, from Sydney to the bush, along with personal tax for more than 400 clients."

But there's a big difference, all the same, between being a man for all seasons and having a trim stable of good performers, which is Robertson's goal. "We got very good advice early on from David Block, who is Chairman of Lloyds Bank and a director of CSR. He said: 'Be selective. Don't take everyone who walks in off the street, and charge a fair fee for a fair day's work'."

Software

In achieving this goal, the FAMAS and Attache software have proved invaluable. "FAMAS works very crisply compared with the old Canon, it's like chalk to cheese, and very flexible. For instance it can do its own formatting for financial statements, whereas the Canon was very programmed," says Robertson.

FAMAS's general ledger is basically used for client accounting — preparation of audits, directors' reports, and annual statements. It collates from the raw records to produce profit and loss, trading statements and balance sheets.

"For example, we have a client with a large sportswear store who has 48,000 entries a year. If we did it manually it would take two to three weeks, but with the computer it takes a maximum of three days," says Robertson. This means that the computer has increased throughput and decreased the time clients are charged for, allowing him more time to find new clients, cultivate existing ones, and trim down unproductive work.

Not only Robertson is using his time to better advantage since the computers

arrived — a second IBM PC, with 33Mbytes arrived 18 months ago. "We also use the computer to do debtors' and creditors' statements, with Attache, for clients who would otherwise be doing it themselves, say a husband and wife enterprise, where they feel their real talents would be better employed elsewhere. Even when this kind of enterprise takes on staff, accountancy may not be anyone's strong point."

This kind of service is much in demand from Robertson's small-to-medium clients. "For instance we have one firm based in Armidale with a branch at Lindfield on the North Shore, using an Osborne PC. But the two directors want time to develop export markets, so they've handed their debtors' ledger over to us. We also have a husband and wife printing business at Lidcombe, who found it frees their staff to do what they're best at."

In this way the computer allows Robertson to become more involved with clients, and he now has four directorships and two direct equity participations in small businesses. "It would never have happened if we couldn't provide good information up to six months ahead for them," he says. All corporation and trust partnerships are set up on FAMAS.

Another advantage of the computer is that the accountant can, in his turn, help clients to avoid pitfalls when they come

nutshell, you could say Attache does most of what FAMAS doesn't," purely for debtors and creditors' monthly work for clients, plus invoicing and stock control, whereas FAMAS produces statements and does the profit and loss and balance sheet side of things. In other words, Attache does the day-to-day money crunching to get the money in.

The profit and loss and balance sheets are done monthly or quarterly, with the Attache information batched and then keyed into FAMAS. They are not, however, interfaced, but two separate parts of a client's work.

Mastering the system

Robertson had mastered basic fingering techniques with the old Canon, and had no trouble mastering the IBMs. Nor was the software any problem. "FAMAS and Attache are very user friendly. If you can read a book and operate a calculator, you should have no worries," he says.

Both FAMAS and Attache are main menu driven, on hard disk, so there's no need to mess about swapping floppies.

Robertson suspects, though, that there may be some older sole practitioners who are still nervous about taking the PC plunge, in which case they may be pleased to know that O'Reilly's provided in-house training on the IBM, installed the computer, sent

another technician to install the programs, and finally despatched supportperson Jane Moore to teach Robertson and his secretary how to use it. "We never had a moment's trouble," he says.

The second IBM was installed with the same care. "All data was transferrable and there was no need for rekeying," says Robertson. Also those clients who had their own IBM PCs could dump their work files on our machines and *vice versa*," he says.

The second IBM PC uses a Mountain hard disk 60Mbytes tape back-up system, manufactured in California and bought through O'Reilly's. "The data files are all on one cassette which so far has used up only 35Mbytes, and we have three back-up copies," Robertson says. "I take one home at night, John takes another, and the third is in the safe so if we walked in one morning and found the filing cabinets had been burgled, we could be operating as normal."

For storage and retrieval, the Mountain hard disk back-up has been revolutionary. Robertson's filing cabinet is now reserved mostly for client correspondence, and there is none of the cluttered-carpet syndrome you may associate with your hardpressed solo tax accountant, or your struggling one-man-band solicitor.

The increasing complexities of taxation and other legislation alas, mean that not all of Robertson's newfound

In this way the computer allows Robertson to become more involved with clients, and he now has four directorships and two direct equity participations in small businesses.

to choosing computers and software, for example Trinity Properties, which has invested in an IBM AT and FAMAS.

"We've also been looking into actual property software packages, like Habitat, which is used by a real estate client down the street," says Robertson.

Apart from doing everything necessary to prepare a financial statement, FAMAS also has a management program, but Robertson doesn't use it very much. "We prefer Lotus 1-2-3 for spreadsheet and cashflow work for our clients," he says.

The FAMAS works in happy partnership with Attache, also bought on O'Reilly's recommendation. "In a



"Attache' and FAMAS have proved invaluable"



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leisure can be spent messing about with his boat, a 14 footer.

Without the chance to mingle with colleagues and exchange news of latest horror stories in these areas, the single practitioner's lifeline is the practice development seminars and lectures given by the two main accounting professional groups, the Institute of

Robertson suspects, though, that there may be some older sole practitioners who are still nervous about taking the PC plunge...

Chartered Accountants, of which Robertson is a member, and the Australian Society of Accountants. "We get all the latest information on improving audit standards, changes in payroll tax, entertainment allowances, motor vehicle legislation, and sales tax developments, which may sound pretty dull but can be a matter of life and death to accountants," he says. There are also lectures on computer technology as it affects accountants, for instance reviews of auditing software packages.

Robertson explains that in the last few years, both these professional bodies have undergone big changes, shedding forever the old fusty image of furled umbrellas and caution at all costs. "They've loosened up a lot lately," says Robertson who believes that thanks to the computer, accountants can now find time to come out from under the paperwork and spread their wings in other areas.

For Robertson, this means continuing to develop his 'boutique' to the point where it flows even more smoothly, and to do more consultancy work for small businesses. Ideally, there'll be overseas travel as well, a modest four weeks now and then. "It may not sound much" says Robertson, "but in a solo practice holidays are always a problem, and without computers, it doesn't bear thinking about."

END

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Taking Precautions

Although some will argue otherwise, health hazards due to working with VDUs are a real problem for many users. Wendie Pearson and Graham Hardy examine the symptoms, and give expert advice on how to overcome them.

In the wake of numerous reports on alleged VDU health hazards, increasing research is being conducted throughout the world.

Despite the nonchalant attitude of some manufacturers who say there are no risks, the catalogue of VDU-related complaints is large. They include potential damage to the foetus, repetitive strain injury, eye strain, and skin rashes to name but a few. So... are VDUs bad for your health? Despite the vast number of completed studies, conclusions are invariably woolly, with little advice to go on; which isn't much help to personal computer operators.

However, after looking at some of the alleged hazards, the average personal computer operator will probably come to the conclusion that there is enough evidence to suggest that it might be better to avoid spending too many hours per day in front of a screen and keyboard.

VDUs and pregnancy

If you're thinking of starting a family or increasing the one you already have, the great VDU/Pregnancy Debate might be worth considering.

Following a case in Aarhus, Denmark, when eight out of 10 pregnant women who operated VDUs at a library there had miscarriages, doctors began a five-year study to discover if there was any connection between foetal damage and/or miscarriage, and the use of VDUs by pregnant women.

Dr Cay Ole Larsen of the Department of Occupational Health in Aarhus said: 'Terminals will be used increasingly in

the future, so it is important to do something now — no later. Any health risks must be made clear before too many people are exposed to them.'

The doctors will study members of Denmark's biggest office workers' union which has an 80 per cent female membership. The study will compare reproductive outcome of those working on VDUs with those who don't use them.

Larsen feels there might be a link between working on VDUs and what the experts call 'adverse reproductive outcome'. But I don't think the problem is microwaves,' he said, 'I am convinced it is the stress factor and this is one of the things we will study.'

If it turns out that there is a link between miscarriage and VDU work, the findings will be even more alarming, bearing in mind that the women in the Aarhus library only spend part of their day working on terminals. In the US and Canada, at least 10 clusters have been reported since 1980, and the National Institute of Occupational Safety and Health (NIOSH) in Cincinnati, Ohio, has looked into three of these. One concerns the case of four women who worked on VDUs at the Toronto Star newspaper, each of whom gave birth to malformed babies.

NIOSH is also studying 2000 women using VDUs and 2000 who aren't, to compare their reproductive outcome — that study should be completed in late 1987. NIOSH's Dr Teresa Shnorrr said she was unable to confirm any findings on the subject yet, and that currently NIOSH was not recommending that pregnant women be moved away from VDUs.

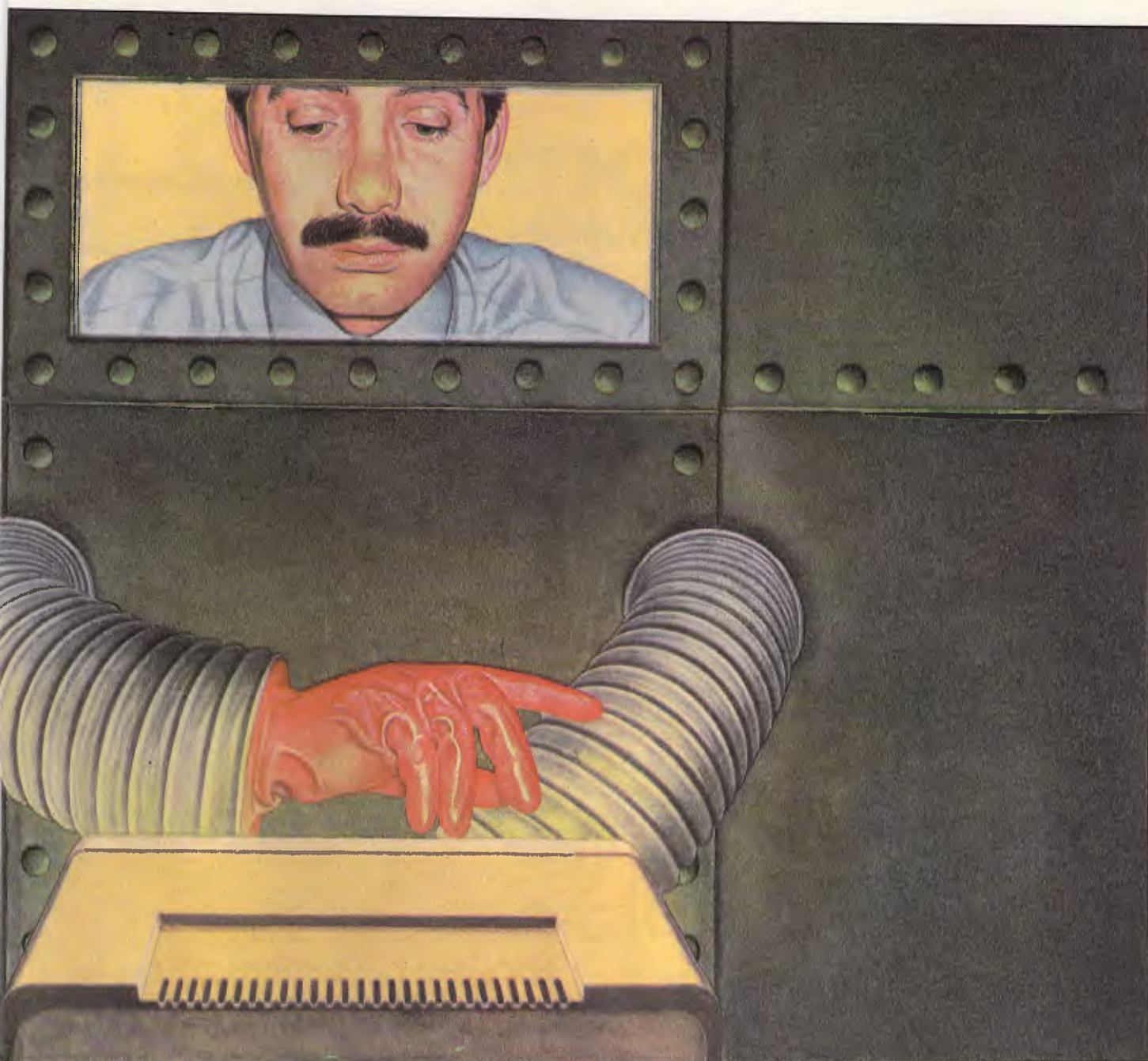
In the UK, a study carried out by the

Civil Service Medical Advisory Service for the Council of Civil Service Unions caused a stir in autumn 1984. In a study of women exposed to VDUs for three months before and three months after conception, 36 per cent resulted in miscarriage, stillbirth or malformation. This was compared to 16 per cent in a group of women not exposed to VDUs.

The British Civil Service Unions consequently warned pregnant women not to work on VDUs until more detailed research has been carried out.

Dr Semmence, who carried out the survey, said at that time that he didn't feel the study carried any weight and that 'pregnant women are always anxious.' Quite apart from stating the obvious, this ignores the fact that VDU operators in





this study had a 20 per cent higher incidence of reproductive trouble than their colleagues who didn't work on terminals. In addition, a figure of 36 per cent is abnormally high; the usual level of miscarriage is more like 10 per cent, according to medical sources.

A 1984 survey carried out by a Montreal doctor looked at 2504 pregnancies in which a VDU was not used and found a miscarriage rate of 5.7 per cent. In 586 pregnancies in women using a VDU for fewer than 15 hours a week it was 8.2 per cent, and in 709 pregnancies in women using VDUs for more than 15 hours a week it was 9.3 per cent. By contrast, the rate of miscarriage in 5867 pregnant workers not using VDUs was 7.8 per cent.

In Australia, in 1978, four women suffered miscarriages after working with VDUs at a city branch of the Bank of Adelaide.

Under union pressure the Australian Radiation Laboratory tested the machines and many others — 50 altogether — for X-rays but found there were no detectable X-ray emissions.

Nevertheless, this together with the more recent reports from overseas and fears that other forms of radiation may be emitted, particularly as machines become defective, has caused concern among trade unions.

The Australian Council of Trade Unions adopted a policy that pregnant women should have the right to transfer away from screen based equipment to

alternative work without loss of pay or seniority.

Numerous employers and unions have also reached agreement on the right of pregnant women to transfer away from VDUs on the basis that it is better to be sure than worry.

In Sweden, pregnant women may also request that they stop work with VDUs and may be allowed to do so on the grounds of reducing worry.

A note of caution also appears in Britain's National Radiological Protection Board guidelines: 'Although there is evidence to suggest that the developing embryo is not sensitive to magnetic fields encountered in nuclear magnetic resonance clinical imaging, studies, yet to be confirmed, reported changes which



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could have developmental consequences. It was considered prudent, therefore, on this tentative evidence, to exclude pregnant women during the first trimester when organ development is taking place in the embryo until more conclusive evidence is forthcoming.

Dr June Hayes-Light, a British psychologist who advises on the choice of microelectronic equipment in schools, said: 'I wouldn't advise a pregnant teacher to spend much time sitting in front of a computer with the kids. The attitude of micro manufacturers in brushing off the problem is understandable, though, as they are afraid a scare will mean a drop in sales. However, pregnant operators should limit their time with a computer because it's worth their while to be careful.'

Research and debate

While concern in Australia has been almost entirely confined to word processing and office workstations and the larger computer systems, most of the concern is quite valid for personal computers particularly those used for work or research or any other purpose involving hours of use per day.

After all, people using personal computers can drive themselves as hard as any tyrannical boss could and without ergonomically sound work stations or union negotiated work breaks.

Repetitive Strain Injuries have caused pain and suffering as well as loss of career and disablement to thousands of people including many professionals.

And early results from extensive research into the effects on eye health of computer operators show there is some association between eye problems and computers although it's too early to tell what the association is.

The new National Occupational Health and Safety Commission based in Canberra and formally established in December 1985 has, among its many priorities, several VDU related problems for investigation.

High among these is RSI but research has also begun into ionising and non-ionising radiation which is emitted to some degree by computers with cathode ray tube (TV) screens.

While the Commission's research has only just begun, the debate on the causes of RSI has reached the stage where it is also of interest to the personal computer user.

At Flinders University in South Australia, Dr Graham Wright has written a pamphlet outlining three major factors associated with RSI.

One is ergonomics which deals with such matters as desks, arrangement of

computers, the type of keyboard, lighting which glares off screens — all of which cause us to work in an inefficient posture and, work in the one posture for too long because the work station cannot be readily varied to allow an easy change of posture.

The second factor is how the work is organised and how fast and for how long we have to work. While rushes of work are inevitable, too many rushes for too long can cause RSI.

The third factor is stress or tension while working hard and long at a keyboard. While Dr Wright emphasises

If you're thinking of starting a family or increasing the one you already have, the great VDU/Pregnancy Debate might be worth considering.

the sorts of tensions and stress in office work, it can also equally apply to tension caused by domestic or business affairs.

In other words, the personal computer operator who plunks his machine on the kitchen table or office desk works frantically for several months to complete a research or business project while fighting his spouse, business partner or mother-in-law may be running a risk.

How much of a risk varies from one person to another, but chiropractors say if you have a back problem, such as a misalignment of the spine, the risk is greater, while a report in the New Zealand Medical Journal has suggested that fluoride taken in water or foods may heighten a deficiency of magnesium in some people's metabolism giving rise to musculo-skeletal disorders such as RSI.

The effect of computer screens on the eyes of operators has been subject to debate.

Earlier alarms about cataracts have subsided because tests by the Australian Radiation Laboratory indicated emissions were well below dangerous levels.

However, there is new evidence in Australia to suggest that VDUs are associated with eye problems, which although relatively minor, can cause discomfort such as blurred vision.

The School of Optometry at Melbourne University has begun a six year study of 1300 employees of the State Electricity Commission of Victoria — half of them VDU operators and the

other half non-VDU personnel.

Professor Barry Cole said the results from the first year test showed that "VDU operators did complain of visual discomfort and visual disability, blurred vision more often than the control group."

"The second finding we've found is that VDU operators are more shortsighted than the control group."

Professor Cole was cautious about interpreting the results because of a range of possibilities.

One of several possibilities was that operating a VDU was an intensive visual task that often involved people working continuously, while another was poor ergonomics of the workplace involving straining to see screens or source documents.

He said the expression of the severity of the symptoms of discomfort "are all at the very mild end rather than at the severe and disabling end."

"So we are looking at slightly higher discomfort visually for VDU operators."

As far as the higher amount of shortsightedness among VDU operators, Professor Cole is also cautious. As the figures are based on first year data, the second year data might show whether the gap between computer operators and non-VDU operators is increasing.

"In other words, if the process is continuing then that will become another piece of evidence that might suggest VDUs do tend to make you shortsighted," Professor Cole said.

For the personal computer operator, Professor Cole's research would appear to suggest that if you are experiencing eye problems a trip to the optometrist may be worthwhile.

Intensive visual tasks tend to emphasise eye defects which might otherwise present no problems. And if you are presently wearing glasses, they may no longer be suited for you or may require adjusting for the fact you are working at a different distance.

As Professor Cole pointed out, "In the case of some special SEC control workers, they have in fact three distances to work at. They have their VDU screens, panel controls at long distances across the room, and other things at ordinary reading distances."

"So it is necessary to prescribe trifocal glasses for that particular operation," he said.

While the introduction of computers into the office workplace has meant an increase in stress related diseases, it's hoped the personal computer operator is not affected in the same way.

In many offices, the employee previously engaged in secretarial and

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clerical work may find herself deskilled by the introduction of a computer and isolated behind a terminal from her fellow workers.

The software package she may have to work with may threaten system crashes through operator error or a wipe out of input and stored data.

She may also have to cope with conditions such as a record being kept of error rates and keystroke rates and requirements such as 13,000 keystrokes per hour.

Evidence is now accruing that these sorts of stresses are greater than those of executives or even, as the United States NIOSH found, air traffic controllers.

Other problems, possibly having a similar cause to stress, are face rashes and dermatitis.

Face rashes are thought by some researchers to be associated with static charges, and anti-static filters and anti-static floor coverings help to some degree.

In Britain, some researchers feel that dermatitis occurs due to the great build-up of positive ions within a few inches of the VDU screen, caused by the cathode ray tube. The high positive surface charge on the outer display face of the tube attracts negative ions in the immediate airspace, and accelerates the positive ions initially at the operator and then out of the airspace.

This results in increased positive ion concentration in the air breathed by the operator, and later creates total ion deprivation as the remaining positive ions are propelled out of the airspace.

Problems with ions

The beneficial effects of negative ions have long been known, but there are various problems associated with the positive variety. A laboratory study in 1976 estimated that one third of the population would experience significant medical symptoms if negative ions were withdrawn from the air.

These symptoms included irritability, anxiety, headache, neck and back pain, asthma, apathy, depression, nausea, fatigue, allergy, anorexia, transitory irrationality, uncertainty of observation, and hesitant judgement. These symptoms were found more frequently among women than men, and among older rather than younger people.

Another study in 1972 on stress and irritability among air traffic controllers pointed to the danger in distortion of the ionic environment.

Various biochemical mechanisms are supposed to relate to ion deprivation, including sodium/potassium ion

exchange which governs muscle function and fatigue, and thyroxine conversion, which, when inhibited, can lead to irrational behaviour ranging from general irritability to suicide.

When you bear in mind that whatever affects a mother also affects the child she is carrying, it appears that all these factors ought to be taken into account when deciding whether or not to work on a VDU while pregnant.

In making a decision, ask yourself how many people spend several days a week, seven hours a day sitting 12 inches from a TV screen. And although there is believed to be no danger from radiation levels, organisations such as NIOSH admit they are ignorant about the effects of long-term exposure to low-frequency radiation.

In 1982, the Canadian Ministry of Labour's Task Force on Microelectronics and Employment recommended interim rules for VDU work that included the right to job transfer during pregnancy, a five-hour limit on continuous VDU work including hourly rest breaks, and annual eye examinations.

There is no doubt that problems such as migraine, eye strain and backache are often experienced by operators. Dr Bill Butler at the University of Michigan, US,

lighting they have, and so on. We are working with unions and management groups, and a preliminary report will be out in June,' said Butler.

Dr Joe Lary of NIOSH said: 'There is no doubt that some people experience considerable eye strain which causes problems with vision, and behavioural problems. Anti-glare filters are good for avoiding this. Besides, no-one should be cramped into one position throughout an eight hour day — people need to get up and walk around.

'If someone had migraine each time they used a VDU, I would transfer them to another job. After all, you don't want people suffering every day as a result of their employment.'

NIOSH's Dr Steve Sauter added that work done at the centre shows that VDU operators have a relatively high incidence of complaint compared to clerical workers.

At the Labour Research Unit, South London, a big study has just been completed. The unit produced a booklet entitled *VDUs, Health & Jobs* by Alan Doulton and Lionel Foulton, in November 1985. Lionel Foulton said: 'We surveyed trade unionists involved in using VDUs and we received responses covering 17,000 workers. We found

In a study of women exposed to VDUs for three months before and three months after conception, 36 per cent resulted in miscarriage, stillbirth or malformation. This was compared to 16 per cent in a group of women not exposed to VDUs.

said: 'It's pretty much established that improper use of VDUs can result in migraine and eye strain, and all the other usual problems.' Many people have found that amber, black and white or LCD screens are easy on the eyes, while the green and black variety can play havoc. Where this is the case, the only answer seems to be to use a screen filter or transfer to other work.

Butler is currently studying the effects of VDU work on reproductive outcome using a control group, as well as examining the stress factor. Experts have repeatedly said how important this stress factor is, because although an operator may look as though she is just pressing buttons and retrieving information, there is an immense amount of concentration involved, and extra stress is experienced when a machine goes down or won't retrieve the relevant data.

'We are also looking at the general office environment to see whether people, for instance, have a say as to how their chairs are positioned, the type of

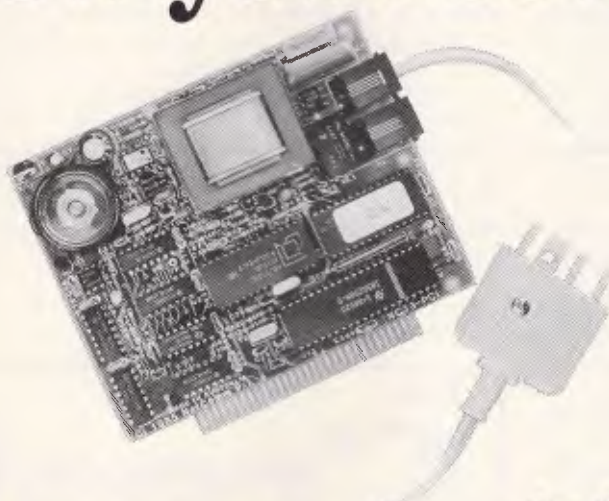
that 63 per cent complained about glare from nearby windows and lights, while 22 per cent complained about problems in reading the text on the screen (this was associated with glare) and 26 per cent complained about the noise associated with workstations, such as computers beeping and printers which are noisy.'

The survey covered eye, muscle and body pains, job stress, skin rashes and reproductive hazards. 'People were concerned about pregnancy, and we found a whole range of agreements that had been reached by trade unions on allowing people to transfer to other work if they were pregnant. We had quite a list of agreements where such things as eye tests were paid for by the employer, and negotiated rest periods were part of the deal.'

According to the survey, the ideal amount of time spent on VDUs is two hours a day, although many people have a four-hour maximum. The study concluded that although there were certain problems associated with VDU



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work, solutions could be found to quite a number of them.

Stress was high, with one third of respondents finding VDU work more stressful than their previous working situation.

Where conditions such as migraine and epilepsy are concerned, experts stress the need to consult your company's physician or your own GP for advice. While brightness, flickering and glare can trigger migraine attacks, similar disturbances can induce epileptic fits, particularly flashing lights.

On the subject of eye strain, those who wear glasses will find that their usual prescription is unsuitable for working on a VDU screen, and they may want to take up the problem with their optician.

With epilepsy, doctors have found that while word processing presents little or no hazards, graphic displays could in theory present a hazard. Television, for instance, owes its epileptogenic effect to two features — the mains frequency flicker of the entire screen, and the linear raster pattern which alternates at half mains frequency (25Hz). The raster pattern, although not visible when text is presented on screen, appears if large areas of the screen are illuminated by graphic displays or an inverse video mode (dark characters on a bright background).

In Australia, many universities are placing a four hour limit per day on the use of word processors or computer equipment by staff.

Monash University for example has a strict limit of four hours for data entry operators and guidelines say a break of two to three minutes should be taken every 15 minutes of continuous keying so as to provide ten minutes total break per hour.

While a limit of four hours has the advantages of limiting the likelihood of RSI and eye strain, it is an arbitrary limit and no guarantee against problems.

A better solution is considered to be one in which there is no single job such as a data entry operator and the work to be done in that regard is rotated amongst several staff.

The four hour limit should also be backed up of course by the use of ergonomic furniture and the training of staff and management in good ergonomic practices.

Conclusion

So what do the manufacturers say? One computer firm suggested none of the problems mentioned in this article would happen to their computers while another approached it from a different angle.

In Sydney, a spokesperson for Apple

Computers, Inga Fuglestved, said Apple equipment fell within the standards of European authorities.

Ms Fuglestved also said the problems encountered are largely related to equipment which is used by people sitting in front of a screen all day doing nothing but typing or other similar data entry.

'It just so happens that Apple computers do not fall into those categories. Our equipment is not meant as dedicated word processors or data entry systems — they are a personal productivity tool.

"You wouldn't really be in a situation of sitting in front of our equipment for hours on end," Ms Fuglestved said.

However, at Hewlett-Packard in Melbourne, Marketing Communications manager Jeff Stewart had an infinitely more practicable approach.

Meeting the problems head on, Mr Stewart said "We've always built ergonomically sound work stations. We spent a lot of time trying to understand what work environment is about, how people behave at work, what sort of machinery can fit the people and we've had leadership products in that area for a very long time.

"We set out to provide a good working environment for our employees.

"We employ a doctor as a consultant and we've had him prepare a course for all our managers and we are giving every single one of our managers a half day training course looking at the potential causes of RSI and looking at what we can do about it — looking at work place design, job design and so on," Mr Stewart said.

Noting that stress appeared to be implicated in many VDT problems, Mr Stewart said "as an employer we try to minimise the stress in jobs.

"What we set out to do is run our business in a management objectives manner giving our employees clear objectives and letting them have the room to find personally suitable ways to get the job done.

"We set out to find variety in jobs. We try to avoid altogether any job in which someone just sits and grinds away at a terminal all day.

"That's the sort of stuff which tends to increase stress and tends to increase the risk of RSI," Mr Stewart said.

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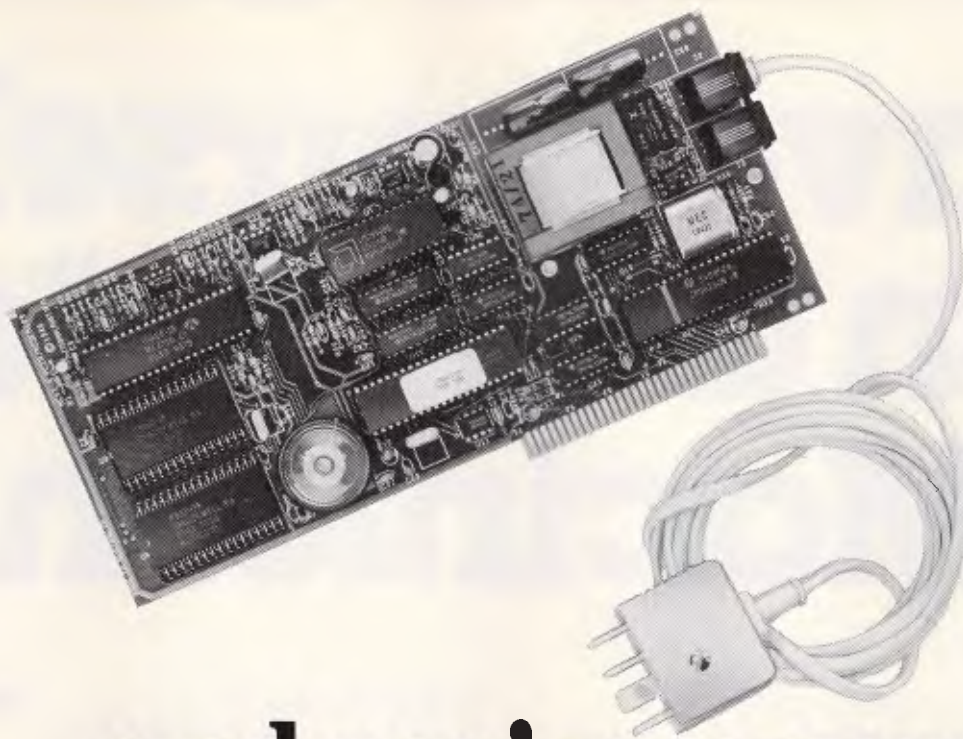
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Microsoft Project

Phil Cohen takes a look at Microsoft's Project, and explains why you might need a project management system in the first place.

If you think about the PERT project management technique at all, you probably think about it being used in the construction industry. It helps construction managers make sure they remember that a particular piece of machinery is needed on a particular day, and to keep track of how the project is progressing and what effect delays are going to have on the project as a whole.

But the techniques used in the construction industry are just as applicable to other industries such as electronics, marketing and even the writing of software. Managers of large projects of any type need tools to help them plan and keep track of what is going on — and what is *not* going on, but should be.

PERT (Project Evaluation and Review Technique) has been around for some years. Basically, it uses two forms of diagram — 'network' and 'Gantt', to show how various activities are related, and where they lie in the project's schedule.

An example of a Gantt chart is shown in Fig 1. Ignoring the rest of the information for the present, the 'activities' which make up the project are listed down the left-hand side of the chart, and a line across the top of the chart shows the date. The symbols under the date line show when each of the activities is scheduled for. A number of different symbols are used — minus or equals signs for when the activities should take place, dots for when they may take place without making the project as a whole run late.

The activities marked using equals signs are the critical activities, the ones which are setting the pace for the project. Any delay in a critical activity will make the project late.

The other type of chart used is network, (see Fig 2). This shows the relationships of all activities. For example, activity 1 (the one with a '1' in the top left of its box) must be completed before activities 2 or 3 can start. Similarly, activity 2 must be complete before activity 7 can start.

Using diagrams like these, it is

possible to keep track of very complex relationships and timings (and also costs, which we'll come to later). That's what PERT is all about.

Microsoft Project

It didn't take very long after the development of PERT and availability of

computers before someone thought of automating the process. The first project management systems ran on mainframes, and typically could not produce network charts at all.

In the past few years, however, some very sophisticated mainframe packages have emerged, most of them capable of driving plotters and other sophisticated

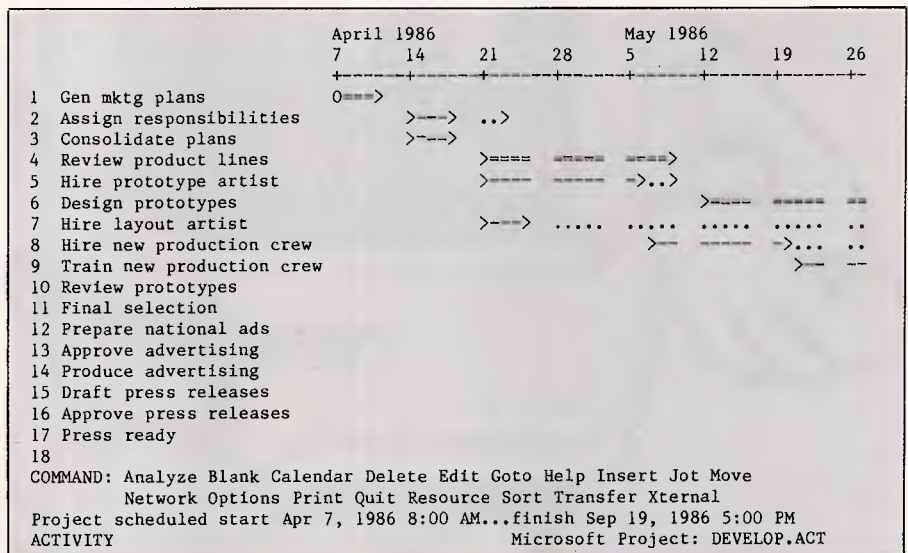


Figure 1: an example of a 'Gantt' chart.

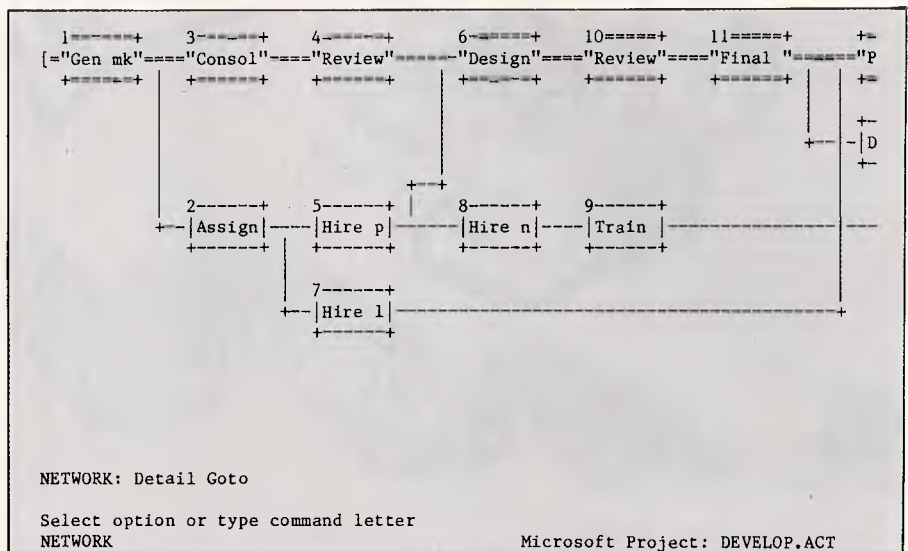
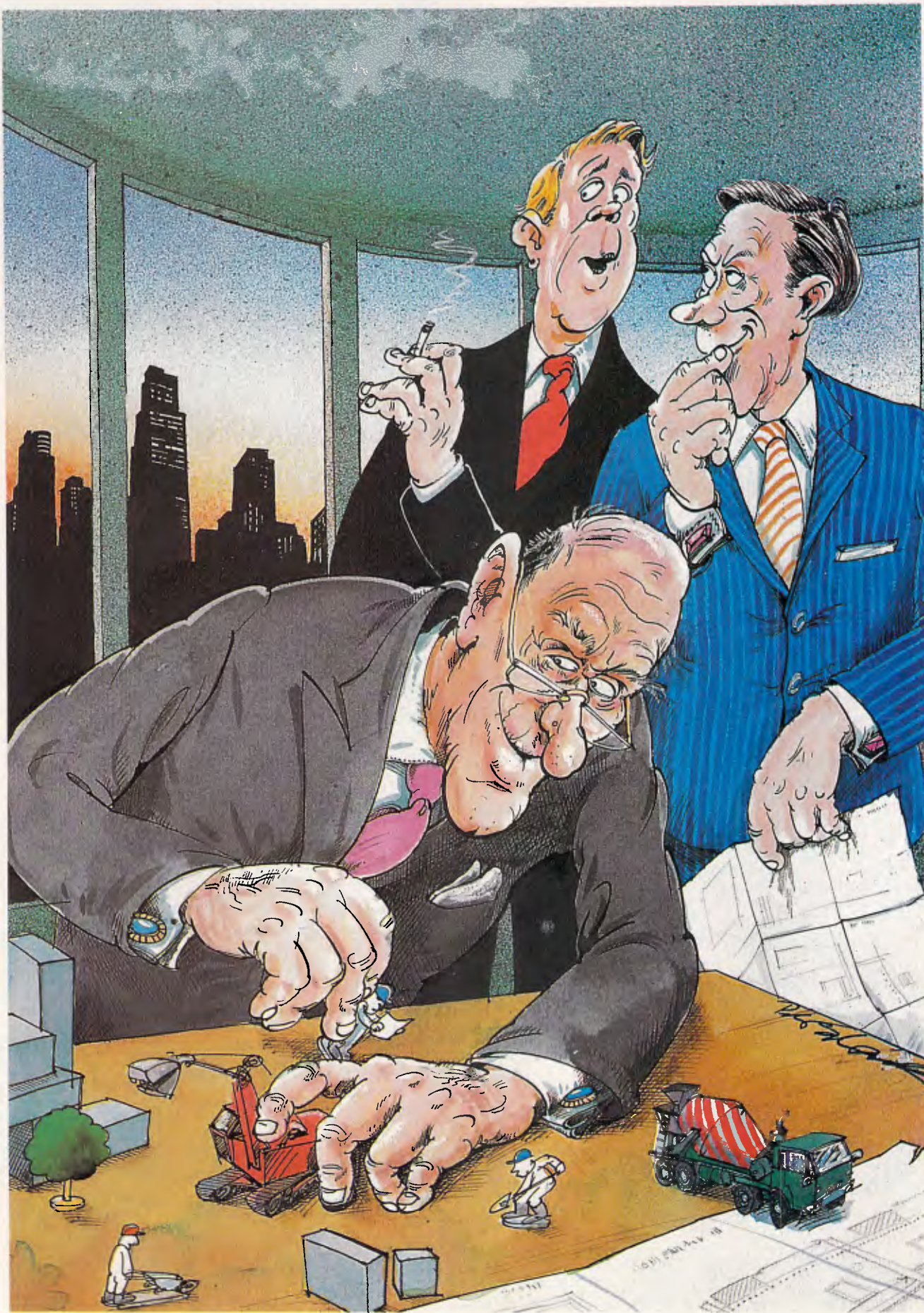


Figure 2: an example of a 'network' chart.





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peripherals for diagram output.

Then along came the micro packages. In general, micros do not have the capacity to handle very large projects — you will still need a mainframe for that, if only because the processing, storage and printing requirements are so immense. A large project may have thousands of activities.

But the micro packages have their uses, especially for small projects with up to a few hundred activities. The packages are typically aimed at the manager who has not thought of using computerised project management before, but has a micro and a software budget and an active curiosity.

Microsoft Project for the IBM PC is one of the friendlier project management packages around, and while not

especially powerful (it can typically handle up to 1000 activities per project with 640k of RAM), is easy to use and has all of the functions you are likely to need for small projects.

Apart from anything else, it is an excellent way to learn what project management is all about.

Figures 1 and 2 are screen dumps taken from Project. There are two screen display options, 'graphics' and 'non-graphics', and all of the screen dumps in this review were made with the screen switched to 'nongraphics'. In graphics screen mode, the IBM PCs block graphics characters are used to pretty up the display.

Options are what Project seems to be all about. The number of different screens (never mind all the reports), is

enough to confuse the first-time user. There are toggles and alternatives all the way through the package, which are designed to ensure that it will fit any user.

For example, the package is designed to work with project timescales anywhere from years to minutes. The scale on the Gantt chart can be expanded so that the screen shows the action over a five year period, or contracted so that it shows what happens over a single morning.

Costs

Costs are handled in project management systems by allocating resources to activities. For example, an activity such as "Write detailed project proposal" might have the Project Manager allocated to it full-time, plus half of the time of a word processor operator, plus a

Microsoft Project for the IBM PC is one of the friendlier project management packages around, and while not especially powerful is easy to use and has all of the functions you are likely to need for small projects.

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3 Recruiter	No limit	2355.00	Month	32.0	3478.14
4 WP operator	No limit	55.00	Day	37.5	2062.50
5 WP equipment	No limit	26.00	Day	35.0	910.00
6 Production VP	No limit	3700.00	Month	22.0	3756.89
7 Prototype artst	No limit	235.00	Day	30.0	7050.00
8 Graphic artst	No limit	115.00	Day	65.0	7475.00
9 Production sup	No limit	2000.00	Month	20.0	1846.15
10 Marketing VP	No limit	3700.00	Month	20.0	3415.38
11 Ad writer	No limit	250.00	Day	40.0	10000.00
12 Marketing mngr	No limit	2750.00	Month	3.5	444.22
13 Ad mngr	No limit	2400.00	Month	2.5	276.92
14 Paste-up artst	No limit	75.00	Day	7.5	562.50
15 PR mngr	No limit	1900.00	Month	5.0	438.46
Cost to complete: 51200.74 Total cost of project: 51200.74					
COMMAND: Activity Blank Calendar Delete Edit Goto Help Insert					
Move Options Print Quit Sort Transfer View					
Select option or type command letter					
RESOURCE Microsoft Project: DEVELOP.RES					

Figure 3: a cost breakdown of the total project.

Jul 31, 1986 12:00 AM Amount		August 1986					
		21	28	4	11	18	25
Draft press releas	1.0	2.0	*****	*****			
Prepare national a	1.0		*****	*****			
			*****	*****			
		1.5	*****	*****			
			*****	*****			
			*****	*****			
		1.0	*****	*****	*****	*****	
			*****	*****	*****	*****	
			*****	*****	*****	*****	
		0.5	*****	*****	*****	*****	
			*****	*****	*****	*****	
PEAK	2.0		*****	*****	*****	*****	
			*****	*****	*****	*****	
CAPACITY	No limit	0.0	*****	*****	*****	*****	

VIEW date: Jul 31, 1986 12:00 AM resource: WP equipment

Enter date

RESOURCE

Microsoft Project: DEVELOP.RES

Figure 4: a histogram display showing when the wordprocessing equipment will be in use.

third of the available time of a word processor terminal.

That activity would be shown as having three 'resources' allocated to it (Project Manager, WP Operator and WP equipment), each with its own cost per hour. Now with this information in the computer, a number of interesting things can be calculated: first, the total cost of the project. Fig 3 shows a Microsoft Project screen dump of that type of cost breakdown.

The next interesting thing is to find out just how much work a particular resource has on at any given time in the project. Fig 4 shows a histogram display from Project which shows how busy a particular resource (in this case, the word processor equipment), is over a particular period.

Now we come to the most powerful and useful part of a micro-based project management package — the ability to "what-if". When you find that the way you have arranged the project is going to give rise to the need for two word processors between the 28th of July and 11th of August 1986 (see Fig 4), what can you do about it?

Or in another case, what if the cost shown in Fig 3 is \$10,000 above your allocated budget? Or if the finish date shown in Fig 1 is a month after the project must be completed?

With a project management package, you can alter the timing and resource

Using a project management package to design a project is one thing — but they really come into their own once the project has actually begun.

allocation of any activity so that the project is arranged to come in on time, and on cost. For example, you can allocate more resources to critical activities (which are together known as the 'critical path'), to make them happen faster. Or you can use less resources over a longer period to reduce costs. Or you can reschedule activities to 'smooth out' the display in Fig 4.

After you have made the alterations, Project will recalculate the whole thing and show you what the effect is. Project management systems are very similar to spreadsheets in that they allow you to make all of your mistakes up front, and then iterate them away later.

Speaking of spreadsheets, Project has the ability to output a variety of cost breakdowns either as a printed report (see Fig 5), or as a file suitable for input to a database or spreadsheet package. This means that after you have made changes to the project schedule, you can find out immediately what effect it's going to have on your profit and loss statement over the next year.

Using a project management package to design a project is one thing — but they really come into their own once the project has actually begun. All too often, small project management packages are only used to plan projects, not to control them once they start. Yet that's the powerful thing about a micro-based package — it's online all of the time, and can be used to show you how the project is progressing, as well as telling you what's likely to go wrong.

As activities are actually started, you can enter the information into Project. If an activity takes longer than it was supposed to, that information can be fed in too. Not only will the finish date of the project change due to these inputs, the critical path may change. This might mean that activities you thought were of secondary importance when the project

started are actually going to hold the whole thing up if you don't do something about it.

Project has a special screen for showing you how the project is going. It allows you to save a copy of the project schedule at any point (usually, just before the start of the project, and at selected points along the schedule — which normally coincide with you getting

agreement from your boss to a change in schedule), and then to compare that 'forecast' with how the project is actually doing.

A sample of this type of 'analyse' screen is shown in Fig 6. It shows Gantt charts for both the forecast and the actual project schedules. By comparing the two, you should be able to see just where things went wrong.

Project: DEVELOP		Date: Mar 7, 1986 12:57 PM		
Time scale: Month				
Period ending	May 1, 1986	June 1, 1986	July 1, 1986	
1 Forecaster	\$1246.14	\$0.00	\$0.00	
2 Production mngr	\$2118.45	\$1765.37	\$2118.45	
3 Recruiter	\$1956.45	\$1521.68	\$0.00	
4 WP operator	\$412.50	\$0.00	\$0.00	
5 WP equipment	\$130.00	\$0.00	\$0.00	
6 Production VP	\$1366.15	\$1195.38	\$853.84	
7 Prototype artst	\$0.00	\$3525.00	\$3525.00	
8 Graphic artst	\$0.00	\$1725.00	\$1725.00	
9 Production sup	\$0.00	\$738.46	\$1107.69	
10 Marketing VP	\$0.00	\$0.00	\$170.76	
11 Ad writer	\$0.00	\$0.00	\$0.00	
12 Marketing mngr	\$0.00	\$0.00	\$0.00	
13 Ad mngr	\$0.00	\$0.00	\$0.00	
14 Paste-up artst	\$0.00	\$0.00	\$0.00	
15 PR mngr	\$0.00	\$0.00	\$0.00	
Total:	\$7229.69	\$10470.89	\$9500.74	

Figure 5: a monthly cost report.

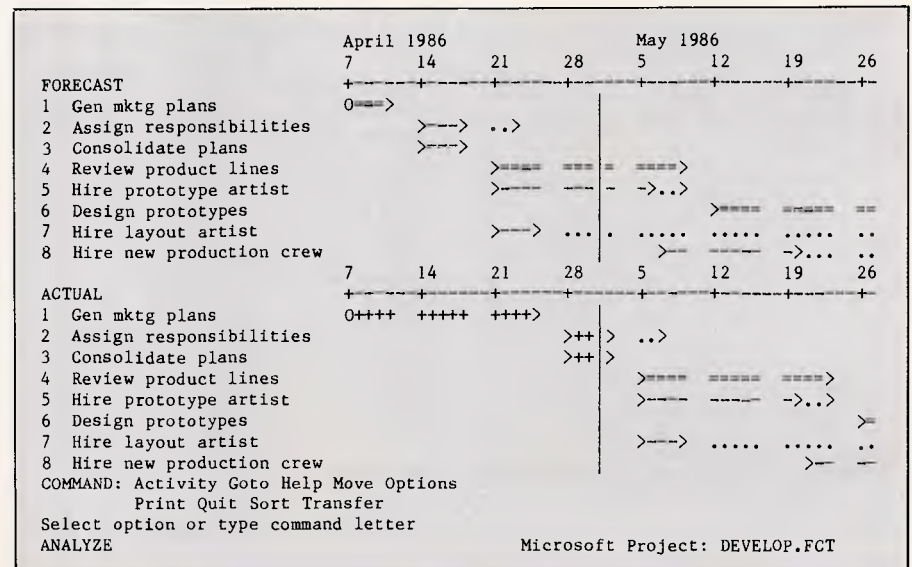


Figure 6: Gantt charts showing both the forecast and actual project schedules.

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I have observed Rule A and B. and my letter
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evaluation is *enclosed/may be
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Reports

Project produces a very large number of reports. Unfortunately there is not enough room to reproduce more than one of them here (Fig 5). There are reports on costs and cost variances, reports that show what's late and why, and an almost endless variety of sub-reports and alternatives.

One particularly nice feature of Project is that it gives you the opportunity to display any report to the screen so that you can see what you are getting before you commit it to paper.

Not only reports, but also network and Gantt charts can be printed, and in one of two styles. Depending on the type of printer you have, Project will either print the charts across the page using normal printer symbols (=, -, etc), splitting them up into sections that you can paste together later, or will produce a print of the graphics symbols actually used on the screen, and print them lengthways down continuous paper in 'banner' form. It's little additions like this that make Project a pleasure to use.

I said earlier that Project could handle around 1000 activities. In fact, the maximum is 999, and that's with the full 640k of RAM available. With 128k of

RAM it can only hold 200 activities.

The maximum number of 'predecessors' for any activity (a predecessor is an activity that has to be complete before another can start), is 16. Only eight resources can be allocated to each activity. A total of 255 resources can be held for each project.

Project lets you get round these limitations (and do a few other useful things), by allowing you to treat one whole project as a single activity in another, larger project. This means that you can, for example, put all of your company's current projects into one 'pot' and find out what the total resource requirement and cash flow is.

Documentation

The manual supplied with Project is one of the best I have seen for this sort of product. One particularly nice aspect of it is that it teaches project management principles as you go along. For example, it doesn't just tell you that you can optimise your project by doing such-and-such, it tells you what optimisation means and how best to go about it under different circumstances.

Along with the program disks you also get a training disk with a complete

computer-based learning course, which again is excellent.

A common problem with computer-based learning packages (and indeed with documentation in general), is that it is difficult to design them to deal with both the experienced and the naive user. However, the Project training disk manages this without problems. I tested it first as a naive user (going through the first part of the course as if I knew nothing about the subject), then skipped my way through the rest to pick up a knowledge of Project adequate to allow me to begin operating it in around half an hour.

Conclusion

Project is the best project management system for micros that I have seen (and I have been using its main competitor for a year or so now). For anyone who wants to play at being a project manager, it would be a very good purchase indeed.

However, remember that if you have very complex projects to manage, Project is not suitable. For that, I suggest you talk to someone about mainframe computers.

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Simulating synapses

Analysis of brain matter indicates one sure way of creating intelligence. But to what extent can the neural network approach be used by machines in either hardware or software? This article reviews the state of the art, and includes a generic Basic program to simulate a synapse network adapting to a particular task.

The challenge to create an intelligent machine leads inevitably back to the human brain. Researchers constantly utilise introspection to analyse how people solve various types of problems in order to plan how machines should approach similar situations. This research takes place on two levels, one being a high level which is goal oriented and revolves around methodologies, the other being more mechanical. This article concentrates on the latter.

Everyone knows that human brains seem to be intelligent, and the detailed structure of the brain is quite well understood by today's science. What is not understood is the overview picture of how things work in the mind. It's known, for example, exactly how the switches in brain matter operate, and how they can interconnect. Even the chemical reactions used to propagate information between switches is well understood. The missing link, however, is how ten billion of these simple switches can be arranged in such a way as to create something capable of thought.

Introspection

Our first step is to take a look at the switches found in brain matter. These switches are called neurons, as shown in figure one. A neuron is a hybrid digital/analogue device in that it contains a number of input lines (dendrites) and output lines (axons), and when the voltage supplied by its inputs passes a certain level, the outputs will fire. In electronics terms, this is known as a Schmitt trigger.

The human brain contains about twelve billion neurons, that is, 12,000,000,000 switches. Now this is

obviously a very large number, but is not beyond the reach of today's technology. One megabyte of memory can today be fabricated on a tiny chip of silicon, so a mere twelve thousand of similar density chips would seem to produce the required level of complexity.

The catch, however, is that the real power of the brain lies not in the number

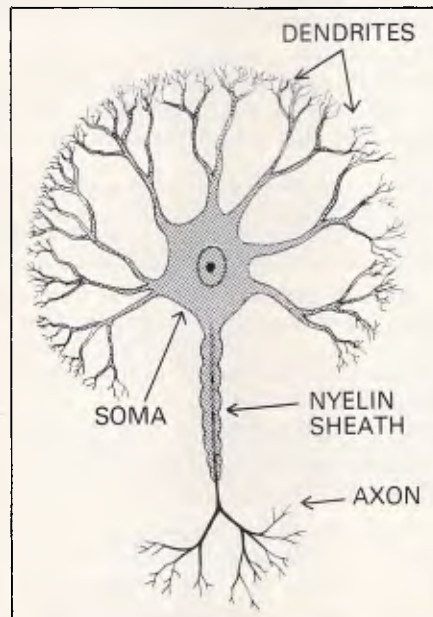


Figure one: the neuron

of neurons (although this is obviously important), but in the interconnections between the neurons. Current thinking is that the average neuron has between 5,000 and 60,000 dendrites, with about the same number of axons. This makes the total number of connections in the brain something like 720,000,000,000,000. This number is

far beyond today's technology, and dwarfs what is man's currently most complicated machine — the telephone system.

However, that degree of complexity need not be beyond tomorrow's technology, as in the last forty years digital hardware advances have reduced size by 10,000, reduced power consumption by 1,000, reduced cost by about 1,000 and increased speed by 10,000 (all estimates being conservative). It would only take another forty years of similar improvements to make a 720,000,000,000,000 connection machine conceivable.

It is interesting to compare the performance of a neuron with that of digital hardware. Can you imagine which wins?

Neurons operate by the potential difference between the inside and the outside of the cell body. The concentration of ions within the cell is controlled by "ion pumps" situated in the cell membrane. The fluid surrounding the cell is just filtered blood, and its ion concentration is regulated by ion controllers in the kidneys. By maintaining different ion concentrations, an electrical potential is created. The dendrites of a neuron interconnect with axons from other neurons, causing contact points called synapses. When a neuron receives sufficient voltage (usually about 10 millivolts) from its inputs (dendrites), the cell fires an impulse down its axon. The impulse propagates down the axon at a few feet per second, carried by fluctuating K⁺ and Na⁺ ions. The speed of the impulse varies with the axon width, and lengthy stretches of axon are coated in a myelin insulator to prevent signal loss and

enhance speed. The entire pulse lasts about 1 millisecond. The axon eventually leads to a dendrite of another neuron (or possibly the same one), and the process repeats itself. The entire process of a cell firing and transmitting its impulse to another cell takes several thousandths of a second, but because everything happens in parallel, quite complex results can occur.

It is interesting to note that although there are billions of interconnections, these connections very rarely change, and rarely are new ones created. Instead, the behaviour of the system is controlled by altering the signal strength and the thresholds required before an impulse is fired.

In comparison, current digital hardware operates in billionths of seconds and its signals are propagated at the speed of light, and so would appear to be about one million times faster. Why is it then that a person can recognise a face and react to it within half a second, whereas a computer cannot.

It's obvious that computers are good at things people find very difficult, and vice versa (this being the key to the successful application of technology), and indeed, the internal behaviours we have just examined seem to reflect this fact. Consider: to recognise a face in half a second, the brain has time to only perform about 100 steps. A computer would take millions of steps to achieve a similar result. If you processed information the way computers do, it would take you about one and one half hours to recognise your own name. If computers processed information the way people do, the average PC could recognise around one thousand faces per second, hear, speak, sing and tap dance all at the same time.

Unfortunately, simulation of the parallel nature of the brain in sequential computing hardware, even given the tremendous speeds available, provides very slow results and involves quite complex mathematics.

Simulation

Research has, however, been going on in this area. Figure two shows a sample section of interconnected switches, and can easily be represented in software.

Each circle in the diagram represents a neuron, separated into three categories representing the function of those switches: input, intermediate and output. Each neuron can be in either an 'on' or an 'off' state. The lines between the neurons represent the synapses, and each line carries its own weight, being the effect placed on the destination neuron if and only if the first neuron were

in an 'on' state. Each neuron has a 'threshold', which the sum of its inputs must exceed in order for the neuron to turn on. Figure two includes some sample weights, thresholds and states. It is a reasonably accurate model of a network of neurons, in that the degree of interconnectivity is high, the switching characteristics are correct, and only the weights and thresholds may be altered — the connections may not. What it does not encompass, however, are connections which branch directly from input to output, connections which feed back into the same switch, and connections from later stages of the network back in to earlier stages of the network.

Given these simplifications, we can consider the current state of each switch to be represented as a matrix, that is:

$A_{active} :$	$B_{active} :$	$C_{active} :$
[1]	[1]	[1]
[0]	[0]	[0]
[1]	[0]	
[0]		
[0]		

We can also consider the weights between the various levels of switches to be matrices:

$AB_{weight} :$	[+7 +2 -3 +1 -1]	$BC_{weight} :$	[+5 12 -7]
	[-4 0 +5 -2 +8]		[-2 +1 0]
	[+2 0 +2 -1 +3]		

The weights not shown in figure one have been filled in above for the sake of example. Finally, the thresholds at each level can also be represented as a matrix:

$B_{threshold} :$	[2 5 3]	$C_{threshold} :$	[4 1]
-------------------	---------	-------------------	-------

Now, to determine the result from a given set of inputs, we simply load the matrix A_{active} with the observed inputs, and perform a series of simple matrix multiplications, that is:

$$B_{active} = A_{active} \cdot AB_{weight}$$

This produces the weighted inputs felt by each switch in B. We then convert these weights to on/off states by moderating B_{active} by its threshold matrix, $B_{threshold}$, in such a way that for each element of the active matrix, the result is 'on' ('1') if and only if the weighted inputs exceed the corresponding entry in the threshold matrix. This results in B_{active} containing only ones and zeros, thereby indicating the state of each switch at that level.

The final result, C_{active} , can be determined the same way. All this is rather self evident, but the challenge is

for the network to *learn* a particular behaviour.

It is interesting that much research has been carried out in the area of learning in networks, and that respected publication, BYTE, recently ran an article on one approach developed by an assistant professor at an American university. After describing an approach he used as a foundation for his work, he stated, in part, "It has a remarkable property: if we keep cycling through all the pairs ... we will converge on a set of weights that causes the right output vector for every input vector, if any such set exists". Now, BYTE has a tendency not to back its more esoteric articles up by cold hard code, so it went without mention that if you actually tried to implement the algorithm as described, it also had the *remarkable*

property of simply not working! It just goes to show that you cannot afford to take these things on faith.

Learning in networks is achieved by showing the network a set of inputs, and also the required outputs that input should generate. The network adjusts its weights and thresholds in such a way

that input and output correspond correctly. The trick is this, not only should that input generate the correct output, but also all of the other input/output samples to which the network

has been exposed should continue to react correctly. Ideally, if there is some regularity to the input/output, the network should also react correctly to input which it has never before seen. The program presented at the end of this article performs in just this way, and will be discussed later.

Often it will not be possible to handle all inputs correctly given a finite complexity in the network. In these situations, intermediate levels of network must be introduced, as in figure two. It is here that the adjustments of weights become very difficult, as there

is no simple way of determining what results are desirable at the intermediate level in order to generate the correct output for all possible inputs. Obviously it is possible, as that's the way the brain works.

Getting back to our matrices, we see that the final result, C_{active} is the multiplication of A_{active} and AB_{weight} giving the intermediate result, B_{active} in turn multiplied by BC_{weight} . Of course, at each level, we moderate the activity results to simple '1's and '0's by using the threshold matrices. However (somewhat simplified), the result can be expressed as:

$$C_{active} = A_{active} \cdot AB_{weight} \cdot BC_{weight}$$

where each of the multiplications are matrix multiplications.

From this equation, we can see that if we have a set of inputs (A_{active}), and a corresponding set of required outputs (C_{active}), then the formula can be transposed to evaluate AB_{weight} and BC_{weight} . Initially this might seem like a simultaneous equation involving matrices, but it's not, as to solve the equation

using simultaneous methods, two equations would be required.

The only solution which can be generated is a set of AB_{weight} and BC_{weight} , all of which generate the correct output for the experienced input. As more input is experienced, the size of the set of candidate solutions becomes smaller, but at every point, any one of the solutions will generate the correct output for the experienced input. Now clearly this is pretty heavy mathematics, and that is why simulation on a sequential computing engine would be so slow, whereas implementation via parallel processing units would be much

faster.

Applications

Given that it is not currently feasible to build a network of 12,000,000,000 cells using current hardware technology, where can these techniques be applied?

One quite successful application

involved the parsing of natural English. One of the big problems with English is the ambiguity which occurs so often, but which people seem to process transparently. How often do you take pause to think when someone says to you "the train is running on time". This simple statement is highly ambiguous when the words are considered in isolation, for example "train" could mean tutor, aim, drill, a part of an evening gown, sequence, pull, or a long thing with carriages. Similarly, "running" could mean using its legs, fleeing, smuggling or operating.

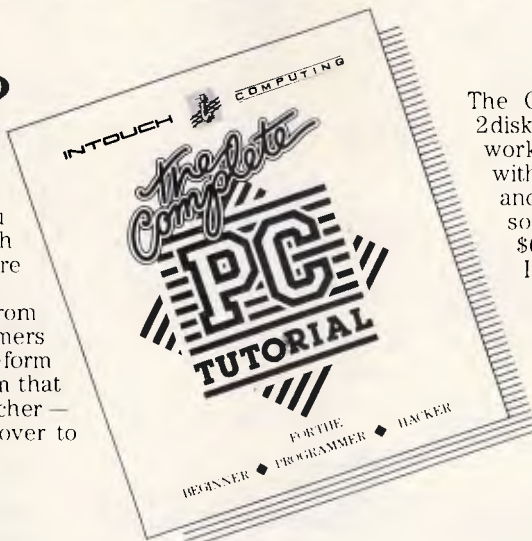
Much work has been undertaken, initially by Schank, constructing 'conceptual digraphs' to represent this type of knowledge unambiguously. For example, figure three illustrates the conceptual graph of the above sentence. While these graphs are useful in that they represent knowledge and facts independently of the way in which a phrase was worded, they do assume that any 'word level' ambiguity has been resolved. For example, the graph in figure three can handle the ambiguity of not knowing where the train is coming from or going to, but it does not represent the inherent ambiguity in the word "train". This is because once we

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are at the conceptual level, we already know that we're talking about a long thing with carriages — the actual words don't matter. Thus the original conceptual graph work was fine for representing knowledge, but lacked somewhat in terms of 'real word interfacing'.

The extensions made using network approaches build a conceptual graph and manage to do it from the 'raw word' level. The graph is built with all possible interpretations included for each word, as well as direct associations. For example, see figure four. As you can see, the various words lead through to their possible associations. Each link in the graph has an attached weight. Links with small circles on either end indicate that two concepts are mutually exclusive, and hence have an inhibitory (negative) weight. By iteratively processing the weighted links, and by drawing new weights from association tables, the network is able to determine the correct interpretation of each word in the sentence.

One interesting side effect of

iteratively processing the network, and the complex feedback which can develop, is that often in the course of processing, what seems like a certain interpretation will be discarded in favour of some other interpretation which seemed initially very unlikely. The fascinating aspect of this is that it corresponds to a large part of humour. One can assume that based on this work, it would be possible to build a program which could recognise certain forms of jokes.

Program

Figure seven shows a simple generic Basic program to illustrate the learning capacity of simulated neural networks.

It assumes a number of input sensors (neurons), each of which is linked (via synapses) to a series of output neurons. The on/off setting of the inputs are determined by an environment to which the network is exposed. The setting of the outputs is determined by normal synaptic rules, and their status can be read and displayed. Each inter-

connection has its own weight, each output has its own threshold, and each input and output may have its own on/off status.

Initially, each threshold takes on a value of '1', and each weight is set to zero. The network learns by being subjected to the environment stored in

The missing link, however, is how ten billion of these simple switches can be arranged in such a way as to create something capable of thought.

the DATA statements at line 1060, which contain sample inputs and the outputs which the network should generate for them.

As each input set is encountered, very simple rules are applied to make the network learn. Firstly, the input environment is loaded into the input neurons. The network is then allowed to generate the output for itself. After this, the output neurons are analysed one by one. Any neuron which turned itself on, but should really be off, has its threshold increased by one. For any which turned themselves off, but should have been on, the weight between that neuron and any of the active inputs is increased by one. Very simple, but quite effective.

The procedure above is repeated for all of the input/output sets the network is allowed to experience, and then the whole process is repeated until all of the input/output sets can be experienced without any changes being generated in the network.

If you processed information the way computers do, it would take you about one and one half hours to recognise your own name.

At this point we have a network which operates perfectly within the bounds of its experience. The program then allows you to enter inputs which the network has not before experienced, and see what output it generates. The results are quite surprising.

Before we all get too excited, however, it's worth pointing out that there will be some types of input/output sets for

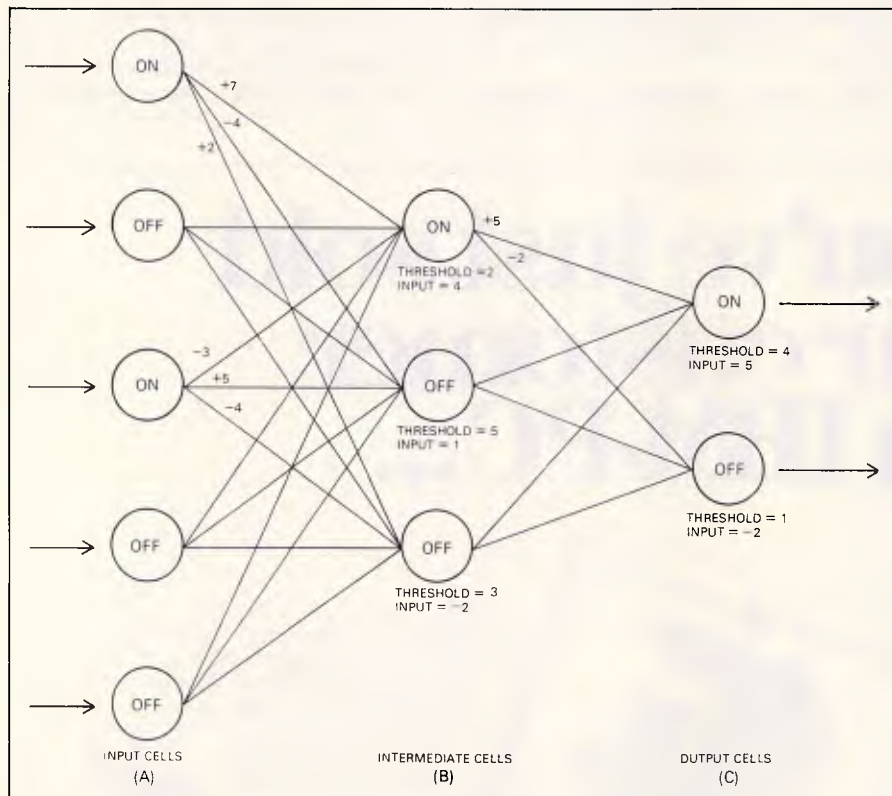


Figure two: a sample neural simulation network

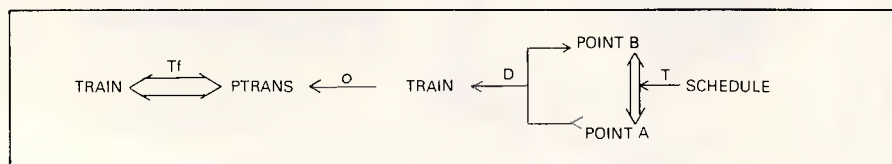


Figure three: conceptual digraph of the sentence "the train is running on time"

PROGRAMMING

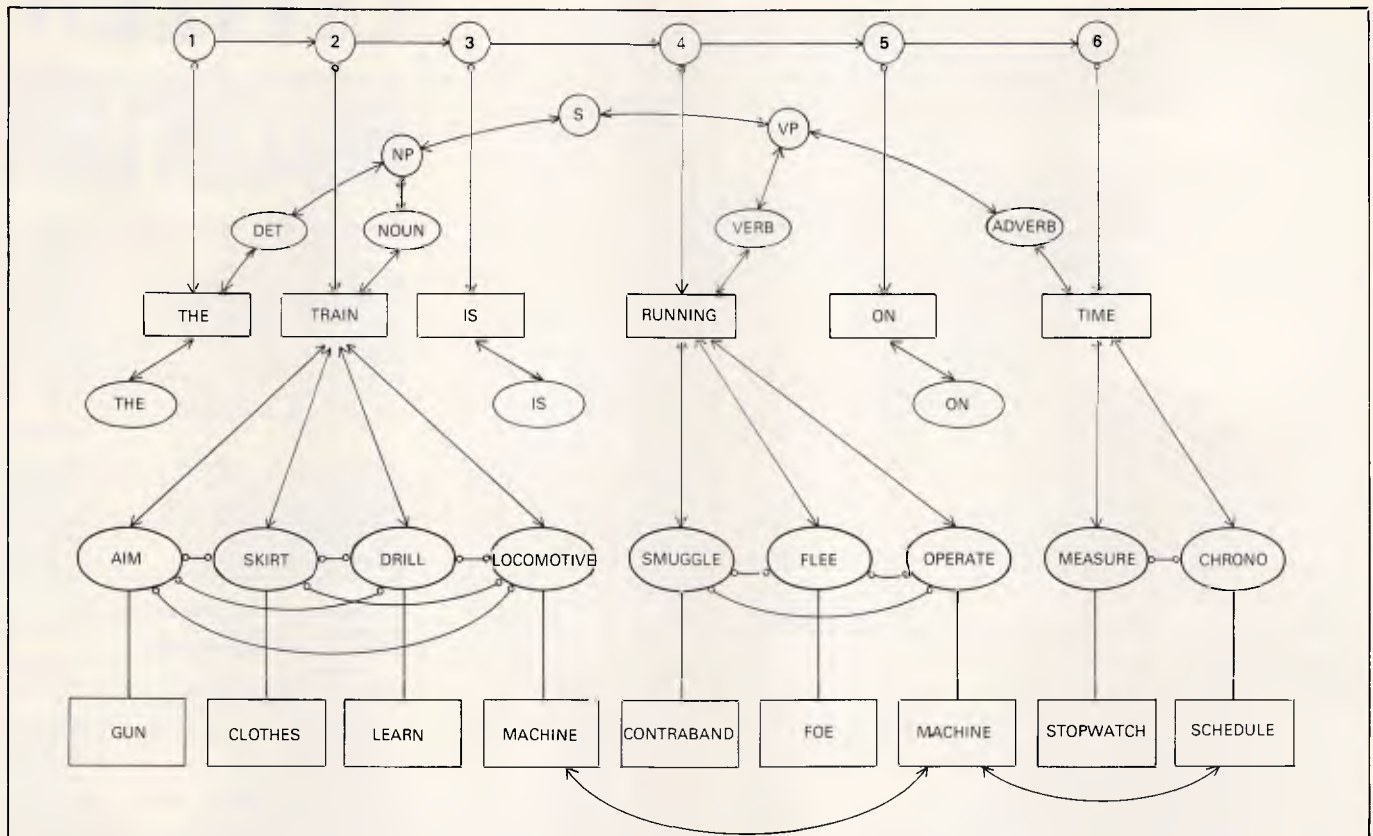


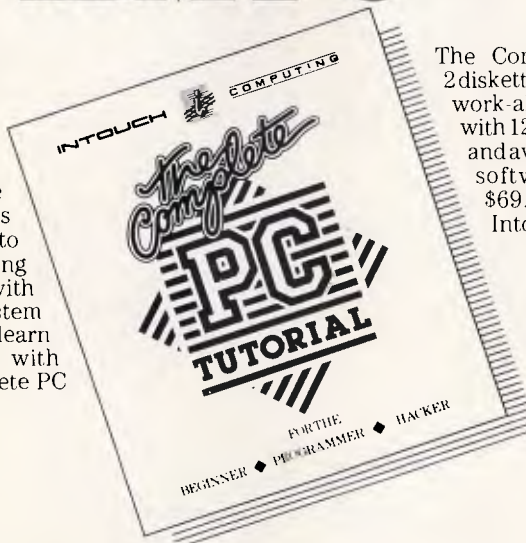
Figure four: interpretations of "the train is running on time"

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PROGRAMMING

```

1060
1070 Data to be Experienced
1080
1090
1100 DATA "0101", "0"
1110 DATA "0011", "0"
1120 DATA "0110", "0"
1130 DATA "1100", "0"
1140 DATA "0111", "1"
1150 DATA "1110", "1"
1160 DATA "1011", "1"
1170 DATA "END"

```

LEARNING PASS 1

```

=====
Data set 1 :
Data set 2 :
Data set 3 :
Data set 4 :
Data set 5 : Weight Weight Weight
Data set 6 :
Data set 7 :

```

LEARNING PASS 2

```

=====
Data set 1 : Threshold
Data set 2 : Threshold
Data set 3 :
Data set 4 :
Data set 5 :
Data set 6 : Weight Weight Weight
Data set 7 :

```

LEARNING PASS 3

```

=====
Data set 1 : Threshold
Data set 2 :
Data set 3 : Threshold
Data set 4 :
Data set 5 :
Data set 6 :
Data set 7 : Weight Weight Weight

```

LEARNING PASS 4

```

=====
Data set 1 :
Data set 2 : Threshold
Data set 3 :
Data set 4 :
Data set 5 :
Data set 6 :
Data set 7 :

```

LEARNING PASS 5

```

=====
Data set 1 :

```

Figure 5 cont...

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Williams DC5

PROGRAMMING

```

Data set 2 :
Data set 3 :
Data set 4 :
Data set 5 :
Data set 6 :
Data set 7 :

Network is now stable

Enter an input string, or END to exit ? 1001
Output is 0

Enter an input string, or END to exit ? 1101
Output is 1

Enter an input string, or END to exit ? 1110
Output is 1

Enter an input string, or END to exit ? 1111
Output is 1

Enter an input string, or END to exit ? 0000
Output is 0

Enter an input string, or END to exit ? 1010
Output is 0

Enter an input string, or END to exit ? 0111
Output is 1

Enter an input string, or END to exit ?

```

Figure five: example of the network learning to recognise when three or more units are active.

which a perfect network cannot be developed. This is because some relationships are sufficiently complex that they require intermediate levels in the network — which this simple program does not support. When an impossible situation is encountered, the program will find that every pass through the input/output sets requires changes to the network, and so will loop continuously. If this occurs, simply interrupt the program and try something a little more simple, or a little more regular.

The size of the inputs and outputs is determined by the variables initialised in lines 160 and 170, and these can be tailored to fit whatever experiments you like. The input/output sets are then defined in the DATA statements following line 1060, and are terminated by the word "END", as shown. Figure five shows a sample execution.

The input/output sets show a series of examples to the network in which a '1' is output if three or more '1's are present in the input, otherwise a zero is output. Notice how there are sixteen possible input/output combinations, but only seven are shown to the network. As the program executes, it shows what adjustments are being made on each pass through the input/output sets. On the fifth pass through, it has developed a network which perfectly models the data provided. The program then prompts the user to enter some other input pattern, and will show what output the network would generate. The impressive thing is that even though only seven cases were shown to the network, it manages to generate the correct output for all sixteen possible inputs.

Figure six shows another example, in

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```

1060
1070 Data to be Experienced
1080
1090
1100 DATA "0100", "10"
1110 DATA "0010", "01"
1120 DATA "0001", "01"
1130 DATA "1000", "10"
1140 DATA "END"

RUN

LEARNING PASS 1      LEARNING PASS 2
=====
Data set 1 : Weight  Data set 1 :
Data set 2 : Weight  Data set 2 :
Data set 3 : Weight  Data set 3 :
Data set 4 : Weight  Data set 4 :

Network is now stable

Enter an input string, or END to exit ? 1000
Output is 10

Enter an input string, or END to exit ? 1001
Output is 11

Enter an input string, or END to exit ? 0011
Output is 01

Enter an input string, or END to exit ? 0000
Output is 00

Enter an input string, or END to exit ? 1111
Output is 11

Enter an input string, or END to exit ? 0111
Output is 11

Enter an input string, or END to exit ?

```

Figure six: example of network indicating in which half of a four state input active states are present

```

100 Synapse Simulation Program
110 Australian Personal Computer Magazine
120
130 Initialise
140
150 DEFINT A-Z
160 INPUT.SIZE = 4
170 OUTPUT.SIZE = 1
180 ACTIVE = 1
190 INACTIVE = 0
200 TRUE = 1
210 FALSE = 0
220 DIM INPUT.WEIGHTS [INPUT.SIZE, OUTPUT.SIZE]
230 DIM INPUT.STATUS [INPUT.SIZE]
240 DIM OUTPUT.STATUS [OUTPUT.SIZE]
250 DIM OUTPUT.THRESHOLD[OUTPUT.SIZE]
260 FOR SCAN = 1 TO OUTPUT.SIZE
270 OUTPUT.THRESHOLD[SCAN] = 1
280 FOR SCAN2 = 1 TO INPUT.SIZE
290 INPUT.WEIGHTS[SCAN2, SCAN] = 0
300 NEXT SCAN2
310 NEXT SCAN
320
330 Main loop
340
350 CHANGING = FALSE
360 GOSUB 400
370 IF CHANGING = TRUE THEN GOTO 350
380 GOSUB 870
390 END
400
410 Run through supplied input stream once
420
430 PASS = PASS + 1
440 PRINT "LEARNING PASS "; PASS
450 PRINT "=====
460 RESTORE

```

run through the input
keep doing until stable
then ask for input

reset to start of data

MICROTEX 666

Still keying in programs? Forget it!
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telesoftware downloading on
Microtex 666 (page *6663#.)

which the output size has been increased to two (with a corresponding change to line 170). Here, our data tries to express that if either one of the left two input bits is on, then the left output bit should be turned on, and the same for the right two bits. Yet once again, it manages to build a network which generates the correct output under any circumstances. It even manages to handle the 'corner cases' in the most obvious fashion, in that if no input bits are turned on, then don't turn on any output bits. Similarly, if bits on both sides of the input data are on, then turn on both output bits.

Sure, it's not very hard to write programs to behave in these two ways. The point is, however, that here we have one program — *with no indication of what it is supposed to do*, apart from a series of examples, and it manages to build a network which not only deals with the examples correctly, but also recognises the underlying patterns involved, and can apply itself correctly to input data it has not before seen.

Clearly, the more examples you give it, the better it will be able to build a network which deals with unseen input data. However, it is interesting to experiment with how little information you can give it and still get 100% correct results. A little playing around indicates that the most important examples are those which lie on the dividing line between the output categories, in other words, best results are achieved if the subtleties are exemplified in detail, while the obvious needs very few examples.

There can be no doubt that the network exhibits a capacity to learn. The program shown here could easily be enhanced so that if the user supplies an input which the network incorrectly deals with, the user could tell the network the correct answer, and the network could assimilate this new information and integrate it with its existing knowledge.

Not having intermediate levels of 'neurons', the program has obvious and strict limitations. Unfortunately, introducing intermediate levels would change the program from one hundred lines to many pages in length, and so this enhancement is left to the reader.

Conclusion

This approach to artificial intelligence complements last month's article on mutational evolution quite well.

In mutational evolution, all links are of equal weight and it is the connections which are altered, according to random factors. The end result is something which can recognise patterns in a

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```

470 SET = 0
480 READ INPUT.PATTERN$
490 IF INPUT.PATTERN$ = "END" THEN GOTO 730
500 READ OUTPUT.PATTERN$
510 SET = SET + 1
520 PRINT "Data set "; SET ; " : ";
530 IF LEN(INPUT.PATTERN$) <> INPUT.SIZE THEN PRINT "invalid input: ";
    INPUT.PATTERN$ : STOP
540 IF LEN(OUTPUT.PATTERN$) <> OUTPUT.SIZE THEN PRINT "invalid output: ";
    OUTPUT.PATTERN$ : STOP
550
560 Set input states as specified
570
580 FOR SCAN= 1 TO INPUT.SIZE
590 IF MID$(INPUT.PATTERN$,SCAN,1) = "1" THEN INPUT.STATUS[SCAN] = ACTIVE
    ELSE INPUT.STATUS[SCAN] = INACTIVE
600 NEXT SCAN
610 GOSUB 750 generate outputs
620 FOR SCAN=1 TO OUTPUT.SIZE
630 IF OUTPUT.STATUS[SCAN] = VAL(MID$(OUTPUT.PATTERN$,SCAN,1)) THEN GOTO 700
640 CHANGING = TRUE
650 IF OUTPUT.STATUS[SCAN] = ACTIVE THEN
    OUTPUT.THRESHOLD[SCAN] = OUTPUT.THRESHOLD[SCAN] + 1 :
    PRINT " Threshold ";
660 IF OUTPUT.STATUS[SCAN] <> INACTIVE THEN GOTO 700
670 FOR SCAN2= 1 TO INPUT.SIZE
680 IF INPUT.STATUS[SCAN2] = ACTIVE THEN
    INPUT.WEIGHTS[SCAN2, SCAN] = INPUT.WEIGHTS[SCAN2,SCAN] + 1 :
    PRINT " Weight ";
690 NEXT SCAN2
700 NEXT SCAN
710 PRINT
720 GOTO 480
730 PRINT
740 RETURN
750
760 Determine output states
770
780 FOR SCAN = 1 TO OUTPUT.SIZE
790 STIMULUS = 0
800 FOR SCAN2 = 1 TO INPUT.SIZE
810 IF INPUT.STATUS[SCAN2] = ACTIVE THEN
    STIMULUS = STIMULUS + INPUT.WEIGHTS[SCAN2,SCAN]
820 NEXT SCAN2
830 OUTPUT.STATUS[SCAN] = INACTIVE
840 IF STIMULUS >= OUTPUT.THRESHOLD[SCAN] THEN OUTPUT.STATUS[SCAN] = ACTIVE
850 NEXT SCAN
860 RETURN
870
880 Network has stabilised - ask for input
890
900 PRINT
910 PRINT "Network is now stable"
920 PRINT
930 INPUT "Enter an input string, or END to exit "; INPUT.PATTERN$
940 IF INPUT.PATTERN$ = "" THEN RETURN
950 IF LEN(INPUT.PATTERN$) <> INPUT.SIZE THEN
    PRINT "Input must be "; INPUT.SIZE; " characters in length" :
    GOTO 930
960 FOR SCAN = 1 TO INPUT.SIZE
970 IF MID$(INPUT.PATTERN$,SCAN,1) = "1" THEN INPUT.STATUS[SCAN] = ACTIVE
    ELSE IF MID$(INPUT.PATTERN$,SCAN,1) = "0" THEN INPUT.STATUS[SCAN] = INACTIVE
    ELSE PRINT "Illegal character in input" : GOTO 930
980 NEXT SCAN
990 GOSUB 750 find output
1000 PRINT "Output is ";
1010 FOR SCAN = 1 TO OUTPUT.SIZE
1020 IF OUTPUT.STATUS[SCAN] = ACTIVE THEN PRINT "1"; ELSE PRINT "0";
1030 NEXT SCAN
1040 PRINT
1050 GOTO 920
1060
1070 Data to be Experienced:
1080 =====
1090
1100 DATA "0101", "0"
1110 DATA "0011", "0"
1120 DATA "0110", "0"
1130 DATA "1100", "0"
1140 DATA "0111", "1"
1150 DATA "1110", "1"
1160 DATA "1011", "1"
1170 DATA "END"

```

Figure 7: the program

progression of input symbols and extrapolate into the future.

The techniques shown here, by way of contrast, involve fixed connections, and alter the weights and thresholds according to simple and repeatable rules. The end result in this case is something which can classify its input, and can recognise patterns in its input so that it can classify input data it has never before seen. The other major feature of this

technique is that new knowledge can be assimilated at any time without disrupting existing knowledge.

While we're a long way from being able to put 12,000,000,000 of these nodes together, connect up legs, arms, eyes and a mouth and send it off to work in our place, nevertheless, the techniques provide true learning capacity which can be utilised in many other areas of computing.

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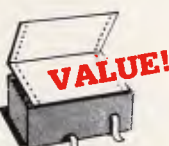
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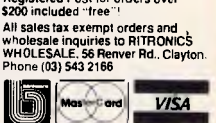


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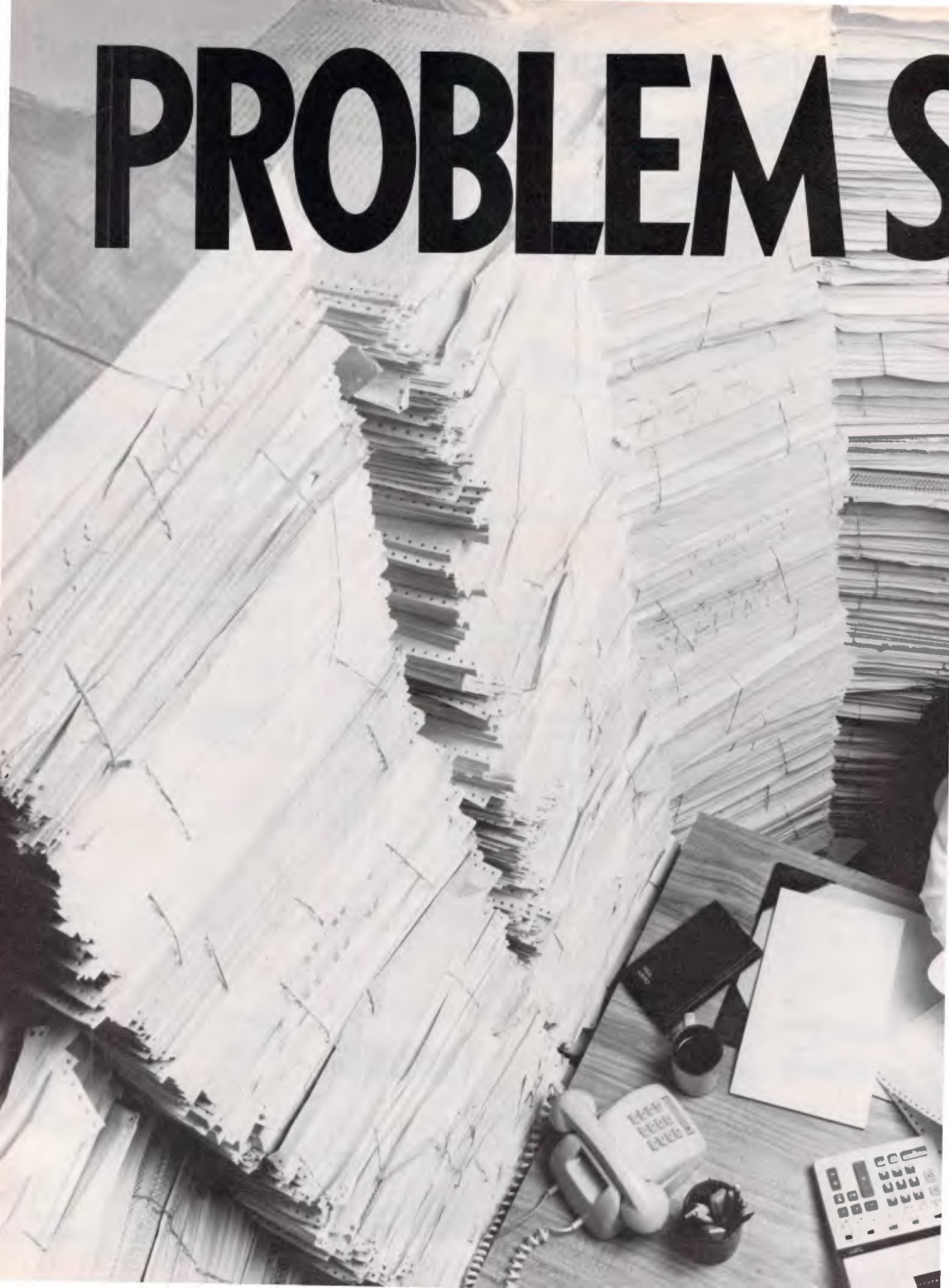
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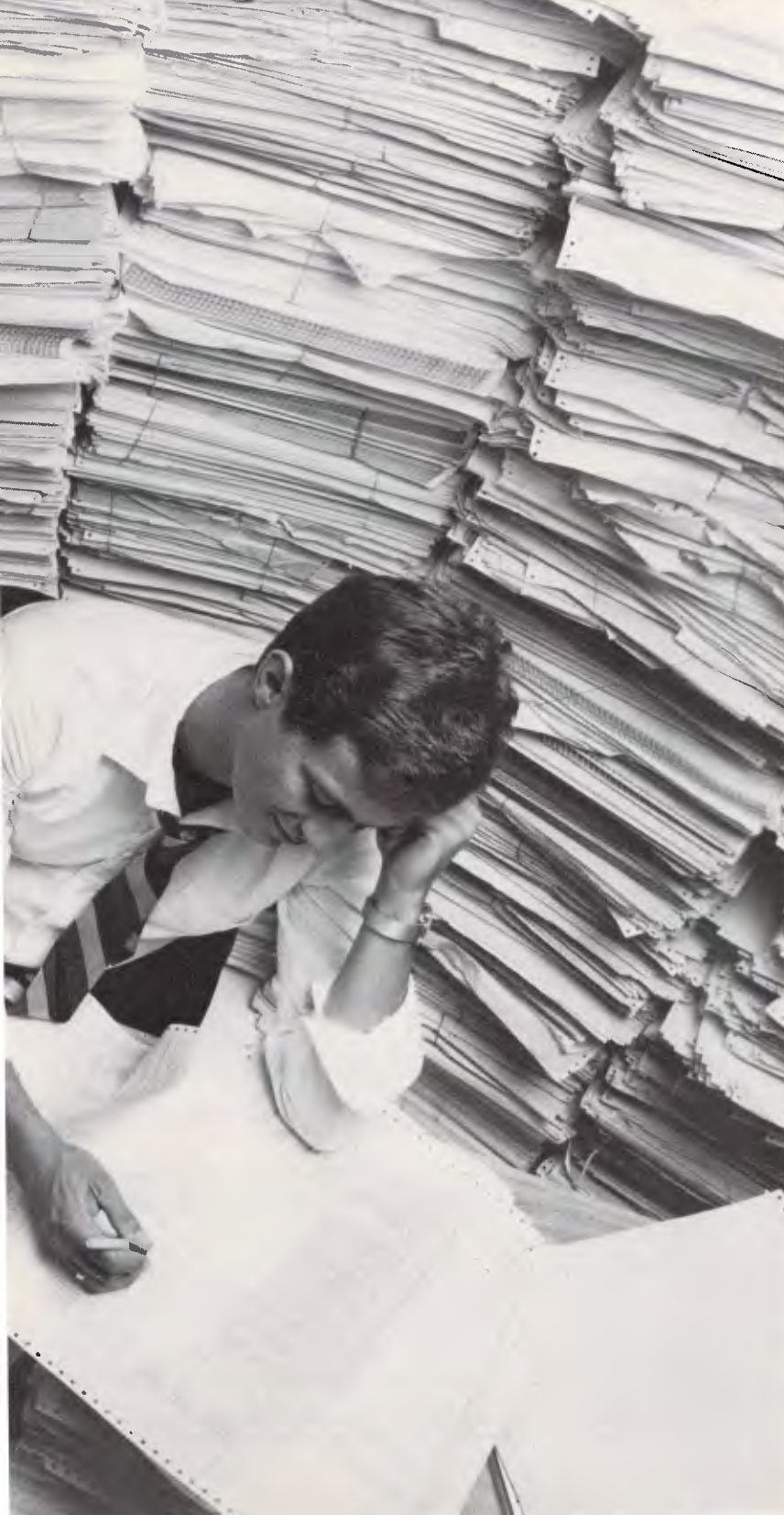


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Super class

The versatility of the ordinary spreadsheet program is revealed by MS Khaira, who gives two examples of SuperCalc as an aid to the teaching of mathematics and science.

One of the most interesting and useful items of software available for micros is the spreadsheet analysis program. It is offered by numerous companies under such names as VisiCalc, SuperCalc, Lotus 1-2-3, and so on. Although the term 'spreadsheet' has been made famous by the computer industry, the idea is fairly old. Edward Thomas Jones first invented the spreadsheet in the late 18th century, and sets of spreadsheets were sold in balance books. The East India Company was among Jones' first clients.

After the advent of the personal computer in the late 1970s, a stroke of genius by programmers Dan Bricklin and Bob Franckston gave rise to the electronic spreadsheet as we know it. Some even say that Bricklin and Franckston did for computing what Henry Ford did for the motor car.

Originally developed for large-scale analysis, the spreadsheet has found applications in the following areas:

- ★ Budgets
- ★ Checkbook register
- ★ Loan and mortgage payment calculations
- ★ Investment calculations
- ★ Stock price tracking
- ★ Profit and loss statements
- ★ Income tax calculations
- ★ Expense reports

However, spreadsheets also offer a little-known capability for performing a wide range of mathematical and scientific computations. It is these capabilities that form a basis for the use of spreadsheets in the classroom for teaching mathematics and science.

What is a spreadsheet?

A spreadsheet is an electronic replacement for the accountant's traditional computational modelling tools — the columnar scratch pad, the pencil and the calculator. It makes the computer as easy to use as a calculator, while giving far more power than a

calculator does. Like an ordinary computer program, data can be saved to disk from a spreadsheet and then reloaded at subsequent times.

The basic format of a spreadsheet is a display of a grid of columns and rows, typically identified by letters and numbers as shown in Fig 1. The columns (the width of which can be varied by the user) and the rows define a 'cell' which is named by the letter and number of the intersecting column and row; for example, B20, K5. Each of the cells can be used for three basic purposes:

- ★ To display a label — that is, alphanumeric information.
- ★ To store and display a number (in

integer, floating point, or exponential notation).

★ To display the output from a formula — that is, an arithmetic expression containing algebraic and logic operators and functions found in most high-level languages.

The last use is the most interesting and important, and much of the power of spreadsheets comes from the capability of such formulae to use as variables the numerical contents of any of the other cells. The variables are simply identified by the names of the cell locations. As an example of a spreadsheet, consider Fig 2. In this spreadsheet, columns A and C are used for labels; cells B4-B6 and D4-

	A	B	C	AA	BB	CC
1						
2						
3						
4						

Fig 1 The basic format of a spreadsheet

	A	B	C	D
1:Example				
2: Number A		Input		
3: Number B		Input		
4: (A * B)		B4=B2*B3	SQRT (A * B)	D4=SQRT(B4)
5: (A/B)		B5=B2/B3	SQRT(A/B)	D5=SQRT(B5)
6: (A + B)		B6=B2+B3	SQRT(A + B)	D6=SQRT(B6)
7:				
	Labels	Formulae	Labels	Formulae

Fig 2 An example spreadsheet

	A	B	C	D
1:Example				
2: Number A		4.5000		
3: Number B		2.5000		
4: (A * B)		11.2500	SQRT(A * B)	3.3541
5: (A/B)		1.8000	SQRT(A/B)	1.3416
6: (A + B)		7.0000	SQRT(A + B)	2.6458
7:				

Fig 3 Spreadsheet calculation

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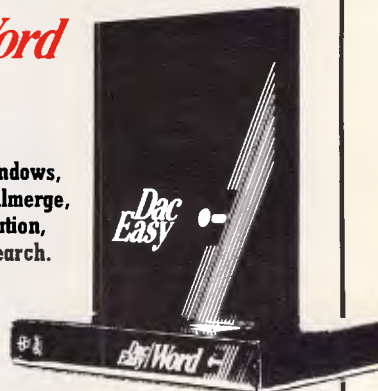
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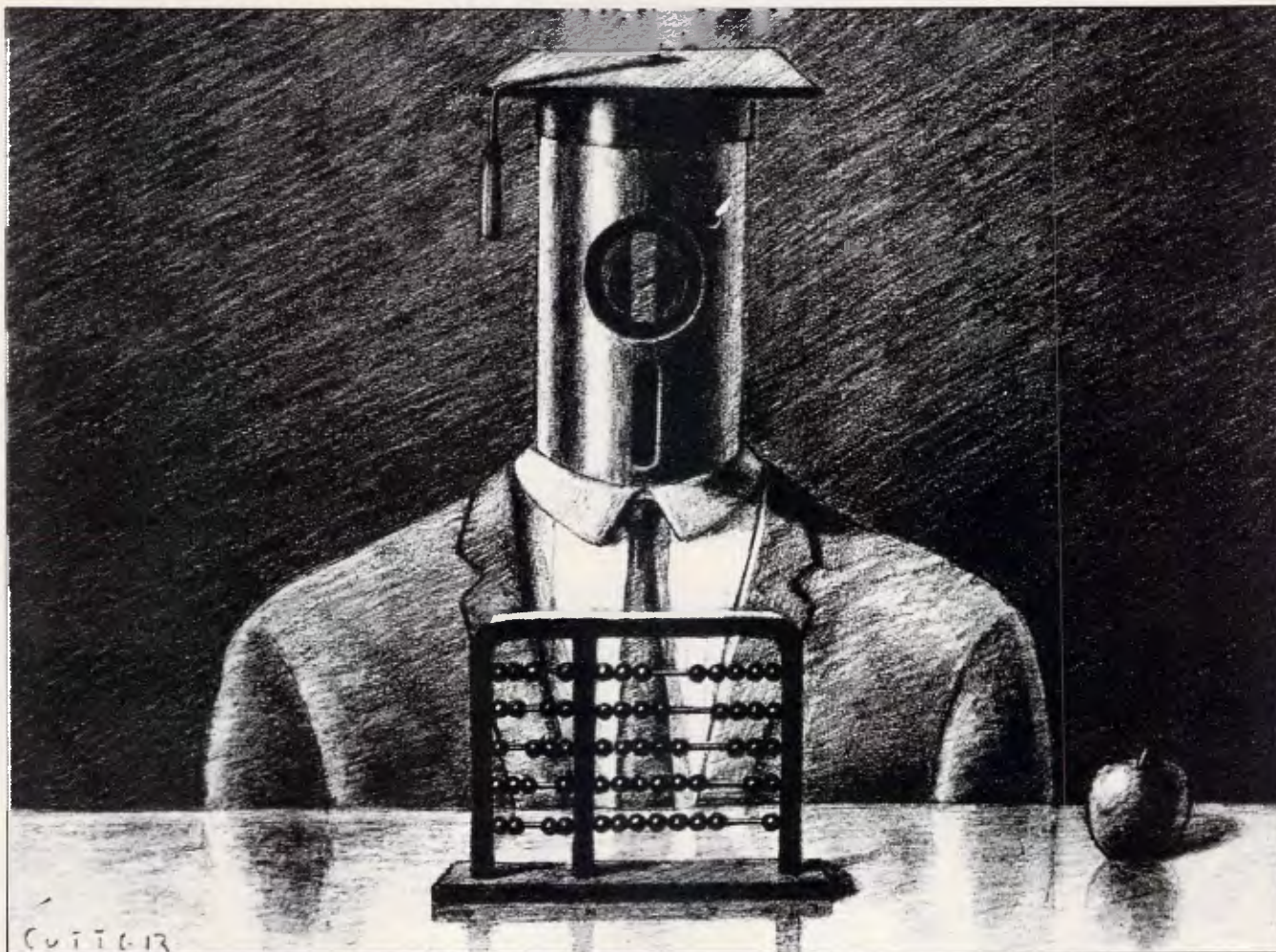
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D6 are used to make various computations on the numbers.

In a spreadsheet such as that shown in Fig 2, a most important property of the program is its characteristic of recalculating the value of every cell defined by a formula whenever a change is made in any of the cells in which numerical data is stored. For example, if the number 4.5 is stored as the number A (cell B2) and 2.5 is stored as B (cell B3), the computer screen will instantaneously appear as shown in Fig 3. If the number A is changed, the display will again change to show the results using the new number A.

The popularity of spreadsheets has been enormously enhanced by the capability of the spreadsheet program to immediately repeat a large number of calculations in response to change in its input. This capability can be referred to as a 'what-if' function, as it makes it easy to ask questions such as: 'What if the interest rate is increased from 7.8 per cent to 8.2 per cent; how is the monthly mortgage payment affected?' This what-if capability has enormous teaching applications.

Spreadsheets typically have many features designed to make them user-friendly. One such feature is formula

	A	B	C	D	E	F	G
1:							
2:							
3:	<i>Solving a Set of 3 Equations in 3 Unknowns</i>						
4:	=====						
5:							
6:	<i>The Equations</i>						
7:							
8:	$3X + 21Y + 3Z = -30$						
9:							
10:	$X + 2Y - 2Z = 7$						
11:							
12:	$2X + 8Y - Z = 2$						
13:							
14:							
15:	<i>The Augmented Matrix</i>						
16:							
17:	3	21	3	-30			
18:	1	2	-2	7			
19:	2	8	-1	-2			
21:							

Fig 4 Entering values in matrix form

	A	B	C	D	E	F	G
14:							
15:	<i>The Augmented Matrix</i>						
16:							
17:	3	21	3	-30			
18:	1	2	-2	7			
19:	2	8	-1	-2			
20:							

Cont...

replication, which is specially useful when large numbers of formulae are to be used. It is applicable to the case where formulae which have an identical form but use different variables must be repeated over a large section of the spreadsheet. The feature makes it possible to enter the formula once only and then to 'replicate' it over the rest of the spreadsheet. For example, in Fig 2, to install the formula in cells D4-D6, the user would simply enter the formula in cell D4 and then instruct the spreadsheet to replicate the formula through cells D5 and D6. The variable names are automatically adjusted in the process.

Other user-friendly features include the ability to delete and insert columns and/or rows while adjusting all formulae accordingly. The user can 'format' the layout of the spreadsheet.

SuperCalc

The examples I use in this article specifically relate to SuperCalc. The concepts are, however, easily applied to virtually any spreadsheet program with only minor modifications. SuperCalc has 63 columns (designated by letters A-Z, AA-AZ and BA-BK) and 254 rows (designated by numbers 1-254); this means that a fully utilised spreadsheet will have 16002 cells. Column widths may be adjusted individually up to 127 characters. Text may contain up to 115 characters, while formulae may contain as many as 116 characters.

To generate a spreadsheet display, SuperCalc is first loaded. Next, a specified sequence of instructions is entered into the spreadsheet followed by the relevant data. SuperCalc combines the data and the instructions to produce a spreadsheet with the desired answers.

Simultaneous equations

To enter alphabetic information, such as the title of your problem, type a quotation mark followed by the information. To enter the information into the active cell (where the bar cursor is placed), press Return. We begin by giving a title to our problem: Solving a Set of three Equations in three Unknowns.

The three equations are entered in the same manner. Make A6 the active cell and type 'The Equations'. Then type "3X + 21Y + 3Z = -30 into A8, "X + 2Y - 2Z = 7 into A10, and "2X + 8Y - Z = -2 into A12. Numbers can now be entered directly without quotes. Enter the coefficients of the unknowns, and

Figure continued from previous page

```

21:
22: Put a 1 in the a(1,1) position
23:
24: A17/A17B/17/A17 C17/A17 D17/A17
25: A18 B18 C18 D18
26: A19 B19 C19 D19
27:
    
```

Fig 5 The simple formula used to generate values

	A	B	C	D	E	F	G
21:							
22:	Put a 1 in the a(1,1) position						
23:							
24:	1	7	1	-10			
25:	1	2	-2	7			
26:	2	8	-1	-2			
27:							

Fig 6

	A	B	C	D
27:				
28:	Put zeroes in column 1			
29:				
30:	A24	B24	C24	D24
31:	A25-A25*A24	B25-A25*B24	C25-A25*C24	D25-A25*D24
32:	A26-A26*A24	B26-A26*B24	C26-A26*C24	D26-A26*D24
33:				

Fig 7

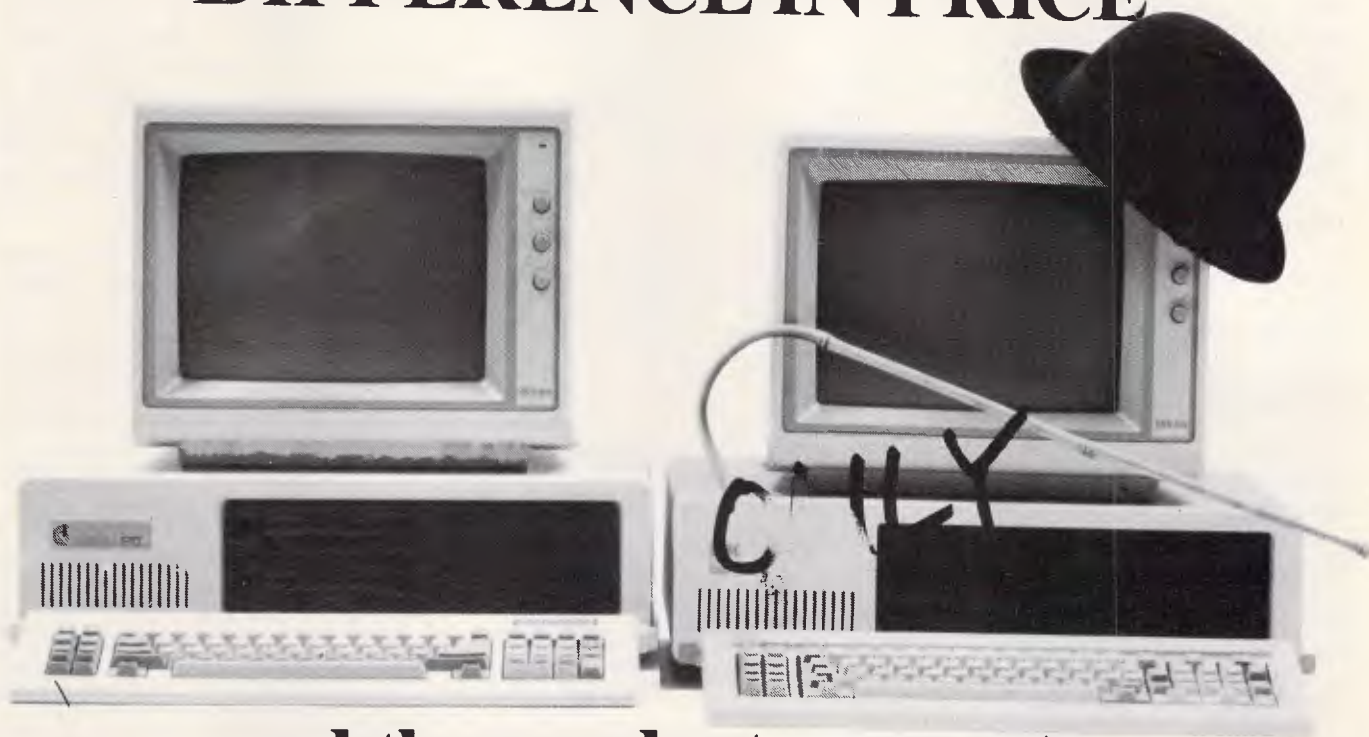
	A	B	C	D	E	F	G
27:							
28:	Put zeroes in column 1						
29:							
30:	1	7	1	-10			
31:	0	-5	-3	17			
32:	0	-6	-3	18			
33:							

Fig 8

	A	B	C	D	E	F	G
33:							
34:	Put a 1 in the a(2,2) position						
35:							
36:	1	7	1	-10			
37:	0	1	.6	-3.4			
38:	0	-6	-3	18			
39:							
40:	Put zeroes in column 2						
41:							
42:	1	0	-3.2	13.8			
43:	0	1	.6	-3.4			
44:	0	0	.6	-2.4			
45:							
46:	Put a 1 in the a(3,3) position						
47:							
48:	1	0	-3.2	13.8			
49:	0	1	.6	-3.4			
50:	0	0	1	-4			
51:							
52:	Put zeroes in column 3						
53:							
54:	1	0	0	-1			
55:	0	1	0	-1			
56:	0	0	1	-4			
57:							

Cont...

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Figure continued from previous page

58:Solution set is:

59:

60:X = 1

61:Y = -1

62:Z = -4

Fig 9

	A	B	C	D
33:				
34:Put a 1 in the a(2,2) position				
35:				
36:A30	B30	C30	D30	
37:A31/B31	B31/B31	C31/B31	D31/B31	
38:A32	B32	C32	D32	
39:				
40:Put zeroes in column 2				
41:				
42:A36-B36*A37	B36-B36*B37	C36-B36*C37	D36-B36*D37	
43:A37	B37	C37	D37	
44:A38-B38*A37	B38-B38*B37	C38-B38*C37	D38-B38*D37	
45:				
46:Put a 1 in the a(3,3) position				
47:				
48:A42	B42	C42	D42	
49:A43	B43	C43	D43	
50:A44/C44	B44/C44	C44/C44	D44/C44	
51:				
52:Put zeroes in column 3				
53:				
54:A48-C48*A50	B48-C48*B50	C48-C48*C50	D48-C48*D50	
55:A49-C49*A50	B49-C49*B50	C49-C49*D50	D49-C49*D50	
56:A50	B50	C50	D50	
57:				
58:Solution set is:				
59:				
60:X =	D54			
61:Y =	D55			
62:Z =	D56			

Fig 10

	A	B	C	D	E
1:	a	b	c	d	Out
2:					
3:	1	1	1	1	OR(AND(B3,C3),AND(D3,NOT(E3)))
4:	1	1	1	0	OR (AND(B4,C4),AND(D4,NOT(E4)))
5:	1	1	0	1	OR(AND(B5,C5),AND(D5,NOT(E5)))
6:	1	1	0	0	OR(AND(B6,C6),AND(D6,NOT(E6)))
7:	1	0	1	1	OR(AND(B7,C7),AND(D7,NOT(E7)))
8:	1	0	1	0	OR(AND(B8,C8),AND(D8,NOT(E8)))
9:	1	0	0	1	OR(AND(B9,C9),AND (D9,NOT(E9)))
10:	1	0	0	0	OR(AND(B10,C10),AND(D10,NOT(E10)))
11:	0	1	1	1	OR(AND(B11,C11),AND(D11,NOT(E11)))
12:	0	1	1	0	OR(AND(B12,C12),AND(D12,NOT(E12)))
13:	0	1	0	1	OR(AND(B13,C13),AND(D13,NOT(E13)))
14:	0	1	0	0	OR(AND(B14,C14),AND(D14,NOT(E14)))
15:	0	0	1	1	OR(AND(B15,C15),AND(D15,NOT(E15)))
16:	0	0	1	0	OR(AND(B16,C16),AND(D16,NOT(E16)))
17:	0	0	0	1	OR(AND(B17,C17),AND(D17,NOT(E17)))
18:	0	0	0	0	OR(AND(B18,C18),AND(D18,NOT(E18)))

Fig 11 Spreadsheet for a logic expression

values from the right-hand sides of the equations in matrix form as shown in Fig 4. In addition to text and numbers, formulae and transformations can also be entered.

The method used to solve the equations is the Gauss-Jordan elimination method. In this method, all but one of the unknowns are successively eliminated from each of the equations until what remains is a series of equations, each in a single unknown. Elementary row operations are used to reduce the matrix of coefficients to an identity matrix. The effect of this sequence of transformations on the augmented matrix is to transform the augmented column vector into the solution vector.

To facilitate the elementary row transformations for computer solution, the diagonal element in a particular row is reduced to one. This row is then used to reduce the other elements in the same column to zero. The procedure is repeated until the matrix of coefficients has been reduced to an identity matrix and the augmented column vector reduced to the solution vector.

Starting with row one the entire row is

	A	B	C	D	E
1:	a	b	c	d	Out
2:					
3:	1	1	1	1	1
4:	1	1	1	0	1
5:	1	1	0	1	1
6:	1	1	0	0	1
7:	1	0	1	1	0
8:	1	0	1	0	1
9:	1	0	0	1	0
10:	1	0	0	0	0
11:	0	1	1	1	0
12:	0	1	1	0	1
13:	0	1	0	1	0
14:	0	1	0	0	0
15:	0	0	1	1	0
16:	0	0	1	0	1
17:	0	0	0	1	0
18:	0	0	0	0	0

Fig 12 Spreadsheet truth table for the logic expression

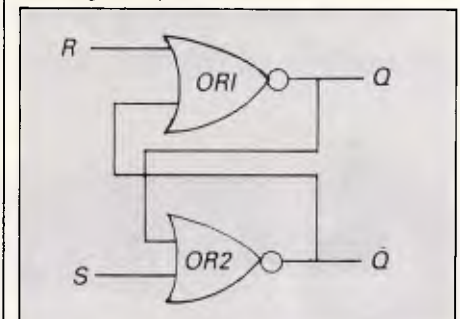


Fig 13 An S-R flip-flop

divided by the value of a (1,1) element, which in our example is 1, as in row 24 of the spreadsheet in Fig 6. The simple formulae used to generate the values in Fig 6 appear in Fig 5.

The other elements in column one are set equal to zero by an elementary row transformation. The elements in the first row are multiplied by the additive inverse of the first element in the row being transformed, which in this example is -1. These elements in the first row are added to the elements in the row being transformed, the effect of which is to place a 0 in the a(i,1) position (where i is the number of the row). This procedure, which yields the formulae in rows 31 and 32 of the spreadsheet in Fig 7, is repeated for every element in the first column as in Fig 8.

In transforming the a(2,1) element, for example, we multiply the a(1,1) element by a(2,1), subtract, and get a difference of zero. We then repeat the transformation on every element in the

second row. This transformation can be written as $a(2,j) - a(2,1) \times a(1,j)$ where j is the number of the column. This formula must be replicated for all elements in the second row — that is, for j = 1 to 3. This can be done using the Replicate command.

The other columns and rows in the matrix are dealt with in a similar fashion. Fig 9 shows the applicable formulae, and Fig 10 shows the results of the manipulations.

Logic networks

Most spreadsheets provide formulae which implement logic operations. For example, the expression $B6 = \text{AND}(B1, B2)$ will store a 1 in cell B6 if the cells B1 and B2 have a value of 1; otherwise a 0 will be stored in B6. Any of the standard logic functions such as OR, NOT, and so on, may also be used. This capability can be applied to a wide variety of digital systems.

As a first example of such an application, consider the construction of a truth table. A spreadsheet to perform such an operation for the logic expression $(A.B) + (C.D)$ is shown in Fig 11. In this spreadsheet, rows 3-18 have been used to enter the various combinations of the values of the logic variables A, B, C and D. The aforementioned formula has been replicated through these rows. The output is shown in Fig 12.

As a second example of the use of a spreadsheet to demonstrate the properties of logic networks, consider the logic diagram for an S-R (set-reset) flip-flop, a circuit commonly encountered in digital applications. One realisation for such a circuit is shown in Fig 13, which consists of a pair of NOR gates. The operation of the flip-flop is shown in Fig 14. Here, row (a) shows the conditions when the inputs R and S are low (off, namely 0) and the output is high (on, namely 1); thus, NOT-Q (Q) is low. In line (b), the effect of putting R high and therefore resetting the output Q low is illustrated. As shown in line (c), the output Q stays low after R is returned to its low state. In line (d), the effect of putting S high, and setting the output Q high, is illustrated. As shown in line (e), the output Q stays high even after S is set to its low state.

In implementing the operation of an S-R flip-flop as described, if the particular spreadsheet used permits feedback reference (circular reference), then the logic operations shown in Fig 14 are

	R	S	OR1	OR1	Q	OR2	OR2	Q
a)	0	0	0	1	1	1	0	0
b)	1	0	1	0	0	0	1	1
c)	0	0	1	0	0	0	1	1
d)	0	1	0	1	1	1	0	0
e)	0	0	0	1	1	1	0	0

Fig 14 The operation of an S-R flip-flop

S-R flip-flop		S-R flip-flop	
Not-Q (Manual)	0	Not-Q (Manual)	0
R (Reset)	0	R (Reset)	1
S (Set)	0	S (Set)	0
(temp Q)	1	(temp Q)	0
Not-Q	0	Not-Q	1
Q (Output)	1	Q (Output)	0
(a)		(b)	
S-R flip-flop		S-R flip-flop	
Not-Q (Manual)	1	Not-Q (Manual)	1
R (Reset)	1	R (Reset)	0
S (Set)	0	S (Set)	0
(temp Q)	0	(temp Q)	0
Not-Q	1	Not-Q	1
Q (Output)	0	Q (Output)	0
(c)		(d)	
S-R flip-flop		S-R flip-flop	
Not-Q (Manual)	1	Not-Q (Manual)	0
R (Reset)	0	R (Reset)	0
S (Set)	1	S (Set)	1
(temp Q)	0	(temp Q)	1
Not-Q	0	Not-Q	0
Q (Output)	1	Q (Output)	1
(e)		(f)	

Fig 17 Operation of an S-R flip-flop

A	B
1: S-R flip-flop	
2:	
3: R (Reset)	0
4: S (Set)	0
5:	
6: Q	NOT(OR(B3,B7))
7: Not-Q	NOT(OR(B4,B6))

Fig 15 Spreadsheet for an S-R flip-flop (requires feedback reference)

A	B
1: S-R flip-flop	
2:	
3: Not-Q (Manual)	0
4: R (Reset)	0
5: S (Set)	0
6:	
7: (temp Q)	NOT(OR(B3,B4))
8: Not-Q	NOT(OR(B7,B5))
9: Q (Output)	NOT(OR(B8,B4))

Fig 16 Spreadsheet for an S-R flip-flop (does not require feedback reference)

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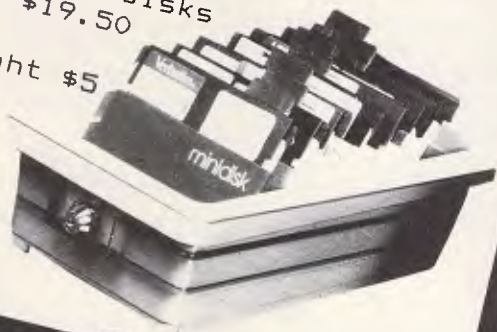
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easily implemented. A spreadsheet for doing this is shown in Fig 15. Most spreadsheets, however, do not permit this, but this deficiency can be overcome simply by assuming an output for the variable which is used as the feedback reference, in this case the variable NOT-Q, and determining the values of Q and NOT-Q based on the assumption. If the calculated value of NOT-Q turns out to be the opposite of the assumed value, then the assumed value is changed and the spreadsheet recalculated. A spreadsheet based on this type of implementation is shown in Fig 16, and the complete operation of the simulated S-R flip-flop is shown in Fig 17.

The principle can easily be extended to a clocked S-R flip-flop. Finally, an advanced application of the logic capabilities of spreadsheets is to use sections of the spreadsheet to simulate complete ICs and then use the formula capability to provide the desired pin-to-pin wiring.

Practical applications of spreadsheets

I have provided two possible applications of the spreadsheet as a

teaching aid here. I leave it up to the reader to motivate himself to explore and find additional uses of this powerful computation tool.

Specific areas in which spreadsheets can be used include algebra including linear, quadratic and general polynomial functions; matrices and simultaneous equations; and, in calculus, spreadsheets can be used to study Newton's Method for solving non-linear equations,

applications of the Trapezoidal Rule, Simpson's Rule, and other numerical integration algorithms. Techniques for solving differential equations is another area. In physics, series resonance in AC circuits and loop analysis of DC circuits can be explored. A natural and easily implemented application is the use of a spreadsheet for grade recording and analysis.

END



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Hitachi CDR-1502S

The progression of technology has led data storage to take on a more sophisticated appearance, in the form of optical storage media, or the CD-ROM. Peter Bright describes different forms of this media, and looks in particular at the capabilities of the Hitachi CDR-1502S drive.

As microcomputers have progressed, the need to be able to store an ever-greater amount of data in an ever-smaller space has grown. As the need has increased, technology has provided the answers.

History

The earliest micros used 8in floppy disks as their mass storage medium. These were soon replaced by the now-standard 5.25in disks, but early drives could store only limited amounts of data by today's standards: the original 5.25in drive for the Atari 800 could only store 88k.

As time passed, both floppy and hard disk technology progressed, and it is now possible to store up to 7Mbytes on one high-capacity floppy disk.

In order to store very large amounts of data, storage engineers turned away from traditional magnetic disks towards optical storage media. At first glance, optical disks have a great deal going for them: they offer high capacity; they are rugged; and they cannot be accidentally erased. But they do have their problems, not least the difficulty involved in manufacturing an optical disk which can be written-to many times.

Optical disks can store much more data in a given area than magnetic disks because optical disks use a low-power laser to read (and sometimes write) the data from disk. The surface of the disk can either be reflective or non-reflective; when the laser light is shone onto the

disk, the amount of light reflected is great or small respectively, depending on whether it is facing a reflective or non-reflective area.

These two states allow binary 0 and 1 to be represented, and therefore make it possible to store digitised data. The use of a precise laser beam allows greater accuracy to be achieved, and computer data takes up much less physical space on an optical disk than on a magnetic disk.

This is well illustrated when you consider that the high-capacity 5.25in floppy disk drive fitted to the IBM PC/AT has 154 tracks, giving 1.2Mbytes of storage. By comparison, a 4.75in (12cm) CD-ROM has 20,000 tracks, giving a capacity of 550Mbytes!

The strange thing about optical storage is that the technology has been around for some time, but its application to micros has been slow. Indeed, optical storage has become more widely used in the video and audio worlds than it has been in the micro industry. In this review I'm testing one of the first commercially-available CD-ROM units — the CDR-1502S from Hitachi.

Before I get too involved in the Hitachi unit itself, it's worth taking a quick look at the different types of optical storage media which are available.

Video disks

Much of the development of optical storage media and methods has been

carried out over the years by Philips. It was also Philips which released the first commercial product based on optical disk technology — the video disk player, which was designed as an alternative to video tape machines. It used large 12in disks to hold digitised television pictures which were decoded in the machine and fed into a domestic TV.

The main advantage of the video disk compared to tape was that the digital signal provided better sound and vision, and that it was possible to instantly skip from one section of the disk to another. The main drawback of video disks was that it wasn't possible for the user to record onto the disk — it was a read-only medium.

The video disk also had limited use as far as micro users were concerned. The main practical use of video disks and micros has been in computer-based training applications where micros have been used to control video disk players in order to form an interactive video system. Video disks have been used in some arcade games where interactive video was used in animated displays. Overall, however, the video disk was not a raging success.

Compact disks

Undaunted, Philips, this time with the aid of Sony, came up with the compact disk (CD). This is based on the same principles as the video disk but is much smaller (12cm), and is specifically

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designed for storing computer data and digitised audio signals rather than TV pictures.

Audio compact disks have proved much more popular than their video counterparts. The original audio master is digitised, and a master CD is produced from which retail disks are then mass produced. The audio CD player runs the digital data through a high-speed D to A converter to produce an analogue signal which is amplified and fed through the speakers.

The format of the disk and the coding techniques are based on a format originally agreed by Philips and Sony, which has since been adopted by most of the Japanese manufacturers. Consequently, the same disk can be used in any manufacturers' players.

In terms of physical format, there isn't much difference between audio CDs and CDs containing computer data. The music, after all, is represented in binary format on the disk in exactly the same way as computer data. As an illustration of this, the Hitachi CD-ROM player was supplied with a demonstration disk on which the first 15 tracks contained computer data and the last 15 music. To test this, I put the disk into the CD-ROM drive and implemented an MS-DOS 'DIR' to list the available files. I then took the same disk home, put it into my audio CD player and listened to the music on the last 15 tracks!

The main difference between audio and computer CDs is in the players rather than the disks. While the lasers, servos, and so on, remain unchanged, computer CD-ROM drives have extensive error-correcting circuitry built-in giving a bit error rate of better than 10^{-12} . The logic of this is that even the most dyed-in-the-wool hi-fi enthusiast can tolerate an occasional 'blip', but a computer can't.

Interestingly, some computer CD-ROM units keep the D to A converters used in their audio counterparts to give software developers the option of mixing computer and audio data. This could be useful for having spoken instructions or error messages rather than traditional text, for example. With 550Mbytes to play with, you could easily spare a few megabytes for spoken error messages!

Worm drives

The major problem with both video disks and CDs is that they are strictly read-only media. The data is placed on the disk when it is produced and there is nothing you can do to change it, which has limited the extent to which optical drives can replace magnetic disks for micro use.

The major objective for optical

developers is to produce an optical drive which is capable of performing multiple read *and* write operations. At the moment, the best that is commercially available is the Write Once Read Many (WORM) drive, which uses a higher-powered laser than CD units to burn non-reflective patches onto the optical disk. The problem is that once the data has been written to disk, there is no way of changing or erasing it. This limits its use mainly to archiving duties.

The next few years should see the commercial availability of hybrid magnetic/optical disks which are capable of multiple read/write operations. Only then will the optical disk be able to fully replace the magnetic disk.

Hitachi CDR-1502S

Hardware

To date, CD-ROM drive manufacturers have been cagey about releasing their products. Hitachi will happily sell you a unit, but you must go and ask for it: the company isn't promoting the unit. And, at the time of going to press, only

'sample units' were available for which you'll pay a whopping 600,000 Yen (about \$4,700) plus sales tax and 2% import duty. This price includes an interface card to the IBM PC and a demonstration disk.

The CDR-1502S (from now on, CD-ROM) we tested came as a free-standing unit which can be sited either on top of or beside a PC. Hitachi also makes a drive which has the same dimensions as a floppy disk drive and can therefore fit inside a micro.

The review model looked very similar to a domestic audio CD player; the main difference being that the usual plethora of flashing lights and buttons which accompany domestic CD players were missing from the computer player.

The front panel houses two buttons (power and open/close) and two LEDs (power and access).

Inserting compact disks into the system is done in the same way as on audio players: you press the open/close button and the disk tray slides out. You insert the disk face down, press the open/close button again, and the tray slides back in.



The rear of the Hitachi drive is even more bare than the front. All that is visible is the power cord and what looks like a Centronics parallel printer connector; this turns out to be Hitachi's 8-bit parallel interface which needs to be run to the host micro. The review drive was supplied complete with a card which slots into an IBM PC or compatible and interfaces the CD-ROM to the main unit.

System software

The main area of interest with CD-ROMs is not so much the hardware but the software. The ability to store 550Mbytes of data is all very well, but it does raise one or two problems; not least of which is that all the data needs to be typed into a computer to be collated before it is transferred to CD. This is all very well if the data is computer-generated, but a CD-ROM lends itself more to things such as parts catalogues, dictionaries, encyclopedias and reference works, rather than rapidly changing computer data.

It transpires that this needn't be as much of a problem as is first imagined. I understand that most of this type of

keyboard work is done in South-East Asia, where there are halls full of copy typists bashing away at VDUs. Allegedly, the major cost is wear and tear on the VDU keyboards rather than labour!

The vast amount of data available on a CD-ROM also presents problems as far as the system software is concerned. One of the problems with PC-DOS version 2.1 as used in the IBM PC is that the maximum disk drive size that it can handle is 32Mbytes. This is awkward, because CD-ROMs can contain up to 550Mbytes.

Hitachi's remedy is to split the disk into lots of 32Mbyte chunks, each with its own boot block, FAT, directory and data area. Hitachi supplied a utility with the review unit which allows you to change between volumes at will.

The idea of taking a 550Mbyte disk and being forced to break it into 32Mbyte chunks is rather silly and severely limits the usefulness of the system. Luckily, help is at hand in the shape of LaserDOS from TMS Inc in the US.

LaserDOS sits with MS-DOS or PC-DOS and allows the whole 550Mbytes of a CD-ROM to be accessed as one MS-DOS drive. You can do DIRs on it, copy from it, and so on, in exactly the same

way as you would on a conventional disk system.

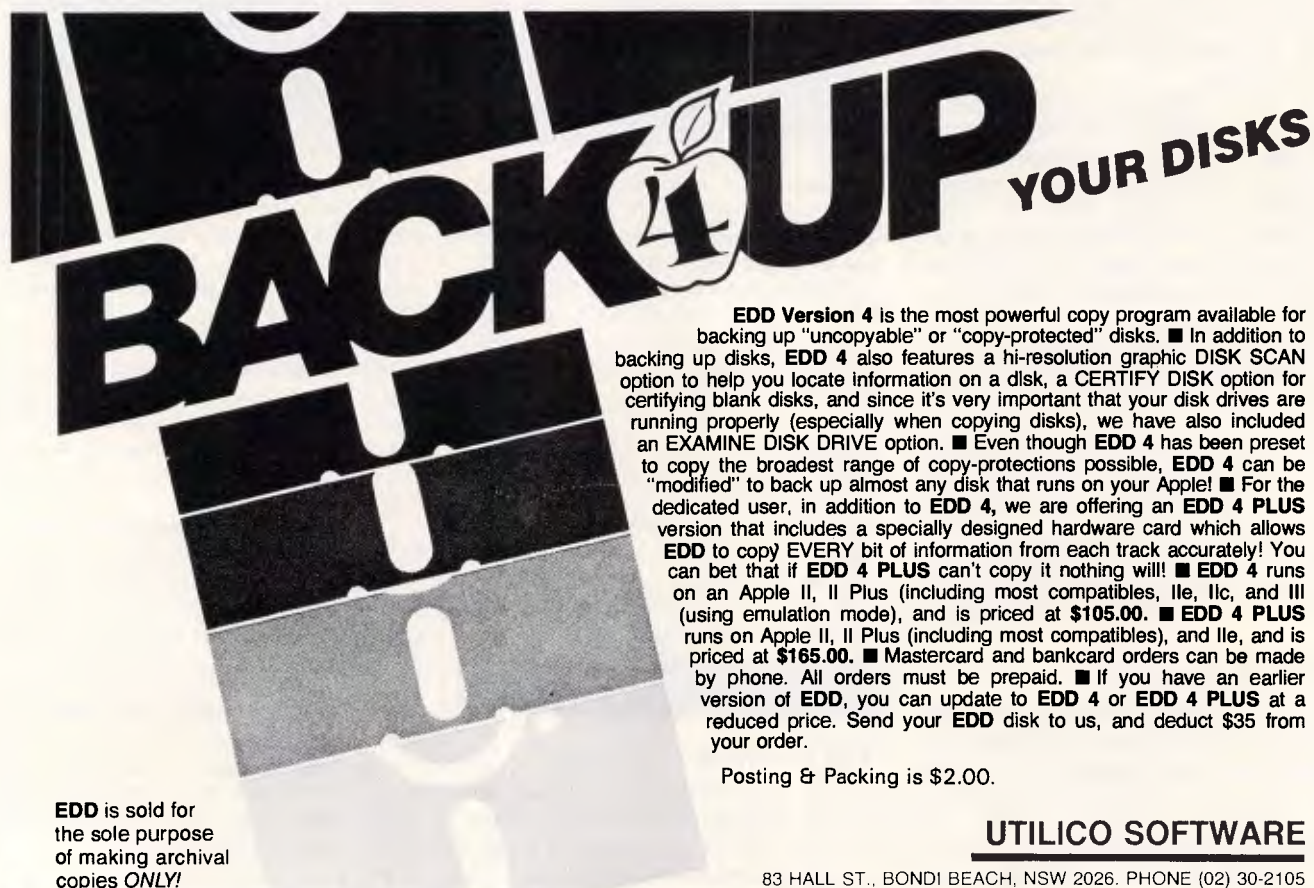
As well as being able to access the full 550Mbytes directly from DOS, the LaserDOS system comes with a disk origination system which runs on DEC Vax supermini computers. This component turns data supplied by a software publisher into a format which can be used to produce a master CD-ROM from which disks can be mass produced.

Applications software

The current problem with CD-ROMs is that while the hardware standard has been set and is being adhered to, there is no *de facto* standard for the software used to organise and read data. This lack of standardisation means that there are a number of non-compatible software systems available for the same drive.

The review drive was supplied with a number of sample CD-ROM disks which used no less than three different means of reading their data from the disks.

The first disk was a Hitachi test disk, which contained both computer data and audio data. The computer data was



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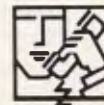
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divided into 32Mbyte volumes to overcome the MS-DOS disk size constraint. The disk contained a number of demonstration programs which displayed different graphics on the IBM screen. Unfortunately, they were mainly designed to use the IBM enhanced graphics card, so didn't reproduce too well on the standard IBM screen.

Other volumes on the disk contained WordStar documents, Basic programs and even sample dBaseIII programs. All the volume files could be examined in exactly the same way as standard floppy disk-based files; the only difference being that you obviously can't change their contents.

The review drive was also supplied with two CD-ROM-based American databases — Embase and Lisa, which both use the Silver Platter system from IMLAC Standard Information Systems in Massachusetts. Embase contains summaries of the world's literature in bio-medicine, and was compiled from the Embase online database and *Excerpta Medica* abstract journals. Lisa contains abstracts of the world's literature in librarianship.

The Silver Platter system is a fairly straightforward database retrieval system which allows you to search the database for specified keywords or groups of keywords. Any records containing the keywords can be browsed, with the keywords highlighted in a different colour onscreen. Both databases use the same retrieval system, so the user interface is the same in both cases.

The final CD-ROMs that I looked at are

based on the TMS Research retrieval system. This system works in hand with TMS LaserDOS, and is easily the most comprehensive of the three systems tested here.

TMS Research works in three main modes: Browsing, Searching and Notetaking.

In Browse mode, the idea is that the data is presented in much the same way as in a book: you can jump into a section and scroll forwards or backwards as the mood takes you. One impressive feature is that if you come across a cross-reference that you want to look at, you simply highlight the reference number and the system takes you to the relevant section. You can also highlight any word or collection of words that you are interested in, and the system will look through the entire database for further occurrences.

In Search mode, you can select a word or phrase and build up search criteria using the normal Boolean logical operators. Search time with most CD-ROM systems is remarkably fast, as the database is indexed down to word level.

One of the nicest features of the TMS Research retrieval systems is the Notetaking mode. This allows you to highlight any sections of text and save them in a notebook file on either hard or floppy disk.

Another feature of the TMS system is that it can store graphic images in Group III Fax format. The idea of using the same storage as Fax document transmission systems is neat, as consequently it is easy to scan images or documents. You

can hang a Fax machine off the back of a PC and obtain a hard copy of any stored pictures.

Conclusion

In general terms, the idea of optical disk drives is certainly appealing. The main problem is that at present they don't possess the multiple read/write capability that is necessary if they are to replace traditional magnetic disks.

Although it isn't possible to write data to CD-ROM disks, they certainly have a place in the micro market. The idea put forward by proponents of CD-ROMs is that they are ideal for the electronic publishing of non-time-dependent data such as reference books and abstracts, and in many instances CD-ROMs are seen as an alternative to the expensive dial-up databases run by professional organisations.

In terms of hardware, the CD format is well tried. The manufacturing techniques and reader technology have been tried and tested in the audio market, but there is no standardisation as far as systems software and retrieval software is concerned. Although disks may be interchangeable at the hardware level, they are likely to be incompatible at the software level.

Hitachi hopes that it will become the *de facto* standard; until then, you'd be wise to take a close look at the software if you are considering a CD-ROM system.

The Hitachi CDR-1502S is available through Nissei Sangyo (02) 923 1522.

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SCREENTEST

B/Graph

B/Graph, a graphing and statistical analysis package, is part of a drain of American utilities which, repackaged and repriced, have found their way to Australia. Nick Walker tests its home computer facilities.

During the past year, the business of importing American home computer software titles and selling them at Australian prices has grown phenomenally. In order for the producers to gain mass sales and hence make a profit, the bulk of the software is of the block-busting arcade game type; which is all very well if you like that kind of thing, but it leaves some high-quality utilities and more specialised games unobtainable or far too expensive.

One of the front-runners in this venture, ECP, looks set to change this by offering a range of utilities from the US software house Batteries Included in addition to its range of US games.

Homepak, an integrated package for home micros (reviewed in APC, December 1985), was the first of these utilities. Now it's the turn of B/Graph, a graphing and statistical analysis program for Apple, Atari and Commodore 8-bit micros.

B/Graph is on disk only, so to get the most from it you will need a disk drive and a printer. You can use it without a printer, but obviously you will not be able to generate a hard copy of any graphs that you create. Batteries Included recommends a second disk drive, but I found one to be satisfactory.

B/Graph consists of nine independent programs which are linked by means of a main menu. Each program is organised as a main menu with subsidiaries, so if you have a particular dislike for menu-driven systems, you won't like B/Graph. Two of the programs are purely concerned with system configuration and DOS operation so I'll concentrate on the other seven, except to say that it's

nice to be able to format a disk without leaving B/Graph.

Graphing

B/Graph's first program is called Graphing, and is the system's fundamental program for graph creation. Apart from the tree of menus, two screens are manipulated with this program — a data entry screen and a graph screen.

Creation of a graph is initiated by pressing 1 from the main menu; this results in prompts for the graph title, the sub-title, the side title, the factor to be graphed and the units for the x-axis.

'More than seven graphs can be obtained, as others can be created by choosing one of the original seven and modifying it once it has been displayed.'

Having supplied these details you drop into the data entry screen, which is somewhat reminiscent of a spreadsheet. Comprehensive editing facilities are available, allowing you to enter data for up to three factors and 100 data points per factor. One of the nicest features of this Graphing module is the approximation system, which will attempt to calculate, albeit in a simple manner, any points for which no data is available.

Having entered your data, you can display it in a variety of forms. A menu of seven items gives the choice of point, line, bar, segment bar, tic market graph, connected market graph and pie chart. Most of these are self-explanatory, but the tic market graph and the connected market graph may be unfamiliar to some readers. They are traditionally used to display stock market information in the form of a vertical line which represents high and low values, and a point on the line which represents closing values. A connected market graph is similar, except that the closing points are connected.

More than seven graphs can be obtained, as others can be created by choosing one of the original seven and modifying it once it has been displayed. When you have selected the type of graph you want, B/Graph will then draw it; once drawn, there are various actions that can be applied to the graph. For example, the F and B keys change the foreground and background colours; E encloses the graph with a solid line; and S takes you back to the graph selection screen where another graph style can be chosen.

When generating a graph, B/Graph uses a fairly complex algorithm to scale the graph for maximum impact. While taking in absolute and relative values, its main objective is to maximise screen utilisation. In the majority of cases this creates the graph you require, but you may want to show how little change has occurred in real terms. Pressing R solves this problem by allowing you to specify your own scaling.

Other options available while a graph

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is being displayed allow you to place horizontal and vertical lines on the graph; fill in areas under a suitable graph, such as a line graph; and attach a line to point or scatter graphs. The most powerful of these options is the O key-function, which overlays the current graph with another — this is very useful when looking for related trends. It is also, however, by far the easiest way to achieve a very messy and untidy screen!

When you are satisfied with the result of your graph-making, you print it by pressing F1 (on the Commodore). Alternatively, pressing F1 from the data entry screen will dump the data to the printer. B/Graph supposedly supports four types of printer — the Commodore 1525/MPS 801, the Epson/Gemini range, the C.Itoh/NEC/Prowriter and the Okidata 92. In fact, this list indicates that B/Graph will work with probably 90 per cent of low-cost graphic printers, but if

'B/Graph consists of nine programs which are linked by means of a main menu. Each program is organised as a main menu with subsidiaries...'

you have a particularly obscure printer attached to your system, you would be well advised to check that B/Graph is compatible with it.

Graphs can be stored on disk in two ways: as straight data; or as a standard screen dump. The data form occupies significantly less room on the disk, but the screendump method enables the image to be loaded into most popular art packages for any final cosmetic touches; it is also the form that the Imaging/ Labelling takes as input.

Imaging/Labelling

The Imaging program performs just two simple tasks, but both are useful for producing and presenting the final version of graphs created. (Imaging only deals with graphs stored in the screendump form.)

The first of Imaging's tasks is customisation of graphs to create more professional-looking examples. In this role, Imaging allows you to add text anywhere on the graph in four text sizes and numerous colours, so you can highlight points of interest or give extra emphasis to graph labels.

The second function of the Imaging program allows you to connect a related

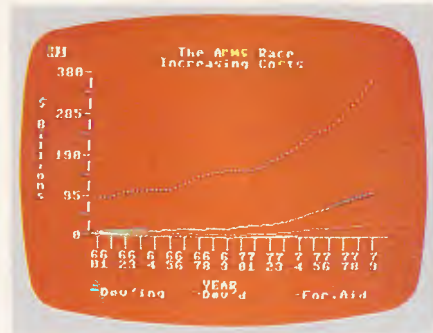
series of graphs into a 'slide show', which is useful if you want to give a presentation using a selection of graphs.

Data Manipulation

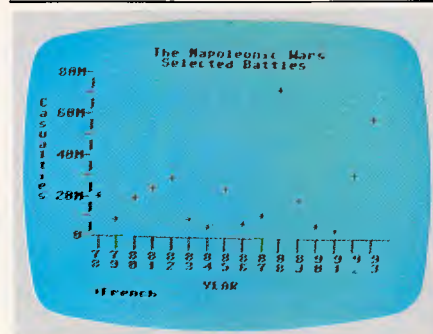
The Data Manipulation program is

referred to as File Manipulation on the main menu, and it allows you to perform a number of functions on the raw data without the need for reference to a graph.

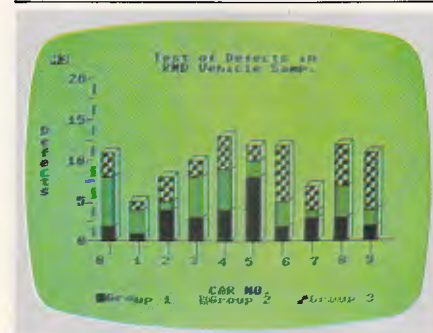
The first File Manipulation option is a technique that is primarily used in sales forecasting, though it can be used on



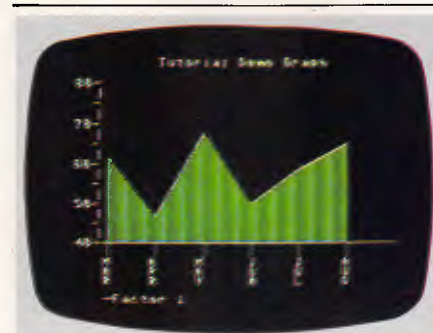
Three-variable line graph



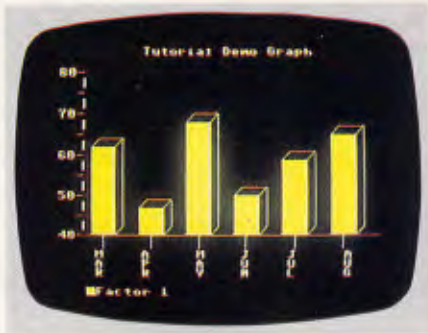
Point graph



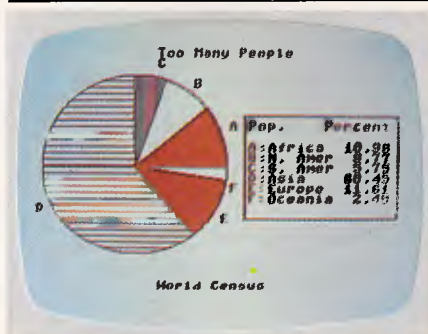
Stacked three-dimensional bar graph



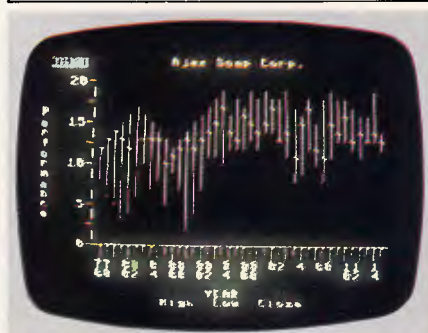
Filled single-variable line graph



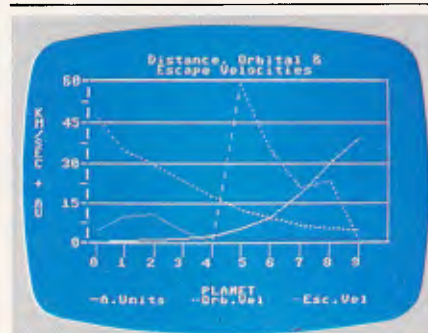
Standard single-variable bar graph



Pie chart



Tic tac market graph



Line graph on horizontal grid

other time/series projections, called 'exponential smoothing'. It involves the use of prior sales data, and estimates for prior sales data, to project future sales.

The formula for exponential smoothing is $F(t+1) = a \times A(t) + (1-a) \times F(t)$ where t is the time period, $A(t)$ denotes the actual sales in that period, $F(t)$ is the forecast or estimate, and a is the smoothing coefficient. The smoothing coefficient is a value between zero and one, and is used to smooth the peaks and valleys in the data. The closer it is to one, the more emphasis that is placed on actual sales; the closer it is to zero, the more emphasis that is placed on projected sales.

Exponential smoothing is best used for data which fluctuates randomly around a given value, rather than data

'Home computers are often criticised for their inability to perform any serious tasks due to their games-orientated designs. B/Graph uses a games-orientated feature — high-resolution colour graphics... to create a serious application.'

with a specific trend or seasonal variation, although it can be used satisfactorily for the latter. It is also more suitable for short, rather than long-term projection.

The second File manipulation option is 'moving averages', which calculates an average for a given number of adjacent data points. It adds the values for the points within a specified period and divides the total by the number of points. Moving averages smooths out the seasonal variations, and gives a good picture of the general trend. Typical examples of its use are when seasonally adjusting unemployment figures or data for electricity usage.

The geometric moving average is also supported; this is essentially the same as moving average except that it takes the values, multiplies them and takes the n th root (where n is the specified period).

The remaining File Manipulation options are simpler. The 'factor rollover' option is used for an ongoing business: it allows you to maintain figures for, say, a two-year period, with figures being removed from the top as they are added at the bottom.

Although File Manipulation's 'algebraic

operation' option is fundamentally simple, it is the most powerful option of the program. A third factor can be generated from two others by any equation using addition, subtraction, multiplication and division, with more complex algebraic operations being used on a single factor. B/Graph uses the algebra built into the micro's Basic, which gives you a wider range of mathematical functions such as sin, log, exp and Boolean logic.

The real power of the File Manipulation options in B/Graph comes from the fact that if, like me, you don't really understand data manipulation operations, you can still produce a graph.

Also worth mentioning as functions of the File Manipulation program are three options which allow B/Graph to accept data in VisiCalc, SuperCalc and straight ASCII form.

Statistics

B/Graph's aforementioned graphing functions put the package one step ahead of comparable products, and the inclusion of comprehensive statistics brings it into line with many business packages costing up to 20 times more.

There are two programs associated with the statistics package — Statistical Analysis and Regression (items five and six on the main menu respectively). Unfortunately I am unable to explore the depths and intricacies of statistics in this review, but suffice it to say that once again, the real power of B/Graph lies in its ability to produce a graph of whatever statistical function you have applied. I would even go so far as to say that B/Graph is an excellent aid for those studying, or having an interest in, elementary statistics — it certainly taught me a lot about all those strange terms such as 'chi square test' and 'Poisson distribution'. For readers with a knowledge of statistics, a list of B/Graph's functions is shown in Fig 1.

Price & documentation

The B/Graph package includes a 120-page manual which features a tutorial for the easier graphing functions, and a reference guide for the graphing and statistical functions.

There is an excellent introduction which has been written by a statistician and covers the use of many types of graph.

B/Graph costs \$59.95 and is available on disk for Apple, Commodore and Atari home computers.

(1) T-test — tests the probability that two samples come from the same population.

(2) F-test — similar to T-test; tests the probability that two or more samples come from the same population, but also looks for significant differences.

(3) Chi-square test — tests the suitability of fit of two sets of data: that is, how a result fits to an expected value.

(4) Normal distribution — tests the probability that a sample comes from a normal distribution curve.

(5) Poisson distribution — tests the probability of obtaining a certain result in a chance situation.

(6) Binomial distribution — tests the probability of obtaining a certain result in a chance situation.

(7) Simple correlation — tests how well elements in different factors correlate with each other in a linear manner.

(8) Rank correlation — shows how close two rankings are.

(9) Regression — attempts to fit standard mathematical curves to a set of data points.

(10) Interpolation — retrieves a corresponding x value for a given y value, and vice versa.

Fig 1 Statistical operations available from B/Graph

Conclusion

Home computers are often criticised for their inability to perform any serious tasks due to their games-orientated designs. B/Graph uses a games-orientated feature — high-resolution colour graphics, together with the micro's mathematical computing power, in order to create an excellent serious application.

Graph production may be rather specialised for many users but it has a surprising number of implementations, especially as a forecasting tool. Similarly, B/Graph's statistics capabilities may seem to apply to no-one but statisticians — until you take the plunge and experiment with them.

B/Graph offers a professional-quality graphing and statistics program that becomes increasingly invaluable as its features are revealed. I hope it achieves the success it deserves, as this will hopefully encourage more serious American software to follow the same route to Australia.

B/Graph is available from ECP 3A/39 Kenneth Road, Manly Vale, NSW 2093. Telephone: (02) 949 7300.

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When the magic's gone

GAME: *Lord of the Rings*

MACHINE: Commodore 64/128, Spectrum

SUPPLIER: Melbourne House

PRICE: \$44.95

If Tolkien were alive today, I doubt that he'd appreciate his work being the subject of a computer game, as his stories were written to edify and galvanise the imagination of children — properties which are sadly lacking from the majority of today's software. That said, Melbourne House has been quite reverential in its treatment of *Lord of the Rings*, although much of its original magic has been lost in the transfer from paper to silicon.

Tolkien's *Lord of the Rings* is a trilogy centred around the adventures and misadventures of a band of characters in



Middle Earth. *The Fellowship of the Ring* is the first book in the series and the source for Melbourne House's game, which, incidentally, is also the first in a series of three.

Lord of the Rings (part one) begins in a Hobbit hole, screened from the outside world by a green door. Here are gathered four characters: Frodo Baggins (Bilbo Baggins' scion), Merry, Sam and Pipin. Frodo has in his possession a ring of dark powers, handed down to him by his father who had stolen it from Gollum several years earlier. Were this seemingly harmless piece of jewellery to fall into the wrong hands, Middle Earth would become prey to the scourge of the ring wraiths and Sauron.

Gandalf, the wise, wizen-faced wizard who had previously helped Bilbo capture the ring, exhorts Frodo to take it to Rivendell, where Elrond will advise him what to do with it.

Knowing the journey will be fraught with danger, Gandalf advises Frodo to take a circuitous route and adopt a pseudonym. He also warns him not to wear the ring because, apart from mak-

ing him invisible, it would weaken him and draw him into the clutches of the ring wraiths. Thus informed, Frodo and his friends set out on their journey from Bag End in Hobbiton, to the serenity of Rivendell.

For his journey into Middle Earth, the player can take charge of any one of the four adventurers. If the character dies, or becomes unsatisfactory in a particular situation, it's possible to change character using the Become command. Whichever character the player chooses, no character is alone as it can communicate with the other three, using the now almost legendary 'Inglish', a language akin to English that's claimed to have a vocabulary of over 800 words. In the blurb accompanying *Lord of the Rings*, Melbourne House makes the apocryphal statement that this is '... the largest choice of words ever offered in any home computer game'; a claim that raised a few eyebrows at Level 9 and Infocom, no doubt.

In play, *Lord of the Rings* is very Hobbit-like, except it's marginally slower and the graphics are less intrusive.

Hobbiters who fancy purchasing *Lord of the Rings* should realise that it is much more difficult than its forbear. Recognising the fact that some people may have problems understanding its game, Melbourne House has included a beginner's adventure with an additional help facility.

If books must be turned into computer games, let them be done so at Melbourne House, one of the few companies capable of turning a literary masterpiece into a seamless, micro-based spectacle.

Chamber creatures

GAME: *The Eidolon*

MACHINE: Commodore 64/128

SUPPLIER: Imagineering

PRICE: \$19.95(c), \$34.95(d)

Lucasfilm has set itself such high standards that even the slightest drop in

quality would be considered a landslide in any other software house's books. Therefore, it is with some relief that I review *The Eidolon*, an interesting Lucasfilm extravaganza.

The Eidolon is a magical subterranean world full of strange creatures that wouldn't look out of place in a Grimm's fairytale. Much as in *Koronis Rift*, the world of the *Eidolon* has been created using fractal graphics, but instead of

forming mountains and valleys, they create a seemingly infinite labyrinth of interconnecting tunnels and caves.

To travel around this Wagnerian world, Lucasfilm has provided the player with a heavily-shielded capsule. Inside this bubble is a control panel containing a clock, an energy indicator and a monster detector. The latter is particularly useful.

The object of *The Eidolon* is to make

your way through the various levels of the underworld. Unfortunately these are all heavily guarded, and can only be negotiated with the death of the creatures that guard each level. There is also a time limit on your survival.

So far I've only made it through three of the Eidolon's chambers, but from what I can gather, there appears to be three guardians per level. To defeat these you require a high degree of energy, which is derived from a collection of coloured orbs found hanging in mid-air about the tunnels. The more orbs you collect, the higher your energy, and the

greater chance you have of defeating the foe.

On finding one of the magical beasts, you must gird your lions and approach it until it changes colour; one of the creatures turns green, another red and another blue. As you move in, the character suddenly becomes animated and charges you.

I have played The Eidolon on several occasions, but only feel that I've scratched the surface of what looks to be a game destined to become one of this year's biggest hits.



Down memory lane

GAME: Scalextric

MACHINE: Commodore 64/128

SUPPLIER: Melbourne House

PRICE: \$29.95

In its search for new material to turn into a computer game, Leisure Genius, the manufacturer, has come up with one of the oddest conversions yet — Scalextric,

the slot-car racing set. But sadly, the emanation does not quite equal the originality of the thought, as the result is a hybrid of the games Racing Destruction Set and Pole Position.

Scalextric comes fully equipped with 17 pre-programmed Formula One circuits. These reconstructions provide good training grounds for the novice driver, but their fascination wears thin after a while.

When your appetite has been whetted by these fairly mundane constructions,

you'll find yourself itching to design more outrageous circuits; ones which give more scope for disaster, for example.

Designing a circuit is a simple, icon-driven process. Pieces of track are picked up from a menu and put down at the appropriate position. Just like its real life counterpart, Scalextric contains banked curves, chicanes and cross-crosses, providing plenty of room for danger. A track can be as large as the confines of the screen allow.

During a race, both drivers have a 3D view along the track, as well as a plan view showing their positions relative to the start/finish line. Only your car and that of your opponent are on the track. This gives you more room in which to manoeuvre, but not enough to stop you crashing into the other vehicle.

Scalextric is a reasonably good racing game, but it makes you wonder what Leisure Genius thought it could achieve by launching this trip down memory lane.

Faint hearts and Super Joe — a one-man battle

GAME: Commando

MACHINE: Commodore 64/128
Amstrad

SUPPLIER: ECP

PRICE: \$19.95 cassette,
\$29.95 disk

Recently Alligator stepped on Elite's toes by launching a game based on an arcade smash, Commando. Elite had reputedly bought the rights to the title, and wasn't happy with Alligator's encroachment onto its territory. In retaliative spirit, Elite told an unrepentant Alligator that it could sell its game, provided some minor changes were made to its graphics.



Now that Elite has launched its 'official' micro-based version of Commando, it's obvious that it allowed Alligator to sell Who Dares Wins II in the knowledge that its product was by far superior.

Elite has a right to be smug about its actions, because Commando/Space Invasion is a *tour-de-force* of sight and sound with nail-biting action.

There have been several Commando pastiches launched over the past few months, but none do as much justice to

the original as this one. The graphics are superb, and the music is even more stunning than that found on Monty on the Run.

For those unfamiliar with the Commando scenario (and there can't be many by now), it is a game about Super Joe's one-man battle against an unnamed enemy. The aim is to move Joe further and further into enemy territory, gunning down or blowing up as many of the multitudinous foe as possible.

Initially the task is quite simple, but as he pushes on further behind enemy lines, the hazards become more frequent and diverse. His only hope is to collect enough grenades to defend himself from the enemy's final onslaught as he tries to enter its garrison.

Elite's Commando provides some of the fastest and most furious action available on a home micro. Definitely not a game for the faint-hearted.

END



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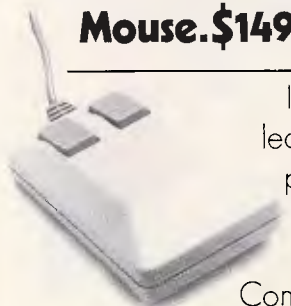
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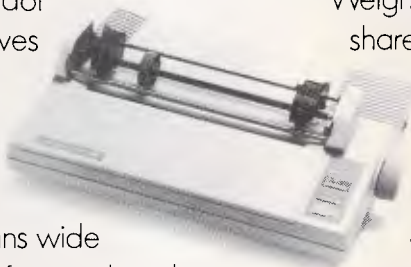
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SCREENTEST

Paradox

Paradox is an American package, similar to Lotus 1-2-3, which aims to bring together facilities from both spreadsheet and data management systems.

Kathy Lang takes a look at how the capabilities merge.

Until about eighteen months ago, software writers maintained a clear distinction between spreadsheet packages and data management systems (DMSs). Spreadsheets handle information in a single rectangular table, held in the memory of the micro, and concentrate on good numeric processing with lots of functions; most also include direct graphical display of the spreadsheet. The essence of such packages is interaction, so control is exercised either directly from the keyboard, or through sequences of keystrokes stored in a file for subsequent re-use. Typical spreadsheets for the business market include Lotus's 1-2-3 and Sorcim's SuperCalc.

Data management systems, on the other hand, handle information in discrete records, usually allowing you to view just one record at a time; where the package allows several sets of records to be related, displaying and editing information from the whole set is allowed. Graphical display is rarely included. Control over DMSs ranges from the menu/keystroke approach used by the simpler packages, through combinations of menus and the ability to store keystroke sequences, to command languages of varying degrees of power up to that of a conventional programming language. In the upper part of this market, first dBasell and now dBasell are the market leaders.

With the advent of the so-called integrated packages, these distinctions began to blur. Even with a closely integrated package such as Symphony, however, you must still define to the package which area of your worksheet is really a database, and it's possible to

corrupt data by making mistakes in cell references. The data must still be contained in a single regular table, with no possibility of explicitly relating dissimilar sets of records. Furthermore, all the data must still be held in memory (even though, if you use an extra memory board, this may be an indirect rather than an obvious limitation). In loosely integrated packages such as Smart and Open Access, the distinction between spreadsheet and data management system is clearer, to the point where they can be purchased as independent modules.

A further step down the road towards marrying the spreadsheet and data management approaches is represented by Reflex (reviewed in APC, March). Reflex allows you to view your data either as a rectangular table or as a full-screen form showing a single record, and includes powerful calculation features and graphics. (It is also very cheap). But Reflex retains the usual spreadsheet limitation of requiring all data to be in memory, and does not allow you to define relationships between two or more sets of dissimilar records.

Into this arena now steps a package which is being hailed in the US as the answer to these problems. For problems they are, in that, for many people, the need is to handle data using a combination of traditional data management and spreadsheet techniques, without the difficulties which have hitherto impeded that approach. Paradox, from an American start-up company called Ansa, is so called because it aims to provide powerful features in a way which people will find easy to use. These features borrow

extensively from both the spreadsheet and data management camps, to the point where the documentation includes two brief booklets: one an introduction for users of 1-2-3; and the other for dBase users.

Like so many new packages in the business market these days, Paradox is at present available only for the IBM PC and close compatibles. It comes on four disks (one of which contains example data tables) which, when installed on your hard disk, will take up just over 1Mbyte, and needs 512k memory to run. Paradox is copy-protected, using the method which does not require the system disk to be checked whenever the system is loaded, and has one back-up system disk in case your original is deleted or corrupted beyond the possibility of uninstalling it. (Sympathise though I do with software suppliers concerned to combat rip-off merchants, I still feel that people should think carefully before coming to depend heavily on copy-protected software, especially from an as yet unproven company.)

The basic Paradox display shows a menu of options and then, once a set of records is loaded, a table with up to 22 rows, each containing a record, on the screen. At that stage, apart from the use of names for column labels rather than letters and/or digits, the display appears quite like that of Lotus 1-2-3. You can load many tables at a time, and resize the image each table presents to enable you to see several at once. (As an alternative, records can be displayed in a form mode, using either the standard form supplied or one designed by the user.) The table approach extends to many areas of



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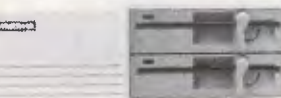
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Paradox; for example, if you ask to see a subset of records from a table, these will be displayed in a special, temporary table set up by Paradox and called Answer, which can be handled just as any user-defined table. A table is also used to define queries — each row contains one group of selection criteria, and each field to be included in the Answer table is 'ticked', giving a visual indication of your choices.

A most unusual feature of Paradox is its memory management; a table will be kept in memory if possible, dramatically speeding up operations for small databases. If a table is too large to be held in main memory, Paradox will keep some of it on disk and 'page' it in as necessary. In addition, the disk version of the table being updated is amended regularly, to ensure that changes are not lost if the system fails. You can force this disk updating more frequently if you like, but at least Paradox takes some of the responsibility — a major objection to using large memory boards with conventional packages is the danger of losing data if the system goes down between your (usually lengthy and therefore irregular) saves.

Unlike most packages which use the table display approach, Paradox allows you to relate tables together when constructing queries, to add records from one table to those in another, and to check the validity of records in one table against values in another. These relationships are, however, only as permanent as the queries or updates themselves — they do not constitute a permanent part of the file definitions, as in packages such as Everyman; in this, Paradox is more like the dBase family.

The dBase similarity extends to the Paradox programming facilities, which considerably extend the interactive capabilities. You can record a sequence of keystrokes and store it as a 'script'; this script, which contains visible equivalents of all function keys, control keys, and so on, can be edited with the Paradox script editor, and extended using commands such as While/Endwhile which are not appropriate at the keyboard.

Constraints

The main constraints and features of Paradox are shown in Fig 1. The limit on record size shown is for keyed records, and at 1350 characters is rather on the low side. For records without a primary key, you can have up to 4000 characters per record. Date fields can be stored in two formats — MM/DD/YY and DD/Mon/YY, and shown in other formats in reports, but nowhere is the DD/MM/YY

format used in Australia to be found, nor is there a special Time format field.

File creation & indexing

Creating a table in Paradox is quick and easy: you just name the table, and then enter the name and type of each field. For alphabetic fields, you give the maximum length as well. If the file is to be indexed, the field or fields which comprise the key must come first in the record; Paradox does not allow duplicate keys. The primary uses of the key are to ensure the correctness of the data (for instance, by stopping you storing two customer records with the same number), and to order the display of complete records, thus in turn speeding access by primary key.

Relationships between tables are not set up at file creation, but are temporarily established when they are required for queries or for table amendment.

Secondary indexes are not set up explicitly in Paradox; rather, they are related to specific sets of selection criteria. For example, if you set up a query which you execute frequently, perhaps to extract information about all customers whose balances exceed a given sum and have been outstanding for a specified period, you can request an option called 'Query speed-up'. This will set up secondary indexes to the file or files upon which the query is based, in order to speed up the retrieval process. These indexes are not updated when records are changed, but they are

amended when next a query is invoked that uses the indexes. No penalty is therefore carried on data entry, but there is some overhead when queries are asked. The extent of this overhead will depend on the size and nature of your application, and needs watching. For example, in my Benchmarks, the extraction of 20 records from 1000 took 27 seconds without an index, and eight seconds with an index — but the Index took 54 seconds to build, and to rebuild after records had been changed. (Fig 2 shows the remainder of the Benchmarks. They were carried out on a 512k system, and I am assured by Ansa that, relatively fast as most of these times are, a 640k system would be significantly faster.)

When a table has been set up, its structure can be modified at any time without penalty; unlike the great majority of packages, appropriate modifications are made to reports, saved queries, and so on, to ensure that they still match the new table structure. (Some products even oblige you to reconstruct all reports based on tables whose structure is changed.)

Data input & editing

Paradox allows data entry and updating either in its table view — that is, with one record per line, or in a 'form' view, in which each record occupies one or more screens. Editing allows you to make changes *in situ* to existing records. Data entry can be carried out either directly



into the table concerned, or into a blank table and then added into the relevant table. For either mode, you can set up a variety of data validity checks, such as checking the range or pattern of data entered, ensuring that a value already exists in another table, giving a default value for a field, or making keyboard entry of a field value mandatory. While entering data, you can use a 'ditto' instruction to give a field the same value in consecutive records.

If you enter data into a blank table for subsequent merging with the original table, you avoid the danger of unwittingly changing existing records, and the manual recommends this approach.

However, using the interactive facilities directly, you cannot prevent the entry of keys which duplicate existing records, and when these are added to the original file, the original records will be overwritten. You could avoid this danger by using Paradox's script-writing feature to check for existing records when the data is entered or when the update is made.

When editing data at the keyboard, there are two ways to find the record you require. You can use the cursor keys to scroll through the table, looking for the records to be changed, which would be a sensible approach where you are identifying records by their key. Or you can set up a query to select the subset of

records to be edited; the selected records will be held in the separate Answer table, in which you can edit them before adding them back into the original table. (The manual appears to suggest that, in this case, the edited records would be thrown out because they duplicate records in the original file. In practice they replace the originals, as you would hope.)

In addition to interactive changes, you can set up automatic changes to all or a group of records, again through the query facilities (Ask on the Paradox main menu), thus enabling you to, for instance, increase the prices of a group of products by 10 per cent. If you need more sophisticated editing, you can set up a script using the full power of Paradox's command language PAL.

Screen display

Tables can be displayed onscreen either in a list format, one record per line, or in a form, one record per screen or screens. Moving between form and list view is achieved by toggling a function key. You can have as many tables open as you like (up to the maximum permitted by the amount of memory you have), and you can move about between them by using two function keys. The list format starts by showing all fields (allowing you to scroll sideways to see those that are off the screen), and up to 20 records at a time, but both these parameters can be adjusted to show fewer fields and/or records. This then makes it possible not only to have more than one table open, but to see them on the screen together—rather like using windows.

The use of tables is endemic in Paradox. For example, when you set up queries, the results are displayed in an Answer table; when you use the automatic updating feature, the old versions of the records are displayed in a table called Changed. If you are used to spreadsheet displays, this approach will seem very familiar. For those with more conventional data management experience, the Form facility should fulfil most needs; a default screen format is provided for each table, and in addition you can set up a maximum of nine forms using paint-a-screen techniques. A big advantage is that a form developed in the interactive part of Paradox can be used as a basis for data entry or query presentation within scripts created in PAL. A form may extend over many screens, and you can move up and down within these screen pages with a single key.

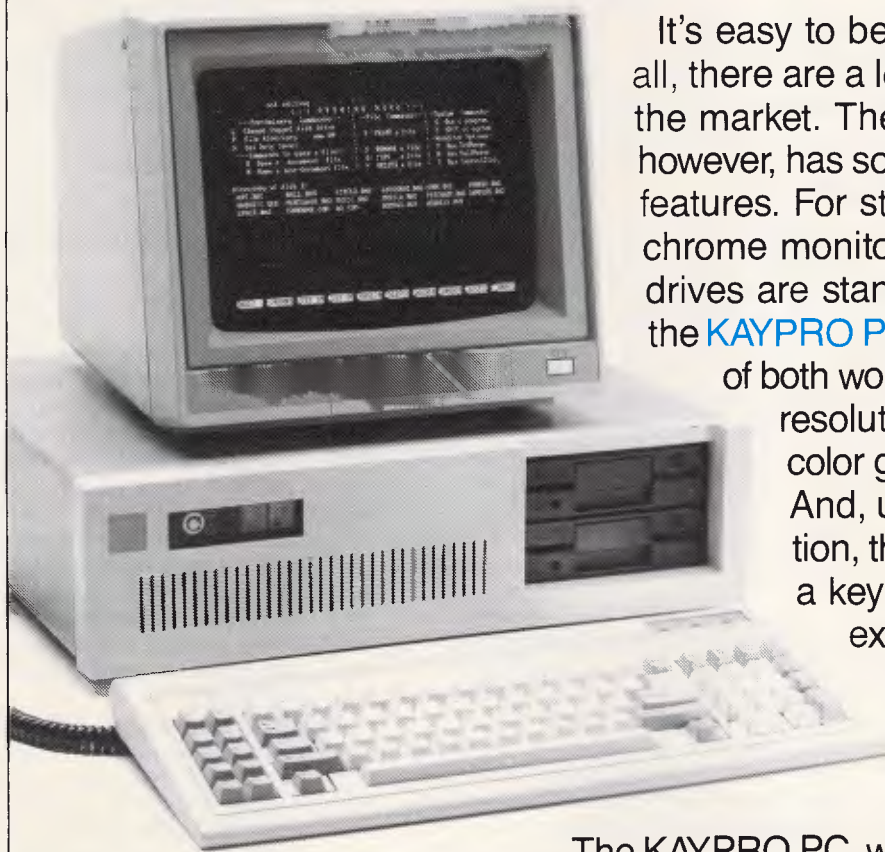
Any report can be displayed either onscreen or on the printer, so for viewing records you can use the full formatting

Max file size	65000 records
Max no fields	255
Max digits	15
Special disk format?	
Link to ASCII files	Yes, can vary formats
Fixed rec structure?	Yes
Amend rec structure?	Yes
Link data files?	Yes
No sort fields	Not stated
Max key length (chars, fields)	Not stated
Data validation	Good
Unique keys	Optional
Store calculated data	On input; or batch process to change specified fields/records
Store selectn criteria	Paint-a-screen
>1 criterion/field?	Yes
Browsing methods	Field may contain specified character(s)
Reference manual+	***
Reference card+	***
Hot-line?	No
Max record size (chars)	1350/4000
Max field size	255
Max prime key length	Not stated
File size fixed?	No
Data types	Numeric (incl. decimal point), character, date, monetary
Fixed record length stored?	Yes
No data files open	Limit depends on available memory
No keys	Not stated
Subsidiary indexes kept up-to-date?	Batch
Screen formatting	Default format supplied; or paint-a-screen
Report formatting	Default format supplied; or paint-a-screen (includes a letter writer)
Totals & statistics	Yes
Combining criteria	AND (must pass all tests), OR (may pass any one test), NOT (must not pass test)
Wild code selection?	Any field for viewing or editing
Interaction methods	Menus, plus interface to conventional programming language
Tutorial guide+	****
Online help+	****

Note: Maximum five stars possible

Fig 1 Features and constraints

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power of the report generator.

Reports

Paradox includes an extremely powerful report generator, giving great flexibility of design and formatting. However, it operates on a complete table; each table has a default report format and up to nine formats designed by the user. Reports operate on only one table at a time, so if you want to select a subset of records or fields, or to show information from more than one table, you must first set up the appropriate table using the Ask facilities.

As report formats relate explicitly to particular named tables, it becomes a four-stage process to produce a selective report, even when using an existing report design and preset selection criteria. The process is simple, and can be automated with a script, but it is not as easy or flexible as one would expect in a package of this type.

Selection & sorting

The selection of records for display through the Ask menu option could be said to be the heart of Paradox — certainly it is an area into which considerable development effort has been put. This is a welcome change from packages which seem to think that the goal of a data management system should be to get data in a subset of fields or records or both.

You fill in a query table, which consists of one or more rows with the same headings as the table to be queried. The process is highly visual, and very straightforward for the most part. For example, to choose a field for display,

you give it a tick (by pressing a function key); all fields may be chosen by ticking the left-most column, which contains the record numbers added by Paradox. To specify conditions a field must meet if a record is to be displayed, you enter the condition(s) in the field in the query specification table. Within a row, all conditions specified must be met for the record to be included; if more than one row of selection criteria is used, then a record must fulfil all the criteria in any one row.

Selection uses a wide range of options: these include comparison operators such as equal, less than, and so on; wild codes to match any character or any group of characters (these use the 1-2-3 conventions rather than the more usual DOS characters); the ability to choose records with blank entries in a field; and an unusual match called 'like'. This allows you to search for values that are close to the one you enter — for instance, if you cannot remember exactly how to spell a foreign surname. Matches may be with constants or with other field values.

You can also ask queries of combinations of tables. When doing so, and in several other query situations, Paradox uses a common mainframe software technique called 'Query by example', in which you enter an example of the type of value you expect to find in the field, and use this to connect fields or tables together. For example, if you have a customer file containing customer number, name and address, and an order file containing order number and details including the number of the customer who made the order, you would relate the two by entering an example value in the customer number field of the customer table, and exactly the same example value in the customer number

field of the order table. The ticked fields in the two tables would then be shown in a single answer table, each showing one customer/order combination.

Where you regularly ask the same query, it is possible to speed up retrieval of the specified records by asking Paradox to build secondary indexes of the fields concerned. Whether this will in fact speed things up depends on a number of factors, including the amount of memory you have, and the extent to which you change the data between queries; for the indexes are updated, not when the table is changed, but when the query is issued. The total amount of time to update the indexes is likely to be less using this approach, and of course it avoids any time penalty when updating records, but in some circumstances it may take longer to recreate the indexes than to carry out the query without using them — I certainly encountered an example of this when carrying out my Benchmarks. I would prefer to see the package take a little longer — a second or two — to save each record, rather than taking a good deal longer when retrieving records in queries. It's worth emphasising, though, that this trade-off arises only when you cannot fit all your data into memory.

If your table has a key, it is displayed in key order; if it does not, it is shown in entry order. When you select records using Ask, the Answer table is shown in order by the first field selected. If you want alternative orderings, the Sort option can be used to sort a keyed table into another in the new order, or to sort a non-keyed table into another or into itself.

Calculation

Paradox's calculation facilities are powerful, and include a wide variety of functions in addition to the usual arithmetic operators and brackets. You can include calculated fields in data entry, calculate field values and aggregate them in Ask and Report, and make calculated changes to records in Ask.

Multiple files

Within the interactive part of Paradox, connections between files are made only through Ask. If you want to query files, you must set up relations between them through an Ask table, in the manner described under 'Selection & sorting'; such queries can be saved for subsequent re-use, but do not have any effect upon updating. (You can, though, check values in one file when entering data in another).

BM1	Time to add one new record	3secs
BM2	Time to select record by primary key	4secs
BM3	Time to select record by secondary key	8secs
BM4	Time to access 20 records from 1000 sequentially on three-character field (same field as in BM2 key)	24secs
BM5	Time to access record using wild code	29secs
BM6	Time to index 1000 records on three-character field	50secs
BM7	Time to sort 1000 records on five-character field	2mins 40secs
BM8	Time to calculate on one field per record and store result in record	2mins 22secs
BM9	Time to total three fields over 1000 records	1 min 39secs
BM10	Time to add one new field to each of 1000 records	4mins 39secs

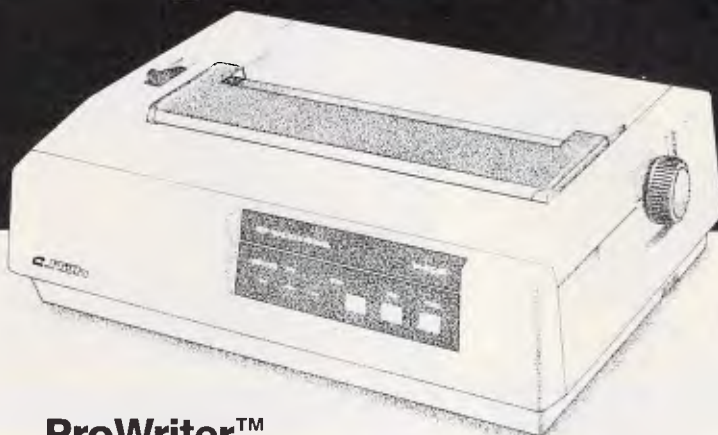
Time to import a file of 1000 records: 3mins 50secs

Notes: NT = Not tested; NP = Not possible, + = including scrolling.
Where two times are given, first is access to first record, second is access to each subsequent record

Fig 2 Benchmark times recorded on IBM PC/XT/H

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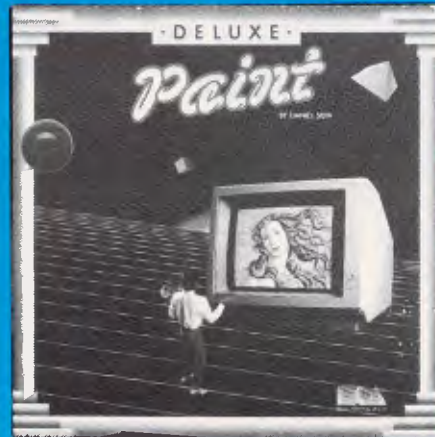
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If you want to update several tables from a single data entry exercise, you must either carry out the operations explicitly each time, or set up a script to automate the process. This is very similar to the approach taken by such packages as the dBase family and Knowledgeman, but contrasts with those systems, such as Powerbase, which regards relationships between tables, as well as within tables, as central to correct data analysis. Its flexibility is at once a strength and a weakness: the advantage is that you don't need to fix the overall data structure at the start, but can link files flexibly as you require. The drawback is that this very flexibility makes it much harder to achieve data integrity, because checks about the validity of data in linked tables must always be made explicitly, rather than being inherent in the defined relationships between the tables.

Tailoring

Paradox has a full command language, very similar to dBaseIII (including procedures with parameters) but with some extra features such as arrays of memory variables. Ansa expects people to start using these features via the script recording mechanism, which allows you to string keystrokes together and record them in a script for later re-use. The script can subsequently be edited and expanded, using both keyboard commands (with function keys being represented by visible equivalents) and

non-interactive commands such as conditionals (IF/THEN/ELSE) and loop control (for example, WHILE/END-WHILE). An editor for scripts is included in Paradox, but you can edit them with your favourite word processor if you prefer. When complete, scripts are held in an intermediate form which should be faster in execution than a full interpreted form.

Links with outside

Paradox includes the ability to import and export files in a variety of formats, including Lotus 1-2-3. WKS files, dBase DBF files (Paradox can distinguish for itself between dBaseII and dBaseIII data files), DIF and pfs files, and ASCII text files with any delimiter. Exporting and importing are very simple — not, as I know to my cost, a universal attribute!

In use

The basic Paradox approach is centred on the use of tables to store data and to handle queries and data entry. You can use forms as an alternative to tables, but you can't avoid tables. Control over Paradox operations is based on a combination of menus and function keys. The current menu is shown if you press F10, and is displayed along the top row of the screen. Menu options can be selected either by moving a highlighted bar with the cursor (in which case, an explanation of the menu option appears

below it) or by pressing the first letter of the option name. Most menus have sub-menus, and some of these show further options. So far, the approach is very similar to that of other packages aimed at naive users, but probably owes more to Lotus 1-2-3 and other spreadsheets than to conventional database systems.

Within tables, you can move around using the cursor keys, go to individual records using an equivalent of the spreadsheet GOTO, and use Ask to find an individual record. Functions keys are used to provide further movement and control functions, such as putting ticks in query fields, and moving up and down images on the screen.

When you become experienced, you will want to automate operations you perform regularly. To do this, you can record sequences of keystrokes in a script, or enter such commands directly using Paradox's own editor or any plain text editor or word processor. The command language includes a variety of statements which would not disgrace a programming language, allowing you complete control over processing, including the ability to set up menus, re-assign function keys and, if you wish, hide Paradox from the user altogether. This takes the ability to control processing much further than spreadsheets permit, though no further than the most advanced data management systems.

Nevertheless there are, as you might expect in such a new package, some rough edges. The production of reports on subjects of data is one good example, where you must go through a four-stage process to carry out an operation which, in a command-based package like dBaseIII, can be achieved in a single statement. I also had some problems persuading Paradox to allow me to edit a table when I had carried out several successive operations on a variety of tables since starting the system; Paradox is not always very good at releasing memory when it should. Ansa suggests, and it seems likely to me, that these problems (which can be remedied by leaving Paradox and restarting) do not arise when your system has 640k memory.

That brings up another point, that Paradox's unique mixture of virtual memory processing and regular disk saves can be expected to be exceptionally effective on small to medium-sized databases, but might not be so effective for larger files. On a 512k system, my Benchmarks on a 1000-record data table were no faster overall than comparable disk-based systems, but on the basis of handling smaller example tables, I would expect a

Package	Cost (\$)	Summary
dBaseIII	976	More advanced version of popular dBaseII package. Allows maximum 10 files open at once, which can be interrelated as you wish on a DIY basis. Flexible indexing, Command-based: can store sets of commands to get close to programming. Only on the IBM PC and clones
Paradox	995	Table-based system for the IBM PC, many similarities to Lotus 1-2-3. Tables can be related. Good querying and reporting, powerful command language. Keeps data in memory if possible; speed on larger tables should be checked. Easy to use at basic menu-driven level
Power-base	795	Powerful database management system with linking of many files, batch updating, up-to-date indexes, reporting adequate (no letter-writer), excellent links with other packages — for example, 1-2-3. No system development tools. Easy to use, documentation excellent
Reflex	249	Hybrid data management/spreadsheet/business graphics. All data must reside in memory, but can filter larger database from disk — updates done correctly when file is saved. Very cheap, good importing, so could provide reporting for other spreadsheets

Comparison of similar data management packages

significant improvement with a bit more memory. However, Paradox does not at present support any extended memory boards such as the Intel Above Board, but this must be an early development, and would greatly affect the effectiveness of the product for large databases.

Documentation

Paradox comes with an impressive — not to say intimidating — array of documentation, including: an introduction with tutorial examples, a user's guide (which includes a menu 'road map'), a guide to the PAL language, and two booklets — one for Lotus 1-2-3 users and one for dBase users. The documentation is well laid out and imaginatively presented, but it is organised totally around the Paradox menu and command options. This is fine most of the time, but occasionally makes it hard to find out how to do something which is not directly provided for in the menus.

Conclusion

Paradox has an extensive range of functions, and takes a novel approach to combining the best elements of data

management and spreadsheet methods of analysing structured data. It also has an extensive range of facilities for system developers. It should be clear by now that the interactive approach used by Paradox owes a good deal to that of

Summary

Supplier: Imagineering
Telephone: (02) 662 4499
Cost: \$995
Systems: PC
Version: 1.0
reviewed:

Features: Data management system: looks like a spreadsheet. Powerful data selection and reporting throughout. Can relate separate files. A keyed file must have a unique key (may be several fields). Stored key sequences plus full command language

Drawbacks: Reporting on linked tables rather clumsy; tables not always ideal. Performance on large files needs watching

Ease of use: At basic level very good, including menus and very visual form-filling. Transition to programming may not be easy

Lotus 1-2-3, so many people will be drawn to it as a way of getting data management facilities in a form with which they are already familiar. By and large, that would be a reasonable approach if the absence of graphics within the package does not worry you, and provided you accept that at least some of the functions you want to perform are likely to be tedious unless you are prepared to learn a little about scripts. This may not be as easy as all that, since the progression from keyboard use may be less natural in a package which builds individual commands onscreen as models of how stored commands work.

For those who are starting from scratch, the conclusion is less obvious. In particular, the table approach is not well suited to all kinds of data, and Paradox is not cheap, so it is well worth doing some initial exploration of your data and its properties before you decide (and perhaps even experimenting with one of the cheaper packages such as Reflex if your data will fit into the memory you have).

But there is no doubt that Paradox will be a force to be reckoned with, and should prove a powerful stimulus in the direction of integrating spreadsheet and database facilities.

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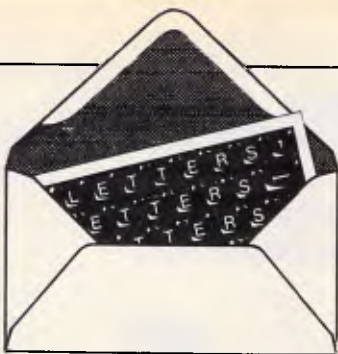
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A subtle difference

I enjoyed 'Banks' Statement', APC February, but I would take issue with two of his comments.

Firstly, he states that Babbage's Difference Engine was a computer. In fact, the Difference Engine was a special-purpose calculator which calculated tables of functions over a limited range of values. It was Babbage's later invention, the Analytical Engine, which

Infinity continues . . .

I have an answer, which I think is logical, and not intuitive, to C Walls' conundrum about infinity ('Letters', APC, January 1986).

It is true that the difference between commensurate terms in the series of even numbers and of odd numbers is unity, but it is unsigned. Mr Walls chose to derive the difference as follows: $(2, 4, 6, 8, \dots) - (1, 3, 5, 7, \dots) =$

use it in arithmetical calculations. In other words, it can be neither positive nor negative.

If you do not agree, then there is another conundrum. Which of the following is true (∞ signifies infinity)?
 $\infty - \infty = 0$ or
 $\infty - \infty = \infty$

If infinity can be used arithmetically, then the first must be true. But if you deduct any finite number from infinity, infinity remains — and, as demonstrated, deduction of one infinite series from another gives rise to a third.

Of course, I consider neither of them to be either true or false, but simply meaningless.

As it happens, after formulating the above reply, I have learned that Galileo made a similar inference about 450 years ago, and that alternative views have been expressed since. According to the theory that education of an individual must follow the stages of emergence of understanding in the history of the human race, I obviously have a long way to go.

B Sunderland

. . . infinite compromise

The answer to C Walls' conundrum (APC January 1986, page 99) is that both C and D are right.

More years ago than I care to remember, I learned at school that plus and minus infinity are, if not strictly mathematically 'equal', at least mutually interchangeable. This is easily demonstrable to anyone who

cares to plot the graph of $Y = 1/X$ from $X = -1$ to $X = +1$.

CS Harper

Radio-controlled Apple

I have an Apple II+ and would like to know if it is possible to write Applesoft programs for an RS232 interface card to control printers, modems and RTTY (in conjunction with amateur radio). Can you suggest ways of doing this, and advise me if the same program can control different modems or RTTY units?

I have seen a TTL to RS232 converter in kit form. Will this be suitable if it is used with the game paddle socket and programmed accordingly?

Is it possible to use the cassette input of the Apple to receive Morse (continuous wave) signals, finding the length of each dot or dash, and the gap between letters and words, and printing the message on the screen?

D Williams

You can certainly control printers and modems from your Apple, using any of the plug-in RS232 interface cards that are available. Most of these are based on a standard chip and offer a range of speeds from 75 up to 19200 baud. The most important speeds for modem communication are 75, 300 and 1200 baud. These are usually selectable by throwing small switches on the

Call no	CP/M	MS-DOS
1	Console input	Console input
2	Console output	Console output
3	Tape reader input (now often used for other special devices)	Auxiliary input
4	Tape punch output (now used for special devices)	Auxiliary output
5	List output (that is, printer)	Printer output
6	Direct console I/O	Direct console I/O

Figure 1

was a true computer. (See, for example, *Charles Babbage and his Calculating Engines* by P & E Morrison (editors), Dover Publications.)

Secondly, Banks implies that the similarities between CP/M and MS-DOS are little deeper than the prompt 'A>'. Fig 1 is a list of six of the system calls in each system.

Further similarities can be found in the other system calls. Could the resemblance between CP/M and MS-DOS be deeper than Mr Banks thinks? Or have I missed a subtle piece of irony?

JS Linfoot

$(+1, +1, +1, +1, \dots)$. However, in order to change the sign, it is not necessary to start the series with zero, because:

$(1, 3, 5, 7, \dots) - (2, 4, 6, 8, \dots) = (-1, -1, -1, -1, \dots)$
In fact, it does not make any difference where in the series you start.

Furthermore, if you state that A is infinitely less than B, this does not infer 'minus infinity', since it is also true that B must be infinitely greater than A.

Consideration of Mr Walls' conundrum has led me to believe that infinity cannot be treated as though it were a number, and it is meaningless to attempt to



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April Newsletter



Hello again,

Just been to the Sydney APC show. The most prominent new product was the Laserwriter Plus linked to the Macintosh. Teamed with PageMaker software it creates a simple and powerful "instant publishing" machine. Great news for anyone who prints anything. (We may even buy one ourselves!)

New Products: With the reduction in tariffs we've been able to get hold of quality imported disks cheaper than the local product. C.I.S. double-sided, double-density 5¼" disks (Japanese manufacture, Taiwanese assembly) are now in stock for your IBM etc at \$24 per box or \$220 per 10 boxes. Imported 3½" disks are also now available. SKC SSDD: \$4.50 inc, DSDD: \$5.50 inc.

Our house branded disks are now being manufactured by XIDEX (who took over Control Data's manufacturing), and by Ver-you-know-who. Specify manufacture you require. Prices are at their lowest point ever at \$1.80 and will probably rise by June as we have reached the best volume price-break available and will now be more susceptible to normal market forces. Printer price have risen about 15% due to the stronger YEN, but we have 20 or so 1090 printers at the old price of \$369. They won't last 10 days so hurry!

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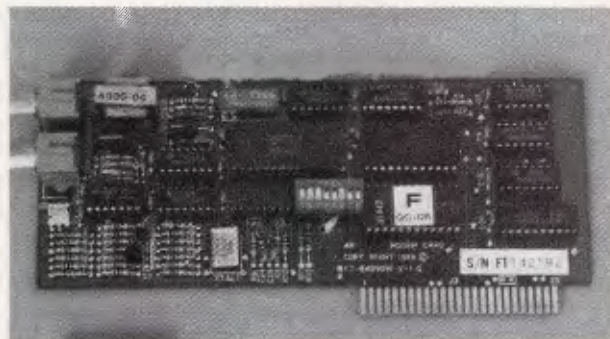
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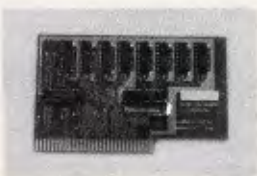
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card, although more expensive cards allow you to change the speed with software — this is obviously more convenient, but it complicates the electronics.

A modem will convert the groups of pulses sent from the interface card into audio tones which can be transmitted by telephone or radio. You could try directly transmitting the tones from the Apple's cassette port, but a wide bandwidth is required — at least 9KHz for reliable operation. The signal is very sensitive to distortion and you'll only be able to pass messages to other Apple users, so this is not really a practical option, especially as there are strict legal limits on the bands radio amateurs can use for data transmission.

RTTY is more difficult to cope with, as the tones used are not the same as those generated by common modems. Three different sets of tones are in common use — amateurs often use 1275 and 1445 Hertz for 0 and 1 respectively.

Another difference between modem communication and RTTY is the encoding system used for characters. ASCII (American Standard Code for Information Interchange) is the seven or eight-bit code used by most computers and modem links, whereas Murray or Baudot code (two names for the same thing) is used for RTTY. This is a five-bit code which uses two 'sets' of codes to communicate capital letters, digits and punctuation. The most common RTTY data rate is 50 baud, although other rates are sometimes used.

It should be clear that, in general, quite different software is needed for RTTY and modem communication. In the case of RTTY you might just as well take a signal directly

from the Apple's cassette port or game paddle socket, generating and decoding the tones in software. The data rate is slow enough to allow you to write the majority of the code in Applesoft Basic, although Integer Basic might be a better choice if you have it. A few short machine code routines will probably be required.

The game paddle socket only provides four single-bit digital outputs and three inputs, so it is probably not compatible with the conversion kit you mentioned. The socket also has a 'strobe' output and four slow analogue inputs.

The original Apple II Reference Manual (January 1978 — the one with a red cover and handwritten pages) contains the circuit of a mini RS232 interface. This is made from two transistors and three resistors, so I don't think you'll find anything much simpler. It is good enough to drive a printer, slowly, but it wouldn't be much use with a modem as it doesn't cater for character input.

You should be able to read Morse code through the Apple's cassette port. I've done this on my System 80, although I found the technique rather sensitive to fluctuations in keying speed and phrasing. I don't know of any commercial software to do the job, but the US amateur radio fraternity may be able to guide you in this regard.

Applesoft Basic is fast enough to cope with most Morse speeds, as long as you write your program carefully. It is best to try to make the system 'self-clocking' — that is, capable of adjusting automatically to the speed of the input.

One way to do this is to measure the length of received tones and wait until you receive a tone at

least twice as long as its predecessor. Work out the duration midway between the two, and call anything shorter than that a dot and anything longer a dash. Dashes are supposed to be three times longer than dots, so this simple rule divides the two quite effectively. Build up the pattern of dots and dashes in a string as you go along. When you encounter a pause longer than a dash, compare the pattern you've found with an array of valid patterns. If you don't find a match, try to re-assess the data-rate; otherwise, print the corresponding character.

It is a good idea to keep valid patterns in two parts — those starting with a dot and those starting with a dash — as you then only need search one group when each character is received. A little trial and error will probably be needed to get things working, and a system like this can be imported almost indefinitely to cope with wider speed changes, background noise, and so on.

On the hardware side, a signal level of about four volts peak-to-peak at the cassette port can be sensed by PEEKing address — 16288. You'll probably have to derive this signal from a speaker output, as most head-phone outputs will lack sufficient output power. If the value you PEEK is intermittently greater than 127, a tone is being received; if it is consistently less than 128, there is no tone. The pitch is not important, as long as it is audible; you'll need a beat frequency oscillator to detect a continuous wave signal in any case, so you should be able to select the pitch manually. SG

Tracing the bug

I have been very impressed

with the Trace/Step/Walk utility in 'Programs' APC December 1985, which is even better than the Trace option on Simon's Basic. Unfortunately, I have just one problem. I have saved a machine code version as explained in the REM statements, but I cannot load this using lines one and two when I have a program in memory, since I have saved to disk and the lines require tape input.

I have tried juggling with lines such as LOAD "Trace*",8 instead of just LOAD, but this crashes horribly. I do not mind having to type NEW, load Trace and then load my program again, but it would be useful to be able to bypass this kerfuffle. Does the author have any comments?

P Bilbrough

The author, Alexander Sassoon, tested the program from disk so it should work as you would wish it to. You should make certain that there is an End command at the end of line one. The command you specify in your letter will load anything on the disk with a name starting with the word 'TRACE', so you might cure the problem by typing the name in full: LOAD "TRACE/STEP/WALK",8

From looking at the loading routine, it seems that the computer would be certain to crash if the variable K was set to any value other than zero before lines one and two were invoked. If your program sets K you should invoke line one with RUN rather than GOTO, as RUN re-initialises all variables. If you don't want to clear the variables you could use K=0:GOTO 1 instead of RUN, but don't put the K=0 command in either line — it must be typed as a direct command.

SG

END



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Reverse but not perverse

Reverse Polish Notation calculators are useful to those in the fields of science, engineering and commerce but, unfortunately, they do not come cheap. Robert Pearson offers a program simulation of a scientific RPN pocket calculator which you can modify on your own micro to suit your specific requirements.

Someone once said that the most important changes in the world are made, not by politicians, soldiers or scientists, but by the inventors of timely names for new ways of thinking.

Whether this is right or not, there is no doubt that the way people think is often conditioned by the phrases available for expressing thoughts. Some contemporary examples are: Personal Computer; Single Parent Family; and Health Foods.

Perhaps an equally important principle is just the opposite: that the burden of a repulsive name can seriously damage the health of a good idea. A classic example is Reverse Polish Notation (RPN) which strikes a chill in the mind of many a newcomer to computing. The alternative name of Postfix Notation is at least descriptive, but not much more enticing!

There are several important uses of RPN in computing; for example, in high-level languages such as Forth and in machines that use a stack for computing rather than an accumulator plus registers. Another useful application is in pocket calculators used for professional work in the fields of science, engineering and business. The use of such calculators is very easy to master and affords a splendid introduction to the uses of RPN generally.

Unfortunately, RPN calculators are not among the cheapest available today, and most people would not wish to make the investment merely as an experiment. The program offered here simulates a basic scientific RPN calculator so that the experiment can be carried out on your own micro.

COMMANDS		
CALCULATOR BUTTON	COMPUTER KEY	
ENTER	SPACE BAR	H
CHANGE SIGN	Letter	E
EXPONENT of 10 (e.g. for 1.2×10^{-3} type 1.2EH3)		
ROLL THE STACK		X
ZERO THE STACK		Z
DELETE X ONLY		D
SWAP X WITH Y		W
COPY X TO MEMORY		M
RECALL X FROM MEMORY		L
INPUT "PI"		F

FUNCTIONS OF X		
INVERT (RECIPROCAL)	$1/X$	V
SQUARE	X^2	O
SQUARE ROOT	\sqrt{X}	R
COMMON LOGARITHM	$\log_{10}(X)$	B
NATURAL LOGARITHM	$\log_e(X) = \ln(X)$	N
EXPONENTIAL	e^X	X
SINE	$\sin(X)$	S
COSINE	$\cos(X)$	C
TANGENT	$\tan(X)$	T
ARC SINE	$\sin^{-1}(X)$	I
ARC COSINE	$\cos^{-1}(X)$	O
ARC TAN	$\tan^{-1}(X)$	A

FUNCTIONS OF X AND Y		
ADDITION	$X+Y$	+
SUBTRACTION	$X-Y$	-
MULTIPLICATION	$X \times Y$	*
DIVISION	X/Y	/
EXPONENTIATION	X^Y	Y

Fig 1 Commands and functions of the simulated calculator

Algebraic Notation

Let us first examine the 'Algebraic Notation' system with which we are all familiar, but often accept, uncritically, when using ordinary calculators.

In the simplest of arithmetic calculations, the keystrokes needed follow the same sequence as the written expression:

Example 1:

$$2 + 2 = 4$$

requires four key strokes:

$$2 + 2 =$$

But when a more complicated calculation is required, including trigonometrical or other mathematical functions, the sequence required is not always the same:

Example 2:

$$10 \sin 30 = 5$$

needs five keystrokes:

$$10 * 30 \sin =$$

Example 3:

$$1 \sqrt{3^2 + 4^2} = 0.2$$

requires 11 keystrokes:

$$1/(3 \times X^2 + 4 \times X^2) \sqrt{=}$$

or tackling it from the other end, only eight keystrokes:

$$3 \times X^2 + 4 \times X^2 = \sqrt{1/X}$$

In each of these examples, you have to interrupt the flow of the written algebraic layout and *reverse* the *normal* sequence to evaluate a function.

The sine of angle 30, therefore, is evaluated by keying in the numeric datum (30) and then evaluating the function by the required operation (sin). Similarly, the square root operation has to be keyed in after, not before, the number on which it operates.

In Reverse Polish Notation, this requirement is accepted as the normal way of doing *everything*, so that one unchanging rule is always applied: DATA FIRST, OPERATOR LAST

In RPN you always ensure that the system is given all the relevant data (operands) before you specify the operator to be used on them. This is so simple and logical that once grasped it is

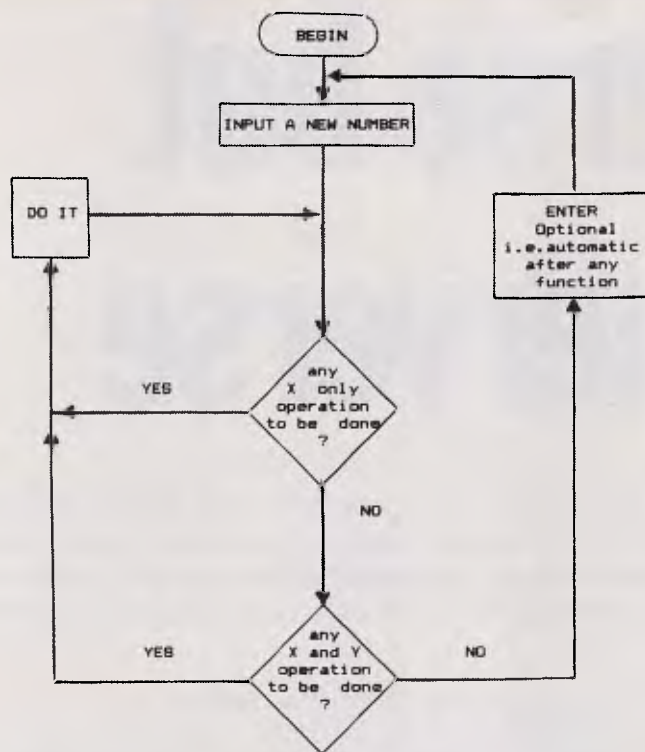


Fig 2 Algorithm of the simulated calculator

unforgettable, and seems quite natural in practical use.

Calculator simulation

The next, main section will be easier to follow and more fun, if you set up the simulation program on your own micro.

It was written for a Research Machines 480Z (using Basic version 6.3B*) but most of the language refinements have been ignored, so that with little or no modification the program can be made to suit most machines.

The many functions are listed in Fig 1 and each is obtained by a single

keyboard character. The characters are chosen to give some mnemonic help; for example, G for common log and N for natural logarithm. The operational algorithm is shown diagrammatically in Fig 2. The simulated calculator has a stack of four registers (Fig 3) labelled X, Y, Z, T and has one separate memory location, M. The simulation allows us to keep an eye on the whole stack and the separate store (though in a real calculator, only the X register would be visible in the display).

Try a very simple calculation such as $2 + 3 + 4 = 9$ and watch the behaviour of the stack (see Example 4).

The only operation that is significantly different from a common calculator is Enter. This button enters a copy of the X-register contents into the Y-register for later use, and raises the rest of the stack to make room (Z copies Y and T copies Z); the top register contents are lost. This action is shown in Fig 4. In the simulation program, the space bar is used for Enter.

No Equals button is needed because the answer (9) appears as soon as the last operation is completed.

The system is remarkably easy to use, and there are hidden subtleties which contribute to the convenience.

For example, after the first $+$ operation two things happen automatically:

(a) the stack drops, leaving the result in X; and

(b) a flag (F in the program) is set to enable an automatic raising of the stack (auto-Enter) if another number is typed.

So, as soon as the 4 is typed in, the stack rises to save the earlier result (5) ready for a new operation. The only time you press the Enter button is to save the very first number entered or to postpone dealing with a number while a later one is processed. Example 5 shows this by using Example 3 again ($1/\sqrt{3^2 + 4^2}$) but this time, using RPN.

Although this is the best way to tackle it, you may prefer to start at the left-hand side and keep to a left-to-right sequence throughout, as shown in Example 6.

Note how the stack accommodates the data with almost no effort demanded from the user. If uncertain what to do next, just ask yourself: 'Have I given all the data for the next operation?' If more data has to be inserted before the next operation, then pressing Enter pushes the existing data one layer further up the stack to make room.

Although a stack with only four layers may seem small by computer standards, it comfortably accommodates virtually all possible calculations if they are tackled by the method shown in Example 4 — and this is the normal way of using RPN

KEY →	2	ENTER	3	+	4	+
Register T	0	0	0	0	0	0
Z	0	0	0	0	0	0
Y	0	2	2	0	5	0
Display X	2	2	3	5	4	9

Example 4

Key →	3	Q	4	Q	+	R	V
Register T	0	0	0	0	0	0	0
Z	0	0	0	0	0	0	0
Y	0	0	9	9	0	0	0
X	3	9	4	16	25	5	0.2

Example 5 Note that Q is used for + sQuared, R for Root and V for Vert

Key →	1	ENTER	3	Q	4	Q	+	R	/
Register T	0	0	0	0	0	0	0	0	0
Z	0	0	0	0	1	1	0	0	0
Y	0	1	1	1	9	9	1	1	0
X	1	1	3	9	4	16	25	5	0.2

Example 6

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- Purchase Order accepts back orders and returns
- Purchase journal
- Automatic interfacing with General Ledger Payables and Inventory

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- Ability to customise invoice for remarks
- Allows return credit memo
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PROGRAMMING

pocket calculator.

Occasional hiccups can usually be circumvented using the separate one address memory M (for instance, when a constant like 0.15 is required repeatedly).

In computer applications the stack can be much larger than four registers (that is, memory addresses for variables), and the completely consistent serial entry of data and operators can normally be followed with no problem of stack size limitation. The program could easily be modified to incorporate a larger stack if desired.

For most common calculations, including quite complicated scientific and engineering design work, the stack limitation is almost a positive advantage because it makes the user organise the calculation into manageable blocks. For instance, it would be all too easy to lose track of a long continued fraction calculation if you insist upon starting at the left-hand side (whichever calculator system is used).

Example 7:

$$\begin{array}{r} 1 \\ 2 + 1 \\ (3 + 1) \\ (4 + 1) \\ (5 + 1) \\ (6 + 1) \\ (7 + 8) \end{array}$$

To make it easy to follow, it is best to start at the far end and evaluate 7+8 first, then 1/15, and so on — for instance, by using the keystrokes shown in the box below.

This example would certainly overflow the little four-layer stack if it were tackled serially from left to right, but you would also find such a sequence very hard to act on, some operators being delayed in action for so many steps. The corresponding problems arise in an ordinary calculator if there are insufficient pairs of brackets and there is the irritation of ensuring matching left-right pairs.

If you remain unconvinced, you might try the left to right method using an Algebraic system. It would look like this:

$$1/(2 + (1/(3 + (1/(4 + 1/(5 + 1/(6 + 1/(7 + 8))))))))=$$

7 ENTER 8 + V displaying	0.066666
6 + V	0.164835
5 + V	0.193617
4 + V	0.238458
3 + V	0.308789
2 + V	0.433128
1 + V and the final result	0.697775

Keystrokes for Example 7

```

1 GOTO 6
2 REM DISPLAY : RESET : GET KEY
3 GOSUB 2000 : N$="":J$="0":D=0:E=0:GOTO 500
4 REM DROP STACK : DISPLAY : RESET : GET KEY
5 GOSUB 1900 :GOTO 2
6 PRINT "=====
10 PRINT " RPN SCIENTIFIC CALCULATOR SIMULATION "
20 PRINT " COPYRIGHT R.H.PEARSON (SEPT 85) "
30 PRINT " PLEASE SET CAPITALS LOCK BEFORE STARTING "
40 PRINT " USE H (NOT MINUS - ) TO CHANGE SIGN "
60 PRINT " USE @ TO FINISH "
70 PRINT "=====
100 P=PI 'USE 3.14159 IF NO PI IN YOUR COMPUTER ALREADY
110 M=0 'MEMORY ZEROED BEFORE START; STORE 0 THERE LATER IF REQUIRED
200 REM OMIT ALL COMMENTS UNLESS THEY SUIT BOTH YOU & YOUR COMPUTER
220 IMAGE ***** 'SET THE NUMBER FORMAT TO SUIT
250 REM 'OR JUST OMIT THE IMAGE STATEMENT
300 GOTO 1520 'CLEAR ALL REGISTERS (EXCEPT M) AND FLAGS
400 REM-----
500 K$=GET$( ) 'LOOP BACK HERE (OFTEN VIA LINES 2 OR 4)
510 IF K$="0" THEN 9000 'TO EXIT PROGRAM
520 IF K$="H" THEN 1200 'CHANGE SIGN
530 IF K$="E" THEN 1100 'SCIENTIFIC NOTATION
540 IF K$>"9" AND K$<-"9" THEN 1000 'NEW NUMBER
550 IF K$="Z" THEN 1500 'ZERO THE STACK (X,Y,Z,T BUT NOT M)
560 IF K$="," THEN 1300 'DECIMAL POINT
570 IF K$=" " THEN 1700 'ENTER
610 IF K$="+" THEN 2100 'ADD
620 IF K$="K" THEN 2200 'ROLL THE STACK
630 IF K$="-" THEN 2300 'SUBTRACT
640 IF K$="*" THEN 2400 'MULTIPLY
650 IF K$="/" THEN 2500 'DIVIDE
660 IF K$="V" THEN 2600 'INVERT (RECIPROCAL)
670 IF K$="R" THEN 2700 'SQUARE ROOT
680 IF K$="W" THEN 2800 'SWAP X AND Y
690 IF K$="D" THEN 2900 'DELETE X REGISTER ONLY
700 IF K$="S" THEN 7000 'SINE
710 IF K$="C" THEN 7100 'COSINE
720 IF K$="T" THEN 7200 'TANGENT
730 IF K$="B" THEN 7300 'COMMON LOG
740 IF K$="N" THEN 7400 'NATURAL LOG
750 IF K$="Y" THEN 7500 'X TO POWER Y
760 IF K$="X" THEN 7600 'EXPONENTIAL
770 IF K$="Q" THEN 7700 'SQUARE
800 IF K$="A" THEN 8000 'ARCTAN
810 IF K$="I" THEN 8100 'ARCSIN
820 IF K$="O" THEN 8200 'ARCCOS
830 IF K$="M" THEN 8300 'MEMORY
840 IF K$="L" THEN 8400 'RECALL MEMORY
850 IF K$="P" THEN 8500 'CONSTANT PI
900 GOTO 500 'END OF KEY CHOICES
990 REM-----
1000 REM NEW NUMBER ASSEMBLED FIRST AS A STRING N$
1020 IF N$<>" " THEN 1080
1040 M$="----NEW NUMBER----";IF F=1 THEN GOSUB 1800
1060 PRINT:PRINT M$:GOSUB 2050:PRINT " ; 'NOTE SEMICOLON AT END
1080 PRINT K$;N$=N$+K$;X=VAL(N$);J$=K$;GOTO 500 'NOTE EARLY SEMICOLON
1090 REM
1100 REM SCIENTIFIC NOTATION USING E
1120 IF N$=" " THEN 1400
1140 IF E=1 THEN 1400
1160 D=0:E=1: GOTO 1000 'D E F ARE FLAGS
1190 REM
1200 REM CHANGE SIGN OF NUMBER OR ITS POWER OF TEN
1220 IF J$="-" OR J$="." THEN 1400
1240 IF J$="E" THEN 1280
1260 F=1:M$="----CHANGE SIGN----" : X=-X : GOTO 2
1280 K$="-" : GOTO 1000
1290 REM
1300 REM DECIMAL POINT
1320 IF D=1 THEN 1400
1340 D=1:GOTO 1000
1390 REM
1400 M$="----INVALID INPUT----" : X=0 : GOTO 2
1490 REM
1500 M$="----CLEAR STACK----"
1520 X=0:Y=0:Z=0:T=0:L=0:D=0:E=0:F=0:N$="":J$="0": GOTO 2
1590 REM
1700 M$="-----ENTER-----"
1730 GOSUB 1800 : GOTO 2
1740 REM
1800 REM RAISE STACK & RESET FLAG F
1820 T=Z : Z=Y : Y=X : F=0 : RETURN
1830 REM
1900 REM DROP STACK
1920 Y=Z : Z=T : RETURN

```

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Reverse Polish Notation (RPN) scientific calculator simulation

(Scientific calculator simulator continued)

```

1930 REM
2000 REM MAIN PRINTOUT
2020 PRINT : PRINT M$
2030 GOSUB 2050 : PRINT X; 'NOTE SEMICOLON AT END
2040 RETURN
2050 PRINT "T ";T
2060 PRINT "Z ";Z
2070 PRINT "Y ";Y,"M ";M
2080 PRINT "X "; 'NOTE SEMICOLON AT END
2090 RETURN
2100 F=1 : M$="-----X=Y+X-----" : X=Y+X : GOTO 4
2200 F=1 : M$="----ROLL STACK----" : L=X : X=Y : Y=Z : Z=T : T=L : GOTO 2
2300 F=1 : M$="-----X=Y-X-----" : X=Y-X : GOTO 4
2400 F=1 : M$="-----X=Y*X-----" : X=Y*X : GOTO 4
2500 M$="ERROR DIVIDE BY ZERO" : IF ABS(X)<1E-37 THEN 2
2540 F=1 : M$="-----X=Y/X-----" : X=Y/X : GOTO 4
2600 M$="ERROR RECIPROCAL OF ZERO" : IF ABS(X)<1E-37 THEN 2
2640 F=1 : M$="-----X=1/X-----" : X=1/X : GOTO 2
2700 M$="ERROR ROOT OF NEGATIVE NUMBER" : IF X<0 THEN 2
2740 F=1 : M$="----X=SQR(X)-----" : X=SQR(X) : GOTO 2
2800 F=1 : M$="----SWAP X&Y-----" : L=X : X=Y : Y=L : GOTO 2
2900 F=0 : M$="----CLEAR X-----" : X=0 : GOTO 2
7000 F=1 : M$="-----X= SIN(X)-----" : X=SIN(X*P/180) : GOTO 2
7100 F=1 : M$="-----X= COS(X)-----" : X=COS(X*P/180) : GOTO 2
7200 M$="ERROR TAN(X) INFINITE"
7210 IF XMOD180<>0 AND XMOD90=0 THEN 2
7220 F=1 : M$="-----X= TAN(X)-----" : X=TAN(X*P/180) : GOTO 2
7230 REM
7300 M$="ERROR LOG OF NEGATIVE NUMBER" : IF X<0 THEN 2
7310 M$="ERROR LOG(0) IS MINUS INFINITY" : IF X=0 THEN 2
7320 F=1 : M$="-----X= LOG(X)-----" : X=LOG(X)/LOG(10) : GOTO 2
7400 M$="ERROR LN OF NEGATIVE NUMBER" : IF X<0 THEN 2
7410 M$="ERROR LN(0) IS MINUS INFINITY" : IF X=0 THEN 2
7420 F=1 : M$="-----X=LN(X)-----" : X=LOG(X) : GOTO 2
7500 F=1 : M$=" X= (X TO POWER Y) " : X=EXP(Y*LOG(X)) : GOTO 4
7600 F=1 : M$="-----X= EXP(X)-----" : X=EXP(X) : GOTO 2
7700 F=1 : M$="-----X=X*X-----" : X=X*X : GOTO 2
7710 REM
8000 F=1 : M$="-----X=ARCTAN(X)-----" : X=180*ATN(X)/P : GOTO 2
8100 M$="ERROR ABS(X)>1 FOR ARCSIN(X)" : IF ABS(X)>1 THEN 2
8120 F=1 : M$="-----X=ARCSIN(X)-----"
8130 IF X=-1 THEN 8160
8140 IF X=1 THEN 8170
8150 X=180*ATN(X/SQR(1-X*X))/P : GOTO 2
8160 X=-90 : GOTO 2
8170 X=90 : GOTO 2
8200 M$="ERROR ABS(X)>1 FOR ARCCOS(X)" : IF ABS(X)>1 THEN 2
8210 F=1 : M$="-----X=ARCCOS(X)-----"
8220 IF X=-1 THEN 8260
8230 IF X=0 THEN 8270
8240 IF X<0 THEN 8280
8250 X=180*ATN(SQR(1-X*X)/X)/P : GOTO 2
8260 X=180 : GOTO 2
8270 X= 90 : GOTO 2
8280 X=180+180*ATN(SQR(1-X*X)/X)/P : GOTO 2
8300 F=1 : M$="-----M=X-----" : M=X : GOTO 2
8400 M$="-----X=M-----" : GOSUB 1800 : F=1 : X=M : GOTO 2
8500 M$="-----X=PI-----" : IF F=1 THEN GOSUB 1800
8510 F=1 : X=P : GOTO 2
9000 END

```

Pocket calculators

In the early days of pocket electronic calculators, both the best and the cheapest (Hewlett-Packard and Sinclair) used RPN for data and instruction entry, but since then the cheaper calculators have standardised on Algebraic Notation.

That the Algebraic types carried the day in terms of quantity sales was as much a triumph of advertising as of good sense, and so it remains today. The advertisements that originally helped to make it popular emphasised applications in which the logic seemed obvious, but kept rather quiet about the fact that RPN was being used for function evaluation.

Real pocket calculators are, in some

respects, superior to the simulation (although most of the facilities of a typical scientific calculator have been incorporated here).

Apart from the obvious matter of portability, there is usually a greater numerical precision in the calculators (often 10 significant figures) and, in the very best ones, great care is given to the behaviour of the algorithms used for producing the mathematical functions. Also, the number range before overflow is often greater — for example, 10^{-99} or even 10^{+499} instead of the rather miserable 10^{+38} typical of personal computers.

The Hewlett-Packard range of pocket calculators using Reverse Polish Notation has led the field for

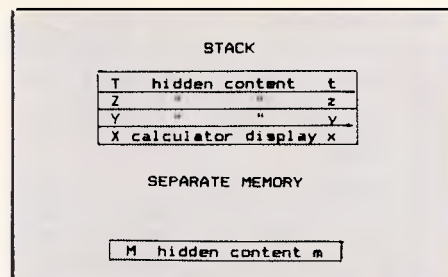


Fig 3 In a pocket calculator, only one register is displayed. In the simulation all are visible.

STACK	BEFORE	AFTER
T	t1	z1
Z	z1	y1
Y	y1	x1
X	x1	x1

Fig 4 Action of the Enter command; the stack is pushed up (t1 is discarded) to make room for a copy of x1 in the Y register

STACK	BEFORE	AFTER
T	t1	t1
Z	z1	t1
Y	y1	z1
X	x1	x2

Fig 5 Effect of a function operating on the contents of both X and Y. The result appears in X and the stack drops, copying downwards

many years. One of the earliest was the HP35 which cost nearly \$400 for a straightforward scientific calculator. At the time it seemed utterly fantastic, and indeed was used by many an electronics engineer to do quicker and more precise calculations than could be done by tedious batch processing using large expensive mainframe computers! Although that price was several times the cost of a comparable calculator today, many of those early calculators have survived virtually a generation of use and are still going strong.

Continued over page

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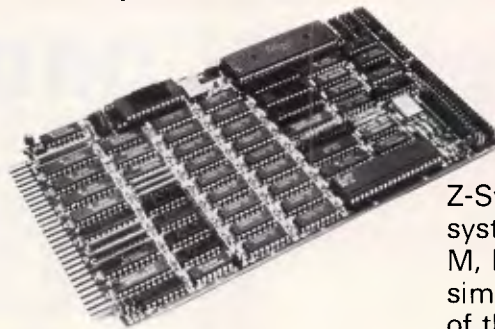
<pre> T 0 Z 0 Y 0 M 0 X 0 --NEW NUMBER-- I 0 Z 0 Y 0 M 0 X 3 --ENTER-- T 0 Z 0 Y 3 M 0 X 3 --X=Y*X-- T 0 Z 0 Y 0 M 0 X 9 --NEW NUMBER-- T 0 Z 0 Y 9 M 0 X 4 --X=X*X-- T 0 Z 0 Y 9 M 0 X 16 </pre>	<pre> --X=Y+X-- T 0 Z 0 Y 0 M 0 X 25 --X=SQROOT(X)-- T 0 Z 0 Y 0 M 0 X 5 --CLEAR STACK-- T 0 Z 0 Y 0 M 0 X 0 --NEW NUMBER-- T 0 Z 0 Y 0 M 0 X 1 --ENTER-- T 0 Z 0 Y 1 M 0 X 1 --NEW NUMBER-- T 0 Z 0 Y 1 M 0 X 2 </pre>	<pre> --X=Y/X-- T 0 Z 0 Y 0 M 0 X .5 --X=PI-- T 0 Z 0 Y .5 M 0 X 3.14159 --X=Y/X-- T 0 Z 0 Y 0 M 0 X .159155 --NEW NUMBER-- T 0 Z 0 Y .159155 M 0 X 1E-3 --X=Y/X-- T 0 Z 0 Y 0 M 0 X 159.155 --X=LOG(X)-- T 0 Z 0 Y 0 M 0 X 2.20182 </pre>	<pre> --X=LN(X)-- T 0 Z 0 Y 0 M 0 X .789284 --X=ARCCOS(X)-- T 0 Z 0 Y 0 M 0 X 37.8813 --X=TAN(X)-- T 0 Z 0 Y 0 M 0 X .777956 --X=ARCTAN(X)-- T 0 Z 0 Y 0 M 0 X 37.8813 --X=SIN(X)-- T 0 Z 0 Y 0 M 0 X .614028 --NEW NUMBER-- T 0 Z 0 Y .614028 M 0 X 2 </pre>	<pre> --SWAP X&Y-- T 0 Z 0 Y 2 M 0 X .614028 --M=X-- T 0 Z 0 Y 2 M .614028 X .614028 --X=(X TO POWER Y)-- T 0 Z 0 Y 0 M .614028 X .37703 --X=M-- T 0 Z 0 Y .37703 M .614028 X .614028 --X=EXP(X)-- T 0 Z 0 Y .37703 M .614028 X 1.84786 ERROR ABS(X)>1 FOR ARCSIN(X) T 0 Z 0 Y .37703 M .614028 X 1.84786 --CHANGE SIGN-- T 0 Z 0 Y .37703 M .614028 X -1.84786 Ready! </pre>
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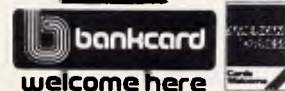
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Nolan's pets

How would you like to own a robot pet? Nolan Bushnell feels that's the way the market is going, with lucrative profits to be made. In our occasional series of interviews, Robin Bradbeer talks with Nolan Bushnell about his robot dream-becomes-reality and his plans for the future.

Bushnell has been called America's answer to England's Clive Sinclair. He started the video game business and founded Atari, which he then sold to Warner Bros before Jack Tramiel bought it. Bushnell then started a number of new ventures including Pizza Time Theaters, a fast-food chain based on video games and robots, and also founded Androbot, an unsuccessful venture into the personal robot business. He has a number of companies in all areas of high technology, including his latest, Axlon, which is marketing robot pets called Petsters.

Q. What's your view of the robot business after the Androbot debacle?

A. The robot business for me has been a real disappointment; I don't like to lose at anything. Up until now, robots have used up a tremendous amount of my capital and returned nothing. God obviously did not intend us to succeed with 'the robot'. The process of creating life has been reserved exclusively for Him, so we have to fight divine intervention if we are to do this. That's one of the reasons why robotics problems are so damned hard. All of us who got started in this business confidently expected to build a machine which behaved as a robot. We thought that it would be easy and we were wrong; it's hard. Now some of us who are still stubborn have decided to take a different tack. We must take into account the disparity between public perception and reality. R2D2 and C3PO created a public expectation of what the Personal Robot can do; this makes things tough. If you had a trillion dollars you couldn't produce the kind of product which could sell for \$10,000.

My new tack is to look at the kind of things which might offend God less! I decided that rather than go for the anthropomorphic-human being type of robot, I would go for one of his lesser creatures: the dog or the cat! There were



Nolan Bushnell, the robot man

'... I don't like to lose at anything. Up until now, robots have used up a tremendous amount of my capital and returned nothing.'

two reasons for this. Firstly, it might appease the divine intervention problem; secondly, it might create, in terms of public perception anyway, a lower expectation.

Q. What do you mean?

A. Well, no-one has ever asked 'Can your cat clean the windows?' I feel *that alone* is major progress. When people ask 'But what can it do?', I reply: 'Have fun with it — it's a companion.' In so doing we have stripped away a tremendous amount of problems. Not a single cat or a single dog has an opposing thumb, so the whole problem of picking things up and putting them away doesn't exist. A cat robot is

not expected to pick things up. Also, dogs and cats are incapable of speech, so there are no problems with speech synthesis. A 'meouw' is a meouw all over the world, so linguistic problems do not exist! Most importantly we can produce it at a reasonable price, around \$35-40 for a small cat, with a bigger cat retailing at approximately \$100.

Q. What do these animal robots do?

A. They run around the home; they wake up; they hear sounds when you call them; they can find their way to you about 90 per cent of the time, which is a lot better than a real cat! They will play games with you — which might also be more rewarding than playing with your own cat! (We will, however, have to wait a few years for the turbo-boost model which will jump up onto your lap!) We think we have done a pretty good job.

Q. Will they sell?

A. I think we've got the formula right this time: the public likes them. We will probably do \$10-20 million business this year which is a start, so we obviously haven't offended God too much. We have taken the differential between what the public *expects* and what the public *will buy*, and we have hit a reasonable price. Now we have something we should have had all along — a base by which each year my cats and dogs will get smarter and they will do slightly better things. And just as surely as with the process of evolution, God won't know what happened to Him!

Q. What's inside these 'pets'?

A. A four-bit microprocessor, some sound sensors and some audio circuitry. The least sophisticated version, which is no more than an audio-controlled toy, is called Petster. It's made in Korea. The more upmarket version is called Petster De Luxe and is made in Hong Kong. It has infra-red sensors and the ability to respond to simple speech patterns. A

leash is supplied in order to control it, and there is a programmable stack so that it can run simple programmable movements. It also has elementary wheel tachometers so that it doesn't spin around, and the wheels are big enough to ensure that he's fully 'carpet-compatible'.

Q. How easy is it for the average person to train one of these 'Petsters'?

A. It all depends on how smart you are! It's easy enough for a child to play with while being complex enough for Dad to have to read the instruction book: there are 56 distinct instructions for the Petster De Luxe, and it'll take you a day to become familiar with all of them. However, basically, you just clap your hands to control the Petster. For example, when it's turned, it's in sleep mode, so clap once (it will correlate

where the sound is coming from), and it will rotate and move forward about 18-24°. The Petster will find you by a series of approximations which pinpoint the sound. If I were to give two claps, the Petster would be able to determine where the sound was coming from and run away. The effect is that if you position yourself between the Petster and someone you want the Petster to go to, you can essentially force it to meet that person. If you were to clap three times, the Petster branches into what I call the 'Obey' mode and follows your instructions for forwards, backwards, right and left. If you give it two double claps, it meowws!

In order to return from the obey mode to the ready-to-play mode, you clap a double clap again. On the De Luxe version you can switch personalities: happy or sad. You can also get it to explore.

Q. Is there any feedback if the Petster fails to understand your instructions?

A. In the cat there's an algorithm which makes it shake its head if it doesn't understand your command.

Q. Have you had any problems with the acoustic sensors?

A. When travelling I've found that the Petster reacts to odd noises, air conditioning, and so on. I've improved it so that it will accept most sharp noises; for example, heavy stamping on the ground. Young kids may have problems, mainly with timing, although a good sense of timing can easily be developed.

Q. Were there any ideas you rejected in the development stages?

A. We did consider having the battery compartments as two long tubes so that when the batteries were dead, the Petster deposited little bundles on the carpet...

Q. What else do you get?

A. You have to remember that this is, after all, a pet: it is not expected to do anything worthwhile and I've tried to adhere to that principle. You get 90 days guarantee, a Petster Health Insurance Policy and a Pet-i-gree — something along the lines of the Cabbage Patch Dolls: I've tried to make it good fun.

Q. How do you see Axlon developing?

A. I intend to concentrate on competitive pricing: no more trying to pioneer the market by underpricing. I started this project very much from the outset not saying what do I want it to do but figuring out the price point I wanted to hit, and I intend to feature it to the hilt under the cost constraints of the profit generations. Make no mistake, this company is based on 'greed and avarice' with me making a bundle!

Q. Have you missed the market now that expectations in the personal computer market-place have turned sour?

A. I really would have liked to hit the market two years ago when computing fever was at its peak. My company is just beginning to ship these robots and I hope to have some on the shelves in Australia very soon. I don't think prices from \$50-\$200 (depending on the version selected) are too expensive. You can't get a motorised toy much cheaper than that!

Q. You're involved with many companies through Catalyst Tech-



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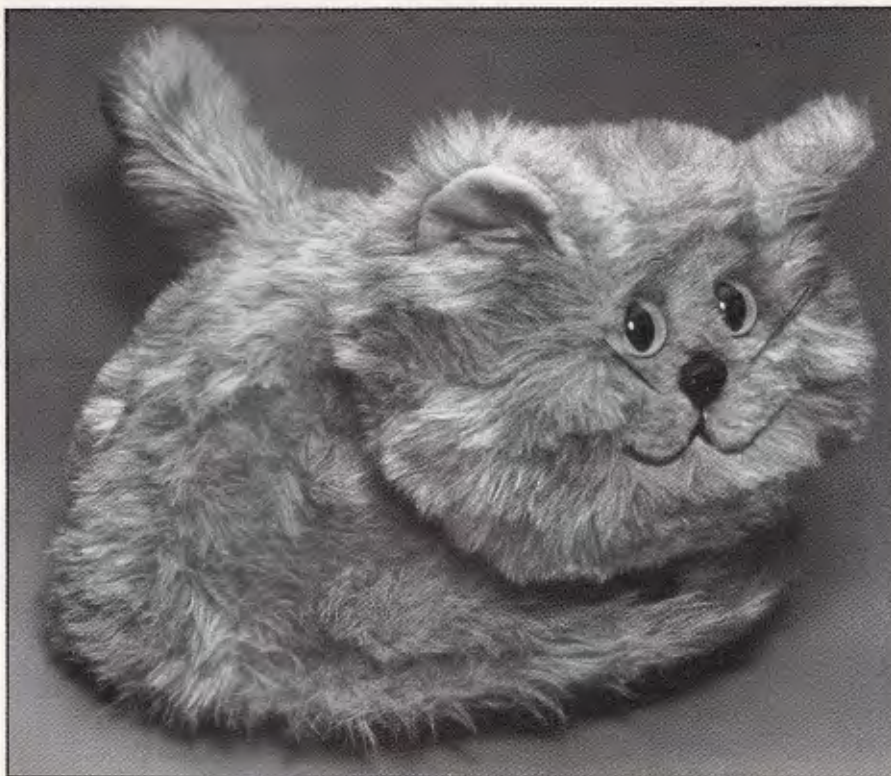
nologies. How much of your time is taken up with Axlon?

A. Most of my effort is going into this project. I've only been CEO of three companies, this being the third. I certainly see the electronic toys business occupying a fair bit of my time during the

"I certainly see the electronic toys business occupying a fair bit of my time during the next few years: it is where the personal robot market will begin."

next few years: it is where the personal robot market will begin. We really will have to start lower down the evolutionary chain if we want to make this market grow to meet our expectations.

Petsters are available at all Dick Smith stores.



This robot cat contains a four-bit microprocessor, sound sensors and audio circuitry: 'Have fun with it — it's a companion!' says Nolan Bushnell

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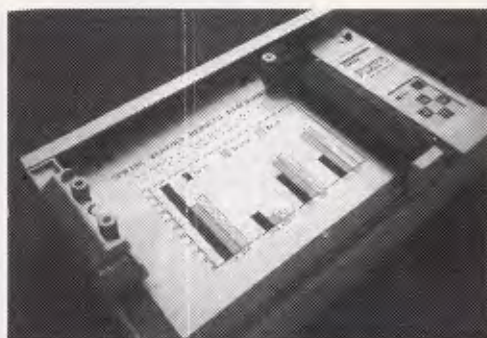
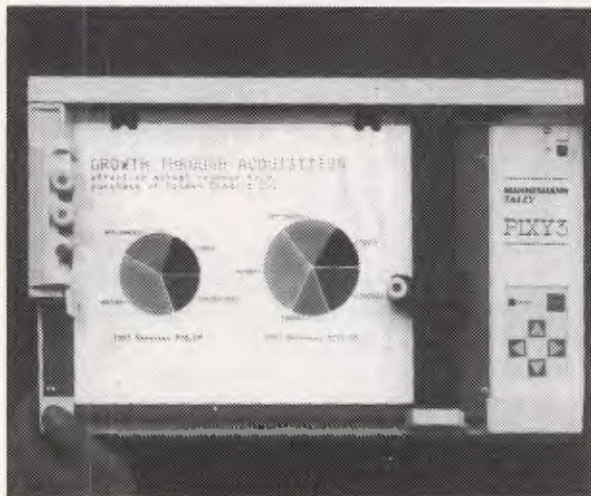
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Height: 12.3 cm (4.9 in)

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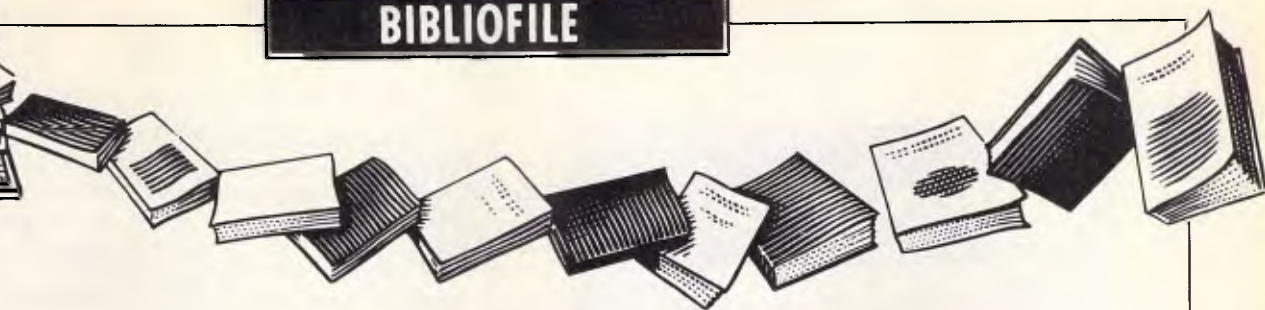
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David Taylor kicks off this month's book review with a rather embarrassing question, but finds solace in the hope of selling software.

DEREK ROWNTREE
**WHO NEEDS
A HOME
COMPUTER?**



Ask me another

Now is a fine time to ask. Here we are with our noses stuck into *APC*, no doubt with our fingers poised over the keyboard and all set to start hacking the night away, and along comes wet-blanket Derek Rowntree with a question like *Who Needs A Home Computer?* The man should be ashamed of himself.

Or at any rate ashamed of the kind of writing which appears to be saying something worthwhile by: (a) putting up a silly proposition; and then (b) knocking it on the head. Take, for example, these superficially wise words on whether or not you might choose to do a spot of word processing on your home micro: word processing has many potential advantages over plain typing/copying. But if you don't type, or don't

generate much typing, or can get typing done quite cheaply, it may not be worth your while to pay for those advantages.

Get away! This barmy argument strikes me as about as useful as pointing out that: 'Running a car has many potential advantages over going by bus/train. But if you don't drive, or don't go out much, or can get people to take you for nothing, it may not be worth your while to buy one.'

There is an irritatingly patronising tone throughout this book, which seems to imagine that because so much overblown advertising and hype surrounds the selling of home micros, all punters are dummies who need to be led away by the nose from making reckless purchases.

So, says Mr Rowntree, people may be being duped into believing they *must* have a computer at home to keep up with the high-tech Joneses. What they ought sensibly to

do, he says, is to examine methodically whether they want to play games, or need to keep electronic household files, or patch into information databases or can really use a micro as an educational tool.

On that last point, spoilsport Mr Rowntree asks: 'What are the alternatives?' And he goes on to suggest: 'Materials for drawing and painting, paper and cardboard, charcoal or crayons... household pets from caterpillars in a jar, through cats and dogs on the mat, to ponies, horses, goats, and a share in the family cow... musical instruments from tin drums, whistles and home-made noise-makers... or conversation, the element that can make almost any situation educational.'

So hands off your micro,

then, and let's be having you playing a tune to your caterpillar in its jar or just talking among yourselves about, well, charcoal and the tin drum, or the home-made noise-maker as a pet.

If you know nothing of home micros, yet suspect that you may be being had by an over-eager selling machine, this book might make you think. If on the other hand you *do* know a thing or two about computers in the home and are not so bereft of ideas as to sit drumming your fingers or reading this book, it might very well make you scream.

Title: *Who Needs A Home Computer?*
Author: Derek Rowntree
Publisher: Methuen
Price: \$16.95 (paperback)

Now hear this

As you might expect from someone with a name like Edward A Van Schaik, who's extruding a tome for \$75.50, with a title that's practically a paragraph in its own right yet is still incomprehensible, this one is not for the faint-hearted.

Unless you're well and truly steeped in the bewildering buzz jargon of all-American corporate management man. I defy anyone to stay awake through one of Ed Van Schaik's prolix, cerebellum-numbing, conceptual sentences — never mind his chapters — as he up-rolls his custom-tailored shirt-sleeves and plunges headlong into a mercilessly punishing analysis of the initiation, contagion, control and integration

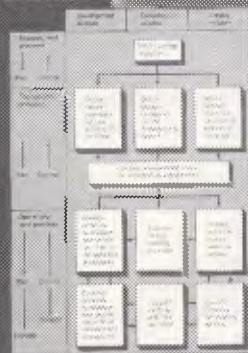
of US I/S functions at this moment in space-time.

Enterprising Ed's primary window, you may or may not wish to take on board, is IBM Corp's rational model of I/S Management Architecture, refracted through a second window on the evolution of that architecture model over time, plus a third on McKinsey & Co's 7-S organisation concept, *vis-a-vis* a business perspective for windows #1 and #2.

Y'all with me?

See, the thing is that Ed, who's from Dallas by the by, is anxious that the people resource in an in-office context should operate in a high-quality manner toward maximising its management capability for the greater glory of the US's Enterprise America Dream. Okey-doke.

A MANAGEMENT SYSTEM FOR THE INFORMATION BUSINESS: ORGANIZATIONAL ANALYSIS



EDWARD A. VAN SCHAIK

Now in order that they accomplish that, analytical teams corporate structure-wise ought advisedly to apply to integrate their data processing, office systems, information centres, use of PCs and LANs and so on, then what say we identify the upshot as consolidated I/S strategy at this time?

Oh yeah?

Sure thing. You gotta relate this I/S process model to that local situation, relate organisational responsibility to the I/S processes, define the requirements for standards, procedures and methodology, justify and prioritise, evaluate

and tune, check out your service mission processes, take a topdown overview, log malfunctions and maybe develop update data plans.

Remembering not to go nuts.

In short, if you can make head or tail of one of Ed's sentences in 10, why I'd say you're doing just fine.

Title: A Management System For The Information Business: Organisational Analysis

Author: Edward A Van Schaik

Publisher: Prentice Hall
Price: \$75.50

Try this for synthesize

It's a source of immense relief to me that Mozart came before Moog, or that Donizetti quit before the digital revolution. Try as I might to come to terms with Parisian *musique concrete* or Cologne's *Elektronische Musik*, let alone Zappa or Zinovieff, cloth-eared insensitivity as a rule prevails. All aggressively avant-garde music, so cun-

ningly concocted from manipulated juice, tends in the end to sound to me like a demented plumber's concerto for Klaxon, bin-lids, doorbell and underwater drills.

I have a sense of shame about this. When the ABC recently hammered out its Karlheinz Stockhausen week, I did sit for hours hoping for revelation, yet still had finally to admit that I'd get as much from sitting with my ear pressed to our Hoovermatic doing a full boil wash.

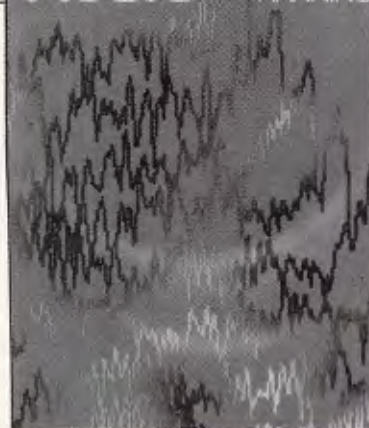
Notwithstanding this Philistine streak, let me say at once that I envy Peter Manning's empathy and greatly admire this excellent book. It's a lucid, well-informed and thoroughly entertaining history of 'artificial' music from its first (19th century) stirrings, through its uncertain progression until the second world war, the

explosive, 'classical' 1950s, and thus to the extraordinary strides which have been made in the last couple of decades, especially in works for tape, live electronic music and the use of electronics in rock.

An academic with considerable hands-on experience of computerised ker-plunks, Mr Manning strikes a nice

ELECTRONIC & COMPUTER MUSIC

PETER
MANNING



balance between critical perspective and technical know-how, but do not imagine either is by any means easily absorbed.

If your musical acuity is as pin-sharp as your predilection for sounds as science, I don't imagine you'll find a more readable resume of this fascinating, frustrating field. Those who do not know their

Nyquist frequency from their elbow might be better advised to take up the banjo or stick with Music Works on the inestimable Mac.

Title: Electronic & Computer Music

Author: Peter Manning

Publisher: Oxford University Press

Price: \$62.50

Holy smoke

Far be it from me to suggest that America's Robert E Davis is off his chump, but you may care to note that this book is dedicated to Our Lord, for giving Bob the strength, courage, wisdom and perseverance to write it. Be warned you may need similar stamina to read it.

If you wanna realise a *dream* to write your own programs, why you just listen in real good now to evangelical Bob. If you wanna *sell that dream* to the whole beautiful

wide world out there, here's what you gotta do. You gotta *believe* in you. You gotta be *positive* in all that you do and in all that you say. Right now you gotta define your *goals*. You gotta go out there and stand up and be counted and say I truly *believe* in myself as a programmer, oh I do.

A computer program is created through an ongoing process of building and changing, Bob says. If you haven't already purchased a computer, you have some important decisions to make, he points out. Knowing what



Tony — Programmer



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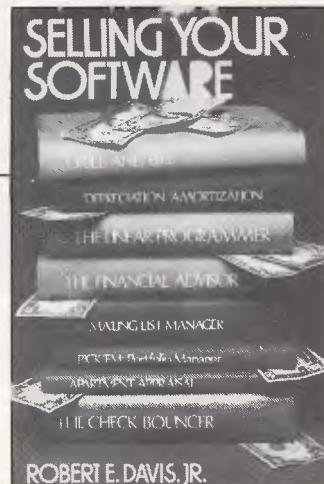
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you want the computer to do is one thing, he cautions, but getting it done is quite another. You gotta watch out for a no-win situation, OK?

Then again, says Bob, very few people will be aware of what you are doing and what you are able to do unless you get the word out. Hey, here's a whole bunch of stuff on Basic commands. Here's some

more stuff on software houses you might wanna contact in Florida, California or New Jersey.

You'd better *believe* it. Oh year. Say g'night, Bob.

Title: Selling Your Software
Author: Robert E Davis Jr
Publisher: Wiley Press
Price: \$35.60



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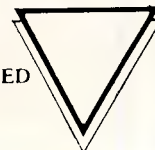
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Keep in touch

Peter Tootill and Steve Withers keep you up-to-date with the bulletin board scene.

Graeme Platt (Sysop of Perth's NEMO BBS) sent us a copy of the manuals for a new game written specifically to run on NEMO. The game is called '42', but that seems to be totally irrelevant apart from the fact that it is the answer to the Ultimate Question.

42 is set in a post-nuclear war Australia, where nomadic tribes roam inland areas, battling with each other for resources. Players take on the role of tribal leaders and try to survive and enlarge their sphere of influence. The idea of prosperity is a long way off in this scenario. While we know that some other systems offer online games, this is the first time we have heard of a multi-player game expressly intended for use on a BBS.

Fido

As you will see in the Corrections and Updates section, there are now two Fido systems running in Melbourne. Several people in Sydney asked us for copies of the software following our description of Fido last year, so with any luck some will come on-line soon. We now have the version for the IBM PC and close compatibles. If you would like a copy, send two formatted, double-sided disks (three if you do not have the LU library utility and NUSQ file unsqueezer), to Steve Withers at the address shown at the end of this column. Please note that if you do not enclose a self-addressed label and sufficient postage, your disks will not be returned — this is *not* an APC service, just something we are prepared to do for potential sysops.

System news

Keeping track of bulletin boards and similar systems is becoming more difficult as the numbers grow. When this

column started, there were only a handful of them, but now there are well over 100. The time when we could check each entry has long passed, and we must rely on your help to keep our list up to date.

While we are grateful to anyone who takes the trouble to contact us, it really would help if you could make it clear whether you know the details are correct (perhaps you used that particular system a few days ago), or whether you are just passing on a list gleaned from a bulletin board.

The problem of maintaining a correct list is made even more important by Telecom's tendency to re-allocate the number used by a BBS soon after it closes. In such cases the new subscribers are often surprisingly understanding, but they can be downright abusive.

The answer could be a BBS that sysops can use to maintain a central database of bulletin board information. The major problems would seem to be finding someone to do the work and pay for the hardware. Perhaps something will come of this suggestion.

This month our thanks go to Mark James, Terry Sweetser, Andrew Waddell, and Lloyd Ernst for providing system information.

Corrections and updates

NSW

Irata BBS (02) 600 9041. 6pm-midnight weekdays, 24 hours weekends.

Keeboard (02) 629 2230. P. Philip Keegan. 24 hours daily.

Omen I (02) 498 2495. P. Ted Romer.

4.30pm-9am weekdays, 24 hours weekends. V21 and V23.

Victoria

AM-NET (03) 366 7055. Peter Hallgarten. 24 hours daily. V21, V23, and packet radio.

Apple Hackers BBS (03) 762 1582. John Forbes. 24 hours daily.

Down Under Software (03) 429 5819. Greg Hudson. 24 hours daily. V21, V22, and V23.

Micropro Computers BBS (03) 568 8180. MV. Graham Broadbridge and Steve White. 24 hours daily.

Millionaire (03) 222 2939. P. Jon Grant. 24 hours daily. Now running Fido software.

National (03) 819 5582. John Blackett-Smith. 24 hours daily. Now running Fido software, with international FidoNet links being arranged.

PC-Connection (03) 528 3750. MV. Lloyd Borrett. 24 hours daily. V21 and V22.

Queensland

Brisbane Microbee RCPM (07) 384 8333. John Wain. 24 hours daily.

WA

The PAD (09) 337 2941. 24 hours daily. V21 and V23.

New listings

NSW

CCBBS BBS (02) 398 2413. 8pm-7am weekdays, 8am-5pm weekends.

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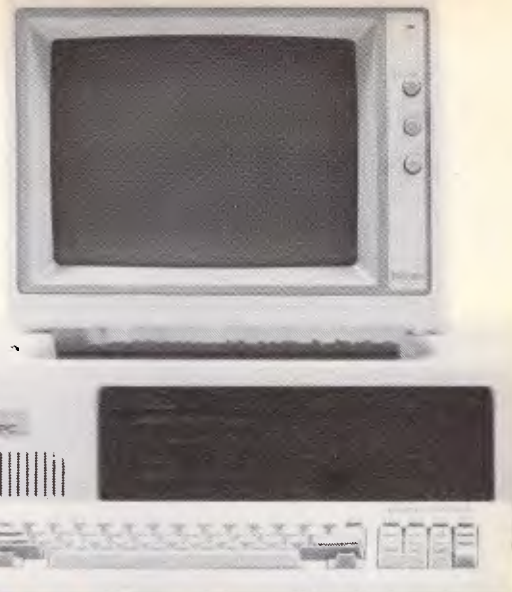
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SMUG-BEE BBS (02) 607 7584. 24 hours daily.

Tandy RIBM (02) 625 8071. 24 hours daily.

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ACT Apple (062) 31 9462. Ian Warren. 10pm-6am daily.

Canberra MICSIG RCPM (062) 85 1026. Ross Elliott. 24 hours daily.

Victoria

HiSoft IBBS Node 1 (03) 799 2001. Richard Tolhurst. 24 hours daily.

HiSoft IBBS Node 2 (03) 799 2041. Richard Tolhurst. 24 hours daily. V23 only.

Sunshine PC (03) 312 2259. Chris Whitefield. 24 hours daily.

The Real Connection (03) 288 0331. Carla Miller. 24 hours daily.

Queensland

AM-PAK RCPM (07) 263 7070. John

Bews. 24 hours weekdays (V21), 24 hours weekends (V22, V22bis, Bell 103).

Brisbane Experimental RCPM (07) 395 1809. Rik Dalley. 24 hours daily.

Computer Orchard (07) 350 1300. Scott Pearse. 24 hours daily. Software downloading (Apple II, Mac, IBM PC).

ED-RCPM (07) 266 3369. Andrew Waddell. 24 hours daily. Emphasis on education, software downloading for many systems.

Hotline (07) 353 3518. Lionel Theunissen. 24 hours daily.

Kangaroo Point TAFE (07) 391 3788. 9am-10pm weekdays, 24 hours weekends.

Midnight Express (07) 856 4363. Lloyd Ernst. 24 hours daily.

SA

Omen V (08) 382 4631. 6pm-7am daily.

Tasmania

Computercraft IBBS (003) 31 8466. Andre Everts. 24 hours daily.

Information wanted

Does anyone know the operating hours for Treasure Trove (ACT) and Illawarra BBS (NSW)?

Have the Sydney Public Access and Sorcerer Users Group (Sydney) RCPMs closed? What about the Skull, Bee-Tech, and ACRI BBSs? Some of our correspondents think they have, but the systems still appear on other lists we have received.

Is the Software Tools system back on line?

The material in this column is presented in good faith, but as it is collated from information provided by readers, APC cannot take responsibility for its accuracy. New information and corrections are always welcome (but please mention whether or not you can vouch for its accuracy), and should be sent to Steve Withers at one of the following addresses: C/- Computer Publications, 77 Glenhuntly Road, Elwood, Victoria 3184. Viatel 06300-0030, ACSnet stephenw@murdu, Teledata 11UNRWITHERS. Acknowledgement will generally be made through this column.

END

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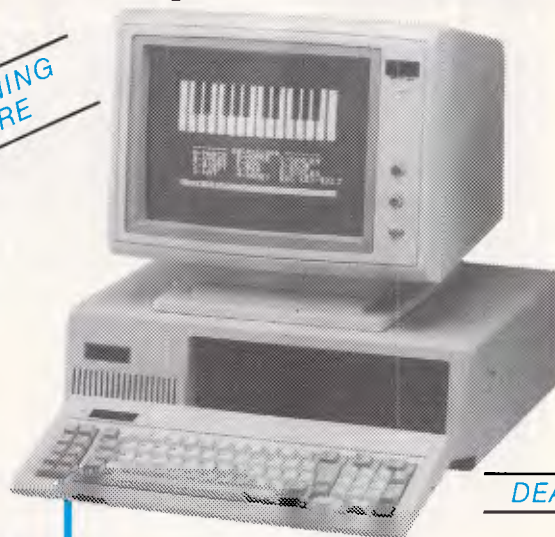
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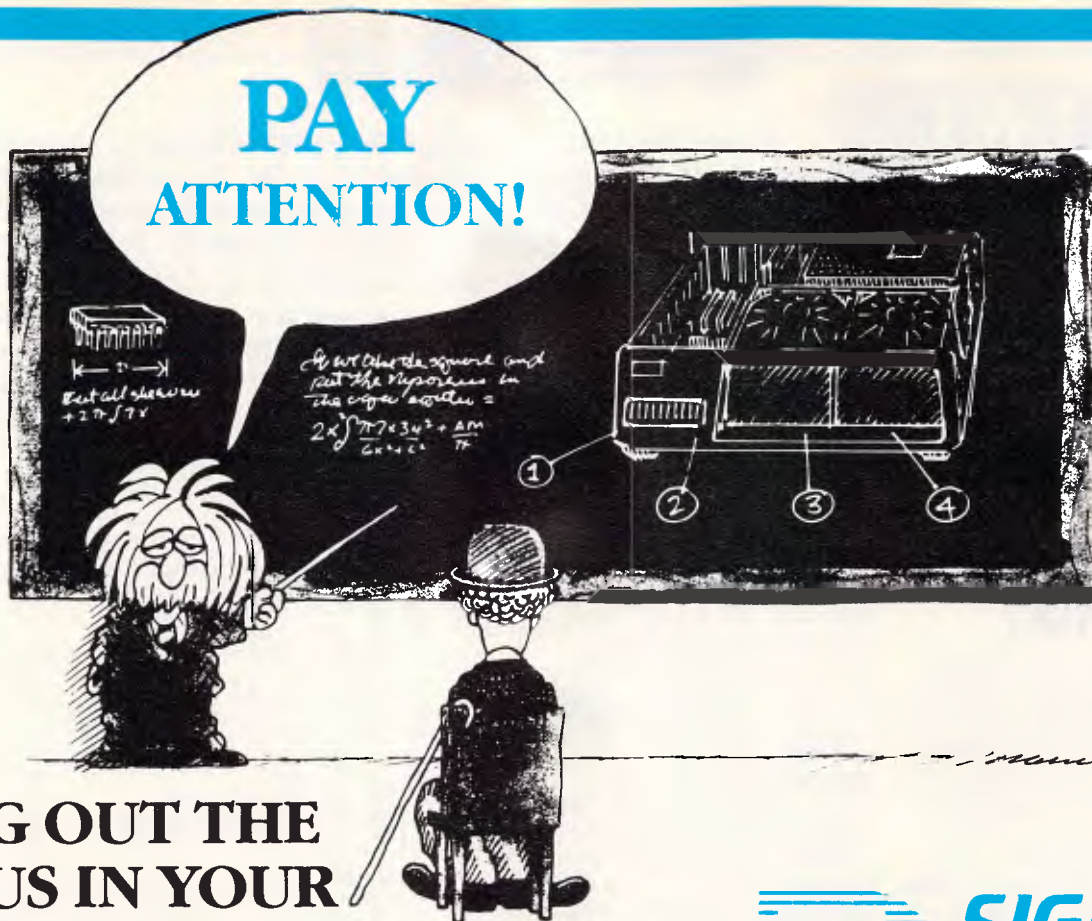
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			cycles	code
1				
DIV16A	PUSH AF	:Save AF.	11	F5
	LD HL,0	:Clear remainder.	10	21 00 00
	LD A,16	:16-bit quotient count.	7	3E 10
1				
DIVLPA	SLA C	:Clearing result bit,	8	CB 21
	RL B	:shift next dividend	8	CB 10
	ADC HL,HL	:bit up into remainder.	15	ED 6A
	SBC HL,DE	:Subtract divisor.	15	ED 52
	JR C,NOGOA	:Skip if rem. too small	7 12	38 03
	INC C	:else set result bit	4	0C
	JR DLTSTA	:and go do next place.	12	18 01
NOGOA	ADD HL,DE	:Add divisor back.	11 19	19
DLTSTA	DEC A	:Repeat for 16-bit	4	3D
	JR NZ,DIVLPA	:quotient.	(12/7)	20 EF
1				
POP	AF	:Restore AF	10	F1
RET		:and exit.	10	C9
1				
1T.	start & ends		48	
1	loop pass 1-16: ([85,85:85]*16-5)		1355	
1			1403	
1				

```

1
1...Exchange functions of A and B to use the quicker "RLA" and
1..."DJNZ" instructions inside the loop.
1...Use "CCF" to convert Carry flag to result bit ready for
1...shifting into C at start of next iteration, substituting
1..."RL C" for "SLA C" and deleting "INC C","JR DLST".
1
1
cycles code
DIV16B PUSH AF          :Save AF.                11    F5
      LD HL,0            :Clear remainder.        10    21 00 00
      LD A,B             :A = dividend hi-byte.   4     78
      LD B,16            :B = 16-bit result count. 7     06 10
1
1
DIVLPB RL C             :Get result bit and       8     CB i1
      RLA               :shift next dividend     4     17
      ADC HL,HL         :bit to remainder.       15    ED 6A
      SBC HL,DE         :Subtract divisor.       15    ED 52
      JR NC,DLTSTB      :Skip if +ve remainder 7 12 30 01
      ADD HL,DE         :else add divisor back.  11    19
      DLTSTB CCF        :Sub Cy become result.   4     3F
      DJNZ DIVLPB      :Repeat for 16-bits.     (13/8) 10 F3
1
1
      RL C              :Get last result bit    8     CB 11
      RLA               :into quotient.         4     17
      LD B,A            :Quotient into BC.       4     47
      POP AF           :Restore AF              10    F1
      RET              :and exit.               10    C9
1
1.T.    start & ends:                                68
1      loop pass 1-16: ((77,71;74)*16-5)          1179
1
1
1
1
1247

```

dividend MSB (most-significant byte) is moved out to carry. Each iteration of the MSB loop takes only 32

time states against the 77 time states that would be used in the division loop. However, the saving is not

```

;...Utilise a pre-division loop to shift the dividend msb out to
;...Carry - quotient is reset at each bit place of shift.
;
;                                     cycles   code
DIV16C PUSH AF           ;Save AF.                11      F5
        LD HL,0          ;Clear remainder.       18      21 00 00
        LD A,B           ;A = dividend hi-byte.    4       78
        LD B,16          ;B = 16-bit result count. 7       06 10
;
MSBLPC SLA C             ;Clear result bit, shift 8      CB 21
        RLA              ;next dividend bit to Cy. 4       17
        JR C,REMSLPC     ;Divide when msb found   7 12    38 07
        DJNZ MSBLPC      ;else loop.            (13/8)  10 F9
        JR EXITC         ;Exit if zero dividend. 12      18 0E
;
DIVLPC RL C              ;Get result bit and      8      CB 11
        RLA              ;shift next dividend ~ 4       17
REMSLC SBC HL,HL         ;bit to remainder.      15     ED 4A
        ADC HL,DE         ;Subtract divisor.     15     ED 52
        JR NC,DLTSTC     ;Skip if +ve remainder 7 12    38 01
        ADD HL,DE         ;else add divisor back. 11      19
DLTSTC CCF               ;Sub Cy become result.   4       3F
        DJNZ DIVLPC      ;Repeat for 16-bits.    (13/8)  10 F3
;
        RL C             ;Get last result bit    8      CB 11
        RLA              ;into quotient.         4       17
        LD B,A           ;Quotient into BC.      4       47
        POP AF           ;Restore AF            10      F1
        RET              ;and exit.              10      C9
;
;T. start & ends:                          68
; loop pass 1-16: ((77,71;74)*16-5)         1179
; msb loop savings: ((77-32)*65535/65536)    45
; msb loop counts:                           12
;
;                                             1214

```



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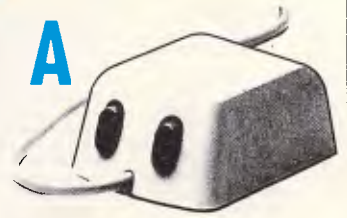
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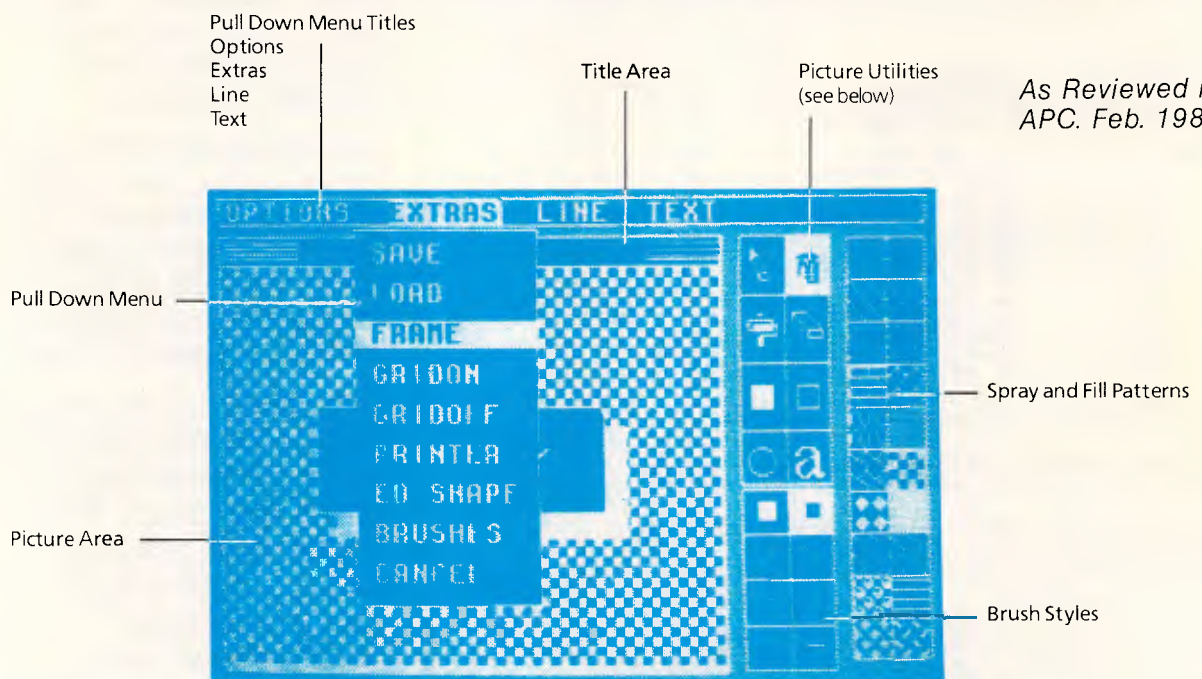
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is not totally incompatible with the pre-loop MSB adjustment of Fig 5. The MSB loop would have to shift ones into the quotient instead of zeros, but adding it to the code in Fig 6 will

1...Use Carry as complement of result bit, finally complementing			
1...the quotient before exit.			
1			
1			
			cycles code
DIV16D	PUSH AF	:Save AF.	11 F5
	LD HL,0	:Clear remainder.	10 21 00 00
	LD A,B	:A = dividend hi-byte.	4 78
	LD B,16	:B = 16-bit result count.	7 06 10
1			
DIVLPD	RL C	:Get NOT result bit and	8 CB 11
	RLA	:shift next dividend	4 17
	ADC HL,HL	:bit to remainder.	15 ED 6A
	SBC HL,DE	:Subtract divisor.	15 ED 52
	JR NC,DLTSTD	:Skip if +ve remainder	7 12 30 01
	ADD HL,DE	:else add divisor back.	11 - 19
DLTSTD	DJNZ DLTPLC	:Repeat for 16-bits.	(13/B) 10 F4
1			
	RL C	:Get last complemented	8 CB 11
	RLA	:result bit to quotient.	4 17
	CPL	:Complement quotient	4 2F
	LD B,A	:hi-byte, into B.	4 47
	LD A,C	:Get quotient lo-byte,	4 79
	CPL	:complement it and	4 2F
	LD C,A	:return to C.	4 4F
	POP AF	:Restore AF	10 F1
	RET	:and exit.	10 C9
1			
1	start & end:		84
1	loop pass 1-16: ((73,67:70)*16-5)		1115
1			
1			1199

out to fractionally less than the timing difference of one iteration, and this is considerably reduced by the MSB loop timing overheads.

Another way of speeding up the division is not to complement the result carry bits individually before

save only a further 25 time states.

Fig 7 shows Wehner's method applied to the 16-bit division. One final addition is necessary on exit from the addition loop to return a valid remainder.

Again, a pre-division

1...Apply Wahner's method.					
1					
1					
				cycles	code
DIV16E	PUSH AF	:Save AF.	11	F5	
	LD HL,0	:Clear remainder.	10	21 00 00	
	LD A,B	:A = dividend hi-byte.	4	78	
	LD B,16	:B = 16-bit result count.	7	86 10	
1					
DSUBLE	SLA C	:Clear result bit and	8	-	CB 21
	RLA	:shift next dividend	4	-	17
	ADC HL,HL	:bit to +ve remainder.	15	-	ED 6A
	SBC HL,DE	:SUBTRACT divisor.	15	-	ED 52
	JR C,DALTE	:Skip if -ve remainder.	7	12	38 0D
DSLTE	INC C	:Else set result bit.	4	-	0C
	DJNZ DSUBLE	:Repeat for next bit;	(13/B)	10	F4
	JR EXITE	:then exit.	12	-	18 0B
1					
DADDLE	SLA C	:Clear result bit and	-	8	CB 21
	RLA	:shift next dividend	-	4	17
	ADC HL,HL	:bit to -ve remainder.	-	15	ED 6A
	ADD HL,DE	:ADD divisor.	-	11	19
	JR C,DSLTE	:Skip if +ve remainder.	12	7	38 F3
DALTE	DJNZ DADDLE	:Repeat for next bit.	(13/B)	10	F6
	ADD HL,DE	:Make remainder +ve.	-	11	19
1					
EXITE	LD B,A	:Quotient into BC.	4	-	47
	POP AF	:Restore AF	10	-	F1
	RET	:and exit.	10	-	C9
1					
1	T. start & ends			56	
1	loop pass 1:	{(67,66;66,53)*1}		66.5	
1	loop pass 2-15:	{(58,67,67,66;64,53)*14}		903	
1	loop pass 16:	{(69,79,78,78;76)*1-5}		71	
1					
1					
1				1984.5	

shifting them into the quotient, but as the completed quotient outside the division loop. The net saving for this simple act is 48 time states, shown in Fig 6.

Post-loop complementing

adjustment to move the dividend **MSB** out to carry will save a further few time states, but the method rules out savings by producing the complement of the quotient.

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Mike Mudge delves into Diophantine Equations with Markoff Numbers.

Definition. A 'Markoff Triple' is a triple of positive integers (p,q,r) which satisfies the equation: $p^2 + q^2 + r^2 = 3pqr$.

There are two singular Markoff Triples (1,1,1) and (2,1,1) and, since the equation is quadratic in each of the variables, it is known that one integer solution leads to another. It is further known that apart from the two singular solutions displayed above, all other solutions have distinct (different) values for p, q and r. Each solution is, therefore, said to be a 'neighbour' of just three others; these being the three with which it shares just two common values.

Note. A Markoff Triple is not ordered, since the equation is symmetrical in p, q and r then (p,q,r), (p,r,q), (q,r,p), (q,p,r), (r,p,q) and (r,q,p) are indistinguishable.

For example, (433,5,29) is a neighbour of (29,5,2), (6466,5,433) and of (37666,433,29) because:

$$433^2 + 5^2 + 29^2 = 3.433.5.29 = 188355$$

$$29^2 + 5^2 + 2^2 = 3.29.5.2 = 870$$

$$6466^2 + 5^2 + 433^2 = 3.6466.5.433 = 41996670$$

$$37666^2 + 433^2 + 29^2 = 3.37666.433.29 = 1418915886$$

and further each of the last three triples in the example shares two common values with the first.

The ordered list of numbers found in Markoff Triples defines the sequence of Markoff Numbers, of which there are only thirteen less than one thousand. Recall that the sequence of Fibonacci Numbers is defined algebraically, thus $F_1 = 1, F_2 = 1, F_n = F_{n-1} + F_{n-2}$. Thus $(F_n) = (1,1,2,3,5,8,13,21,34 \dots)$.

It will be found that eight of the first 13 Markoff Numbers are also Fibonacci Numbers.

Problem

(ia) Determine all the Markoff Numbers

less than any given integer; count how many of them are also Fibonacci Numbers.

(ib) Using the fact that each Markoff Triple has three neighbours, display these triples in the form of a tree and answer the outstanding question of whether or not the display is a genuine binary tree: can the same Markoff number be generated by two different routes through it (see Fig 1)?

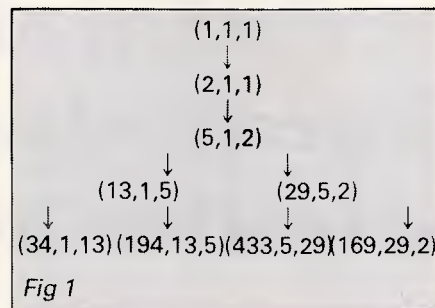


Fig 1

A related Diophantine Equation is:

$$5(p^2 + q^2 + r^2 + s^2 + t^2)^2 -$$

$$7(p^4 + q^4 + r^4 + s^4 + t^4) = 90pqrst$$

Now apart from trivial solutions such as (1,1,1,1,1) and (2,1,1,1,1), the only solution which the author is aware of is (2,7,19,47,59) when each side of the equation equals 66385620, the individual terms on the left-hand side being 186294080 and 119908460.

Problem

(iia) Obtain the above solution by a search technique.

(iib) Extend the bounds up to which this is the only known non-trivial solution from p,q,r,s,t less than 100 and hopefully discover other solutions.

Readers are invited to submit their attempts at problems (i) and (ii) above to: Mike Mudge, C/- APC, 2nd Floor, 215

Clarence Street, Sydney 2000.

Submissions, which must reach me by 25 May 1986, will be judged using suitable vague criteria. A prize will be awarded for the best entry received.

Please note that submissions can only be returned if a suitable stamped addressed envelope is provided.

Diophantine Equations — October 1985 review

This problem gave rise to a number of very well presented submissions. Space does not permit the listing of the full solutions obtained to Case 1, order A, B & C; these are to be seen in the recent paper by Leo J Alex in *Mathematics of Computation*, vol 44, no 169, January 1985 pp 267-278, and maybe obtained from me (at the above address) if required.

After considerable thought it was decided that this month's prize-winner should be Ghislain Deridder. Ghislain used his recently acquired Amstrad CPC 6128 in Amstrad Locomotive Basic and explored numerous Case 2 problems in addition to complete analysis of Case 1. The programming was not very ambitious but nonetheless functional, and run times were quite realistic; the submission included a discussion of the limitations of the work submitted and possible ways of overcoming these.

Perhaps the prize will help Ghislain in some way towards the acquisition of a printer for the system, although the listings he submitted were carefully copied and should encourage other readers without a printer to try their luck with a submission!

USER GROUPS UPDATE

Below is a list of updates and additions to the full User Group Index published in the January issue of APC.

The 80 Gamer User Group has recently been formed. The group caters for TRS-80, System 80 and Color Computer users. For more details contact: Jim Fisher, 37 Fairburn Avenue, West Pennant Hills, Sydney NSW 2120.

The Spellbinder User Group (SBUG) now meets on the 4th Monday of each month, 6pm, at Room 9, Ground Floor Trades Hall, corner of Dixon and Goulburn Streets, Haymarket. More details may be obtained by

contacting Kathie Hanson, PO Box 171, Matraville NSW 2036. Telephone: (02) 694 1523.

A new group, OZBEEB, has recently been formed for users of the BBC Model B microcomputer. The group meets twice a month at the Australian Film and Television School — Open Program, 3 Lyon Park Road, North Ryde. A general meeting takes place on the 4th Monday of each month at 6.30pm, and on the 2nd Wednesday of each month the group has

organised talks and demonstrations. An annual subscription for full membership to OZBEEB is \$10. For further information contact: OZBEEB, PO Box 1030, Parramatta NSW 2150.

The Melbourne PC User Group meets on the 1st Wednesday of each month, at 6pm in the Ground Floor Auditorium 1, Clunies Ross House, 191 Royal Parade, Parkville. The group caters for IBMs and compatibles. For more details contact: Melbourne PC

User Group, The Secretary, PO Box 1728P, Melbourne Vic 3001. Telephone: (03) 486 1555.

A new club, Southern Tasmanian Amstrad Club meets at 7.30pm on the first Wednesday of each month at Elizabeth Matriculation College, (1st Floor). For further information contact Vern McKay (002) 29 4528, or write to 137 Roslyn Avenue, Blackmans Bay Tas 7152.



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LAZING AROUND

Brain-teasers from J J Clessa

Quickie

My wife's age is my age with digits reversed. The difference between our ages is one eleventh of the sum of the ages. Since I am the elder, how old is my wife?

No answers and no prizes.

Prize puzzle

Find three different digits such that, in whatever order they are used to make a three-digit number, that number will *not* be divisible by: 3, 5, 7, 11, 13 or 17.

Furthermore, since there is more than one solution, we are seeking the three digits whose product is the greatest.

To ensure that there is no ambiguity, suppose the three digits are a, b and c. Then, none of the numbers, abc, acb,

bac, bca, cab and cba, must divide by 3, 5, 7, 11, 13 or 17 and also $a \times b \times c$ must be as large as possible.

Answers on postcards please, or backs of envelopes, to reach us not later than 15 May 1986. Send your entries to APC, Lazing Around, April Prize Puzzle, 215 Clarence Street, Sydney 2000.

Good luck.

January prize puzzle — winner

Well, unfortunately a typesetting error seemed to upset many readers in the January 1986 prize puzzle. The word 'factorised' appeared as 'fractioned' and, although the majority of you understood the intention, several entrants appeared confused.

There was a relatively low entry, perhaps for this reason but also, perhaps, because the problem was rather more difficult than usual.

The winning solutions were:

a) Smallest 127 386 945

= $163 \times 827 \times 945$

b) Largest 438 176 952

= $531 \times 876 \times 943$

The lucky entrant, drawn at random from the bunch, was Peter J Mason of Auburn, NSW.

Congratulations, Mr Mason, your prize is on its way.

By the way, *please* don't forget that in order to qualify all entries must be on postcards, or on the backs of sealed envelopes. Letters are disqualified and are not eligible for the prize draw.

Keep puzzling.

MICROCHESS

Kevin O'Connell keeps you in suspense with the turn of events at the US Open Computer Chess Championship.

A new event, the US Open Computer Chess Championship, was played in Mobile, Alabama last year. It was notable for two things: one was the failure of Hegener & Glaser's team of Mephistos only a couple of months before the company walked away with the World Micro Championship; the second remarkable thing I will relate to you after the results of the Mobile tournament and the following game.

Results of the 1985 US Open Computer Chess Championship (all scores out of 6): (1) Fidelity Elite XC 5½; (2) Bebe 4½; (3-4) Novag Y, Novag Quattro X 4; (5-8) Belle, Fidelity Avant Garde, Mephisto Modular, Fidelity Elite XA 3½; (9-11) Novag Super Con X, Turbostar Comp X, Mephisto Modular S3; (12-13) Turbo Kasparov, Fidelity PC X 2½; (14-16) Novag X, Mephisto Exclusive S, Turbo 6402; (17) Mychess II X 1½; (18) B11 ½.

White: Novag Y. Black: Mephisto Modular. Opening: Dutch Defence

- | | | |
|---|--------|--------|
| 1 | c2-c4 | f7-f5 |
| 2 | d2-d4 | Ng8-f6 |
| 3 | Ng1-f3 | e7-e6 |
| 4 | Bcl-d2 | |

Apparently bad, but there is nothing really wrong with it. Novag made quite a point of leaving normal opening lines

early during this tournament.

4 ... Nb8-c6

Apparently good, but in fact this is a very poor place for the knight in this opening. This square is usually required for the c-pawn, with the knight going later to d7.

- | | | |
|----|--------|--------|
| 5 | e2-e3 | d7-d5 |
| 6 | Bf1-d3 | Bf8-b4 |
| 7 | 0-0 | Bb4xd2 |
| 8 | Nb1xd2 | 0-0 |
| 9 | Ral-cl | Nc6-b4 |
| 10 | Bd3-b1 | d5xc4 |

10 ... c7-c6 is better.



11 Nd2xc4

White has played very simply and now has quite a big advantage, made up of his well-developed pieces, his greater control of the centre, Black's poor bishop and weak e-pawn.

11 ... b7-b5?

Not quite as bad as it looks, but a dreadful move nonetheless. White has pressure on the c-file and it is therefore a terrible mistake to give away the c5 square and leave the pawn on c7 backward (without the possibility of support from another pawn).

- | | | |
|----|--------|--------|
| 12 | Nc4-e5 | Bc8-b7 |
| 13 | Rc1-c5 | Nb4-d5 |
| 14 | Qd1-b3 | |

Of course not 14 Rc5xb5? Bb7-a6.

- | | | |
|----|-------|---------|
| 14 | ... | a7-a6 |
| 15 | h2-h3 | Nf6-e4? |

This loses a pawn. After the exchange on e4, the new black e-pawn cannot be defended.

- | | | |
|----|--------|--------|
| 16 | Bblxe4 | f5xe4 |
| 17 | Nf3-d2 | Qd8-h4 |
| 18 | a2-a4 | b5-b4 |
| 19 | Qb3-c2 | Rf8-f5 |

19 ... Nd5-f6 leaves the c-pawn unprotected.

20 Qc2xe4

White is a secure pawn ahead.

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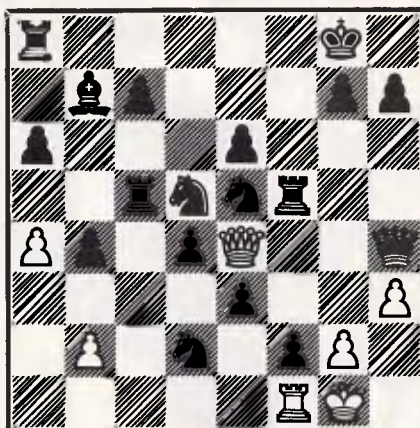
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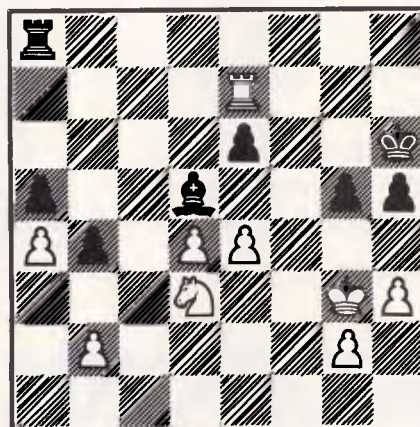


Furthermore, Black now violates a basic rule — when ahead exchange pieces, when behind exchange pawns — by exchanging one pawn and three pieces.

20 ... Qh4xe4
21 Nd2xe4 Nd5xe3
22 f2xe3 Bb7xe4
23 Rc5xc7 Rf5xf1+
24 Kg1xf1 h7-h5
25 Kf1-g1 Be4-d5
26 Kg1-h2 Kg8-h7
27 Kh2-g3 a6-a5
28 Ne5-d3

Useful now, so that Bd5-b3 can be answered by Nd3-c5.

28 ... Kh7-h6
29 Rc7-e7



Look at the difference between the rooks, the black one tied passively to the defence of the a-pawn while the white rook is aggressively placed, attacking pawns, in the heart of the black position.

29 ... g7-g5

30 e3-e4!

30 ... h5-h4+

30 ... Bd5xe4 fails to 31 Re7xe6+ Be4-g6 32 Nd3-e5 Ra8-g8 33 Re6xg6+ Rg8xg6 34 Ne5xg6 Kh6xg6 (when ahead exchange pieces) 35 Kg3-f3 with a trivially easy to win king and pawn ending.

31 Kg3-h2 Bd5-c4

Now if 31 ... Bd5xe4 the previous line would not work (because the black

king would reach White's d-pawn in time), but instead of taking on g6, White puts his rook on a6 and gobbles up the black pawns. However, the next move is, if anything, even more hopeless.

32 Nd3-c5 b4-b3
33 Nc5xe6 Bc4xe6
34 Re7xe6+ Kh6-g7
35 d4-d5 Kg7-f7
36 e4-e5 Ra8-e8?

A final nail in its own coffin. Do you think you will remember when to exchange pieces and when not to? If not, then I do hope that this game will come back and haunt you.

37 Re6xe8 Kf7xe8
38 Kh2-g1 Ke8-f7
39 Kg1-f2 Kf7-g6
40 d5-d6 Kg6-f7
41 Kf2-f3 Kf7-e6
42 Kf3-g4 Ke6-d7
43 Kg4xg5 Kd7-e6
44 Kg5-g6 Ke6xe5

Everything loses now.

45 d6-d7 1-0 (Black resigns)

Saved (from any further agonies) by the operator (who resigned on behalf of the program). And that brings me to the second part of my story about the tournament in Mobile. Instances of players resigning when having a winning position are rare, so I must tell you about the latest example.

In Round Three, Fidelity Avant Garde played Fidelity Elite XC, the latter being the company's favourite. Avant Garde emerged from a scrappy game that rapidly simplified with a clear and easy win — a pawn up in a bishop ending. However, the operator of the Avant Garde suddenly decided to resign for his machine!

David Kittinger, programmer of the Novag machines, summed up many of the participants' reactions when he said of this: 'To me, resigning in a won position goes beyond chess, no matter whether it is in the rules or not. You cannot throw a game. This is fixing a game, it is absurd.'

Fidelity's president later justified the action by saying: 'It is not in the rules, therefore it is allowed.'

This, then, was a very serious omission, either from the rules or by the tournament referee. The most important events, such as the World Micro Championship, are governed by rules which were developed by David Levy and myself.

We stated that the computer event rules were in addition to all the normal rules that apply in human competitions. The only comparable example I know of from human play resulted in both players being awarded a loss. Such things, of course, can affect the outcome of whole competitions.

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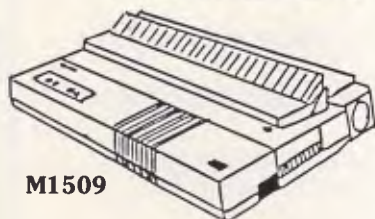
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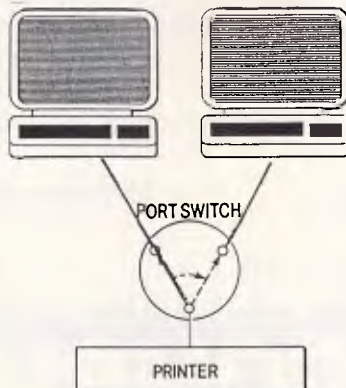
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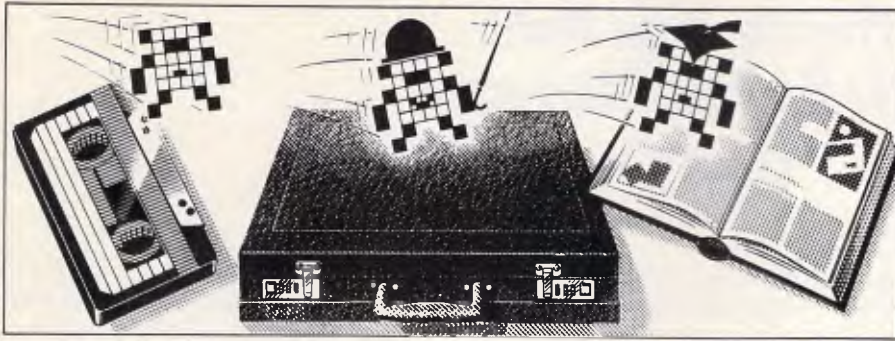
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*Owen Linderholm selects the best of readers' programs.
For details on submitting your own, see the end of this section.*

Program File has been changed to give a greater emphasis to comments and documentation, so programs can be converted to work on other machines more easily. Include whatever documentation you think necessary with your program, and comment your programs carefully.

Please try, if possible, to keep machine-specific parts of programs to a minimum, and point out how they work and what they do in comments. Programs should be structured so that the code can be understood. One other point to bear in mind is that people will be rather more reluctant to type in a long program, so it will have to be especially good to compensate. Machine code and long lists of data statements are especially unrewarding and difficult to type in, and should be avoided.

Let us know your views about the changes in Program File so that we can take your opinions into account.

Now on to this month's programs. The Program of the Month is an unusual one for an unusual machine: it is called MacFractal and is for the Apple Macintosh. If you have not yet come across this computer, it is worth taking a look at the program and the accompanying article just to get a feel for it. The program can be converted to work on other machines and the author, Jack Weber, has included specific instructions on how to do this. MacFractal generates landscapes that are displayed as projections of three-dimensional surfaces. The landscapes generated by this program are very realistic and are produced by a method inspired by Mandelbrot's fractals. The accompanying program documentation gives full details and includes sample output.

For Spectrum owners there is the Intelligent Logic Processor, a program which allows you to design logic circuits made up from standard gates, and then simulate and test them in the computer. This is potentially a useful tool for people

who dabble in electronics, and would also be a good aid in teaching about logic gates and how they work. The program is a little limited in that circuits above a certain size will have to be broken down into smaller blocks to test, but it is well worth trying out. As the program mostly consists of calculations and I/O, it should be possible to convert to other machines without too much difficulty.

For BBC owners there is a simple graphics adventure game called The Cave, in which you explore a cave of three levels. Within the cave lurk goblins, trolls, wizards, dragons, and so on. Gold, elixirs and other strange treasures are to be found. Besides these, some strange events can occur, so keep your wits about you!

Commodore 64 owners can type in the latest in the recent series of additional editing utilities. This allows you to have lines numbered automatically as you enter a program, removes extra spaces and comments from programs, recovers lost programs after crashes or resets, and dumps lists of variables to screen or printer. The program sits in a small block of memory and can be accessed by a simple SYS command. Also for the Commodore 64 is an excellent utility which simulates an 80-column card; it was written by Kevin Riordan.

Amstrad made a big splash recently when it launched the PCW8256. Apart from the extremely good word processing value it offers, the machine comes with an extensive and powerful Basic. Our first program for this machine is called PROGEDIT and makes use of the machine's ability to save programs in ASCII file format. The program can access files saved in this way and provides search and replace facilities, removes REM statements, and also allows extended listings to make them easier to understand. Although the Basic on the PCW8256 is very different from

that on the other Amstrad computers, this program should work with some changes on the 6128, 664 and 644 since they can also save files in ASCII format.

Back to the Program of the Month! Computer-generated landscapes are big business. There is a famous sequence in the film *Alien* where landscapes are computer-simulated using fractals. Lucasfilm, one of the largest and most high-tech film special effects companies, has become expert at producing computer-generated landscapes. Recently it produced a colour still picture of a mountain scene with a lake, and a rainbow in the sky. A road, complete with highlighted wet patches, passes along the side of hill, and even the trees, grass and flowers were created with fractal techniques. This expertise has now been passed on to the computer game market. Readers of 'Screenplay' will remember reviews of the games *Rescue on Fractalus*, *Koronis Rift* and *Eidolon* (*Eidolon* is reviewed in this issue), which all feature fractal-generated landscapes that can be explored.

The theory behind fractals comes from the work of a French mathematician called Mandelbrot. He noticed the similarity between certain types of mathematical equations and many different shapes and features to be found in nature. Recently his work and theories have become fashionable and a great deal of computer time is being used, experimenting with fractals to generate realistic images.

Jack Weber's program, MacFractal, does not use fractals or any of the underlying theory, but nevertheless it produces some very interesting results. It would be possible, using the program, to produce an animated film showing a craggy landscape growing and evolving from a featureless flat plain.



Program of the Month Apple Macintosh MacFractal

by Jack Weber

There are various ways of generating fractal landscapes. MacFractal uses a very simple technique which cannot match the subtlety of Mandelbrot's Gaussian landscapes, but does allow something reasonably convincing to be generated, even on a micro.

The MacFractal algorithm

Imagine a uniform flat Earth. Straight-line faults develop, one at a time, across this landscape and, on each occasion, all the land to one side of the fault is displaced vertically by one unit. The position and orientation of the faults are entirely random, as is the direction of the vertical displacement (Fig 1).

The cumulative result after many such fault movements is that each point on the Earth may have been uplifted or lowered quite a distance from its original zero level but, because whole blocks of land rather than just individual points are being moved, adjacent spots are not likely to be vastly different in altitude. The landscape therefore reflects reality in that intermediate slopes are more common than either vertical cliffs or flat plains, although they too can occur. The number of iterations that is allowed to take place does, of course, have a great effect on the type of landscape produced. Initially, the land is flat to gently rolling; after a few hundred iterations it is hilly to moun-

tainous; after about a thousand it starts to become unnaturally rough.

Program structure

To model this process in the computer, a two-dimensional array $[c\%(x\%,y\%)]$ is set up to hold the altitude of each intersection on a square grid that covers the landscape. This grid is treated like a sheet of graph paper, having x and y axes and with the origin at one corner. Fault lines are then produced by selecting two sides at random and picking a random position along each. These are the end points of the fault; knowing them, it is possible to find the equation of the line that joins them.

The equation of a straight line is $y = m \cdot x + k$, where m is the slope of the line (how many y units it moves for every unit along the x axis) and k is the value of y when $x = 0$ (Fig 2).

The choice of vertical displacement is made by assigning the value 1 or -1 to the variable $q\%$. This value will be added to all grid points lying to one side of the fault line.

When these parameters have been worked out, a pair of nested loops scans every point on the grid to find which side of the line it is on. For each value of x the equation gives a value of y which is on the line; if the point's y coordinate is less than this it lies on one side, if

greater than it is on the other side. For any point with y greater than the line, the corresponding array element has $q\%$ added to it.

After the whole grid has been run through in this way, a new line is generated and the process is repeated. Vertical magnification may be altered by multiplying each element of the array, and subsequent values of $q\%$, by a constant which may be greater or less than one.

The landscape is plotted as an isometric grid with the origin (called (1,1) in this case) at centre top of the screen (Fig 3).

It is important to remember the distinction between grid coordinates which follow the aforementioned convention and screen coordinates which (in the case of the Macintosh) start in the top left-hand corner of the screen. Once faulting has begun, each point may vary its altitude but remains directly above its original position. This makes plotting relatively simply, because we only need to find the base-level position of the point then move vertically up the screen by the number of pixels corresponding to its altitude (that is, the value contained in its array element (Fig 4)).

Base-level positions are calculated (in multiples of seven pixels for the x -axis and four pixels for the y -axis) relative to the grid origin whose screen

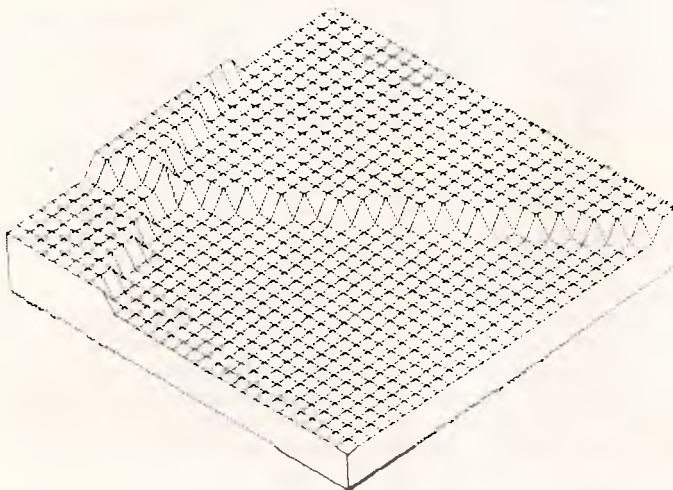


Fig 1 The landscape (vertically magnified 10x) after two iterations

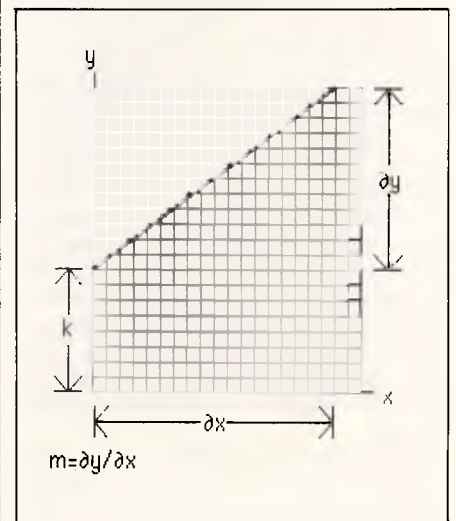


Fig 2 A two-dimensional array is set up on a square grid

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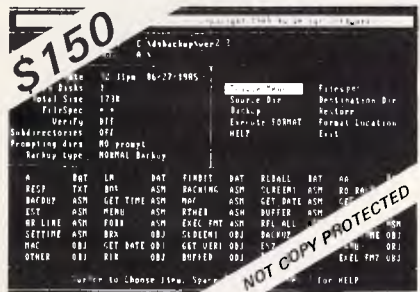
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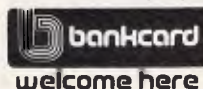
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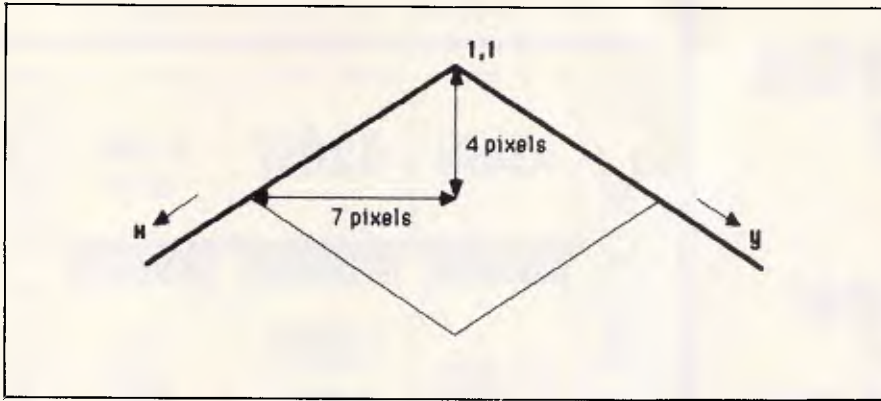


Fig 3 Basic pattern of the initial flat grid

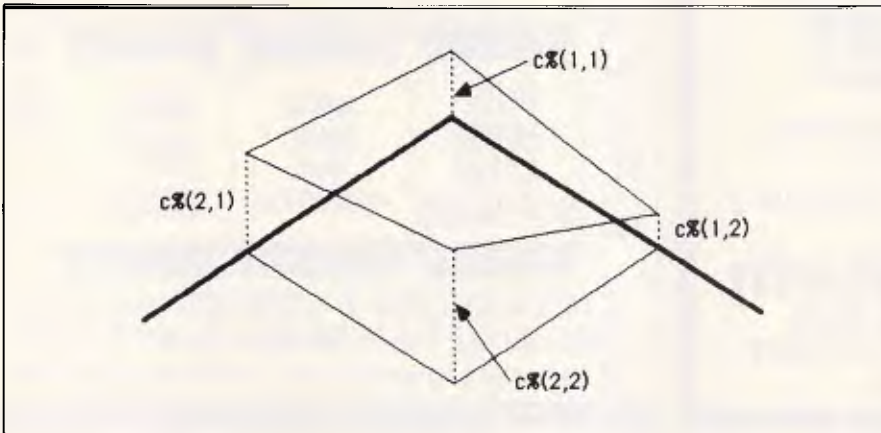


Fig 4 Part of the surface superimposed on its base level grid

coordinates are (xo%,yo%). The value of $c\%(x\%,y\%)$ is then subtracted from the screen y coordinate to give the screen coordinates of the actual point.

Finally, adjacent points on the grid are joined by straight lines. Hidden lines are removed by plotting from back to front and using the Macintosh's ability to draw with any width or height of pen in black or white. Firstly, the line is drawn with a tall white pen to erase anything that would appear below the present line, then it is visibly re-drawn with a thin black pen.

Flooding may be simulated by selecting a water level within the current range of array values and drawing at this level any points which lie below it. The actual array values are not changed as they must continue to be subject to vertical displacement. A fill routine from the Macintosh's ROM Toolbox allows this water level to be uniformly shaded, giving a much more realistic

view of the landscape.

Converting MacFractal

There is no reason at all why this program cannot be run on any other microcomputer, but quite extensive changes will be necessary.

(1) The most obvious point is that line numbers will have to be used, and labels (which take the form 'Flood:' or 'xin:') will have to be removed.

(2) The Macintosh offers a sophisticated user interface of menu bars, windows, buttons, and so on, to allow entry and selection of data using the mouse. These features are handled by lines containing the keywords MENU, DIALOG, WINDOW, BUTTON or MOUSE. In most cases these routines are used to input parameters to the program and can easily be replaced on other machines by simple INPUT statements, using programmable function keys or GET statements to test for keys

pressed. For example, in the subroutine Initialise, the section headed 'Enter frequency of plots' could be replaced by the single line:

INPUT 'How many iterations between plots'; plot%.

(3) Screen resolutions and layouts vary widely. The Macintosh has a usable area of about 500×300 pixels; computers with a lower resolution may be restricted to smaller grids. If screen coordinates start in the bottom left-hand corner, then the minus signs in lines of the form:

$y1\% = y0\% - \text{INT}(\text{magn!} * c\%(x\%,y\%)) + y\% * 4$

will have to be changed to a plus.

(4) Macintosh ROM Toolbox routines will not be available. These all use the CALL statement followed by the name of the routine. Some, such as CALL LINETO(x1%,y1%) are self-explanatory and are easily replaced by other commands. Others, like PENMODE and PENSIZE may be harder to replace, but hidden-line removal should still be possible; remembering that the aim is to erase anything which would show through lower down the screen than the current line. The Toolbox routine FILLPOLY is used to shade squares or triangular halves of squares which are flooded. If your computer does not allow polygon filling, then leave out all the shading subroutines; otherwise new routines, specific to the machine, will have to be written.

(5) As a minimum, all that is required to produce these landscapes on any computer is:

(i) Dimension the array $c\%(x\%,y\%)$ and enter the parameters which are set up in the subroutine Initialise.

(ii) Repeatedly generate fault lines and re-calculate the array as in the subroutine Calculate.

(iii) At regular intervals, plot the grid using the subroutine Dryplot, modified to account for the specific machine's graphics.

Everything else is a bonus that will make the finished display more effective and easier to manipulate, but can quite safely be left out. Conversely, there are plenty of ways to extend and improve on MacFractal; for example, by using colour or by allowing greater freedom of movement to the screen display's apparent viewpoint.

•	• MacFractal	•
•	• © Jack Weber - October 1985	•
•	• Plots fractal landscapes as a 3D grid by taking a random straight line	•
•	• across the grid and raising (or lowering) all points to one side of the	•
•	• line by one level step.	•
	• Full hidden-line removal.	•
	• Landscape may be flooded to any level.	•
	• Adjustable vertical scale.	•
	• Rotation in 90° steps in either direction.	•

PROGRAM FILE

This program runs on a 128k or 512k Apple Macintosh under MS Basic.
Passing this program through the Basic Compressor utility gives a speed increase of about 15%.

GOSUB Initialise

Main program loop prints current generation number in its own window then re-calculates the grid and, if necessary, draws it

mainloop:

```
FOR g%=gs% TO gen%
  WINDOW OUTPUT 3
  CLS
  CALL TEXTFONT(0)
  PRINT USING "*****",g%
  GOSUB Calculate
  IF (g% MOD plot%=0) OR (g%=gen%) THEN GOSUB Plot
```

NEXT

When all iterations done, offer user choice to continue or stop there

```
IF gen%>32000 THEN GOSUB Endless
WINDOW 2,,(20,280)-(140,320),2
BUTTON 1,1,"Finished",(10,2)-(110,18),3
BUTTON 2,1,"Continue",(10,20)-(110,40),3
WHILE Dialog(0)<>1:WEND
  If "Finished" pressed hold display in endless loop
  IF Dialog(1)=1 THEN WINDOW CLOSE 2:GOSUB Endless
  "Continue" pressed so increment generation counter and do 500 more
  gs%=gen%+1
  gen%=gen%+500
  WINDOW CLOSE 2
  GOTO mainloop
END
```

Initialise:

```
Open main output window
WINDOW 1,"MacFractal",(5,40)-(508,335),1
CLS
DIM c%(30,30),d%(30,30),poly%(12)
RANDOMIZE TIMER
Start with magnification=1, 1st generation and no flooding
magni=1
gs%=1
flood%=0
Set up pattern array for shading flood water
FOR i%=0 TO 3
  patt%(i%)=21930
NEXT
Open a window and enter size of grid and number of generations to be done
WINDOW 2,,(100,80)-(400,170),2
CALL TEXTFONT(0)
xin:
  CALL MOVETO(25,20)
  INPUT "Enter extent of X axis (max 30) - ",xmax%
  IF xmax%>30 OR xmax%<2 THEN BEEP:GOTO xin
yin:
  CALL MOVETO(25,45)
  INPUT "Enter extent of Y axis (max 30) - ",ymax%
  IF ymax%>30 OR ymax%<2 THEN BEEP:GOTO yin
genin:
  CALL MOVETO(25,70)
  INPUT "Enter number of iterations - ",gen%
  IF gen%>32000 OR gen%<1 THEN BEEP:GOTO genin
Close that window and open new one to enter frequency of plots
WINDOW CLOSE 2
WINDOW 2,,(100,100)-(400,220),2
CALL TEXTFONT(0)
PRINT "How many iterations between plots?"
BUTTON 1,1,"1",(20,25)-(65,50),3
BUTTON 2,1,"10",(155,25)-(200,50),3
BUTTON 3,1,"50",(20,55)-(70,80),3
BUTTON 4,1,"100",(155,55)-(215,80),3
BUTTON 5,1,"Draw final surface only",(20,85)-(220,110),3
WHILE Dialog(0)<>1:WEND
press%=Dialog(1)
plot%=1
IF press%=2 THEN plot%=10
IF press%=3 THEN plot%=50
IF press%=4 THEN plot%=100
IF press%=5 THEN plot%=gen%
WINDOW CLOSE 2
Calculate screen co-ordinates of grid origin according to size of grid
but they could just as easily be fixed near the centre top of the screen
xo%=33.4-2*xmax%
yo%=80-2*ymax%
```

Put plot manipulation options in menu bar

```
MENU 6,0,1,"Landscape"
MENU 6,1,1,"Rotate left"
MENU 6,2,1,"Rotate right"
MENU 6,3,1,"Magnify"
MENU 6,4,1,"Flood"
```

ON MENU GOSUB Menucheck

Advise user if initial iterations are likely to take a long time

```
IF plot%=1 AND (xmax%*ymax%)<400 GOTO ready
WINDOW 2,,(150,100)-(350,190),4
```

PRINT: PRINT "Performing initial iteration";

IF plot%>1 THEN PRINT "s" ELSE PRINT "

CALL TEXTFONT(0)

PRINT: PRINT TAB(8);"Please wait"

ready:

Open small window to display generation number

```
WINDOW 3,,(10,50)-(60,66),4
```

MENU ON

RETURN

Calculate:

MENU STOP

ortho%=0

Select two sides which fault line will cross

```
side%(1)=INT(RND*4)
```

side2:

```
side%(2)=INT(RND*4)
```

IF side%(2)=side%(1) GOTO side2

Pos subroutines select random positions where line will cross the sides

```
FOR i%=1 TO 2
```

```
  ON side%(i%)+1 GOSUB Pos1,Pos2,Pos3,Pos4
```

NEXT

Set flag if line parallel to Y-axis to avoid division by zero

```
IF xx%(1)=xx%(2) THEN ortho%=1:GOTO skipover
```

Equation of straight line is $y=m*x+k$. Calculate m and k

```
m=(yy%(2)-yy%(1))/(xx%(2)-xx%(1))
```

```
k=yy%(1)-m*xx%(1)
```

skipover:

Select whether points above line are to be raised or lowered

```
q%=INT(RND*2):IF q%=0 THEN q%=-1
```

Check all grid points. If above line raise (or lower)

```
FOR x%=1 TO xmax%
```

First find y co-ordinate of the line at that value of x

```
yp%=INT(m*x%+k)
```

```
FOR y%=1 TO ymax%
```

IF ortho%=0 AND y%>yp% THEN c%(x%,y%)=c%(x%,y%)+q%:GOTO nex:

IF ortho%=1 AND x%>xx%(1) THEN c%(x%,y%)=c%(x%,y%)+q%

nex:

NEXT

NEXT

MENU ON

RETURN

Pos1:

```
xx%(1%)=1:yy%(1%)=INT(RND*ymax%)+1
```

RETURN

Pos2:

```
xx%(1%)=INT(RND*xmax%)+1:yy%(1%)=ymax%
```

RETURN

Pos3:

```
xx%(1%)=xmax%:yy%(1%)=INT(RND*ymax%)
```

RETURN

Pos4:

```
xx%(1%)=INT(RND*xmax%):yy%(1%)=1
```

RETURN

Plot:

MENU STOP

WINDOW CLOSE 2

WINDOW OUTPUT 1

CLS

Use separate plotting routines for flooding on or off

IF flood%=0 THEN GOSUB Dryplot ELSE GOSUB Floodplot

MENU ON

RETURN

Dryplot:

Scan all grid points

```
FOR x%=1 TO xmax%
```

```
  FOR y%=1 TO ymax%
```

```

Calculate screen co-ordinates of first corner of grid square at (x%,y%)
x1%=xo%+(y%-x%)*7
y1%=yo%-INT(magni*c%(x%,y%)+(x%+y%)*4)
Then calculate screen co-ordinates of second corner at (x%-1,y%)
x2%=x1%+7
y2%=yo%-INT(magni*c%(x%-1,y%)+(x%-1+y%)*4)
Draw side of grid square parallel to X-axis
First erase hidden-lines by drawing broad line in white
CALL PENMODE(11)
CALL MOVETO(x2%,y2%): CALL LINETO(x1%,y1%)
Then draw new line
IF x%>1 THEN LINE(x1%,y1%)-(x2%,y2%)
If end of row has been reached then second line not needed so skip on
IF y%=ymax% GOTO loopdry
Draw side of grid square parallel to Y-axis
Calculate co-ordinates of 3rd corner at (x%,y%+1)
y3%=yo%-INT(magni*c%(x%,y%+1)+(x%+y%+1)*4)
Erase hidden-lines as before
CALL LINETO(x2%,y3%)
Draw new line
LINE(x1%,y1%)-(x2%,y3%)
loopdry:
NEXT
NEXT
Draw base of grid
CALL PENNORMAL
First find altitudes of the three visible corners
ca%=c%(xmax%,1): cb%=c%(xmax%,ymax%): cc%=c%(1,ymax%)
Then draw three vertical lines down from these corners
LINE(xo%+(1-xmax%)*7,yo%+(xmax%+1)*4-INT(magni*ca%))-STEP(0,30+INT(magni*ca%))
LINE(xo%+(ymax%-xmax%)*7,yo%+(xmax%+ymax%)*4-INT(magni*cb%))-STEP(0,30+INT(magni*cb%))
LINE(xo%+(ymax%-1)*7,yo%+(1+ymax%)*4-INT(magni*cc%))-STEP(0,30+INT(magni*cc%))
Finally draw the two base lines
LINE-STEP((1-xmax%)*7,(xmax%-1)*4)
LINE-STEP((1-ymax%)*7,(1-ymax%)*4)
RETURN

Floodplot:
FOR x%=1 TO xmax%
FOR y%=1 TO ymax%
Check level to see if this point is flooded. If it is, draw it at water level
IF c%(x%,y%)<m1% THEN ca%=m1% ELSE ca%=c%(x%,y%)
IF c%(x%-1,y%)<m1% THEN cb%=m1% ELSE cb%=c%(x%-1,y%)
Calculate co-ordinates and plot as for dry
x1%=xo%+(y%-x%)*7
y1%=yo%-INT(magni*ca%)+(x%+y%)*4
x2%=x1%+7
y2%=yo%-INT(magni*cb%)+(x%-1+y%)*4
CALL PENMODE(11)
CALL MOVETO(x2%,y2%): CALL LINETO(x1%,y1%)
IF x%>1 THEN LINE(x1%,y1%)-(x2%,y2%)
IF y%=ymax% GOTO loopflood
IF c%(x%,y%+1)<m1% THEN cc%=m1% ELSE cc%=c%(x%,y%+1)
y3%=yo%-INT(magni*cc%)+(x%+y%+1)*4
CALL LINETO(x2%,y3%)
LINE(x1%,y1%)-(x2%,y3%)
loopflood:
Shade any part of square which is flooded
GOSUB Shade
NEXT
NEXT
CALL PENNORMAL
Draw base as for dry
IF c%(xmax%,1)<m1% THEN ca%=m1% ELSE ca%=c%(xmax%,1)
IF c%(xmax%,ymax%)<m1% THEN cb%=m1% ELSE cb%=c%(xmax%,ymax%)
IF c%(1,ymax%)<m1% THEN cc%=m1% ELSE cc%=c%(1,ymax%)
LINE(xo%+(1-xmax%)*7,yo%+(xmax%+1)*4-INT(magni*ca%))-STEP(0,30+INT(magni*ca%))
LINE(xo%+(ymax%-xmax%)*7,yo%+(xmax%+ymax%)*4-INT(magni*cb%))-STEP(0,30+INT(magni*cb%))
LINE(xo%+(ymax%-1)*7,yo%+(1+ymax%)*4-INT(magni*cc%))-STEP(0,30+INT(magni*cc%))
LINE-STEP((1-xmax%)*7,(xmax%-1)*4)
LINE-STEP((1-ymax%)*7,(1-ymax%)*4)
RETURN

```

Menucheck:

```

A menu selection has been detected - find what it is
menunumber%=MENU(0)
IF menunumber%<6 THEN RETURN
menuitem%=MENU(1)
ON menuitem% GOSUB Rotatleft,Rotateright,Magnify,Flood
RETURN

```

Rotatleft:

```

Rotate by reading c% array into d% array with axes interchanged
FOR x%=1 TO xmax%
FOR y%=1 TO ymax%: d%(ymax%-y%+1,x%)=c%(x%,y%): NEXT
NEXT
Then return rotated data to c% array
SWAP xmax%,ymax%
FOR x%=0 TO xmax%
FOR y%=1 TO ymax%: c%(x%,y%)=d%(x%,y%): NEXT
NEXT
GOSUB Plot
MENU
RETURN

```

Rotateright:

```

FOR x%=1 TO xmax%
FOR y%=1 TO ymax%: d%(y%,xmax%-x%+1)=c%(x%,y%): NEXT
NEXT
SWAP xmax%,ymax%
FOR x%=0 TO xmax%
FOR y%=0 TO ymax%: c%(x%,y%)=d%(x%,y%): NEXT
NEXT
GOSUB Plot
MENU
RETURN

```

Magnify:

```

Open window to enter desired vertical scale magnification
WINDOW 2,,(80,100)-(420,220),2
CALL TEXTFONT(0)
PRINT SPC(4);"adjust vertical magnification as required"
Draw magnification selection bar
LINE(15,70)-(325,90),b
LINE(16,71)-(324,89),b
BUTTON 1,1,"OK",(240,25)-(290,55),1
Put scale markings and labels onto selection bar
FOR i%=20 TO 320 STEP 20: LINE(i%,90)-(i%,95): NEXT
CALL TEXTFONT(1)
CALL TEXTSIZE(9)
FOR i%=20 TO 320 STEP 100
CALL MOVETO(i%,108)
PRINT .5*(1+(i%-20)/100);
LINE(i%,95)-(i%,100)
NEXT
Draw magnification pointer to show current magnification
allow it to move with the mouse until the OK button is pressed
LINE(20+(magni-.5)*200,72)-STEP(0,16)
WHILE Dialog(0)<>1
IF MOUSE(0)<>0 THEN GOSUB Mousemag
WEND
WINDOW CLOSE 2
Re-draw grid with new magnification
GOSUB Plot
MENU
RETURN

```

Mousemag:

```

Find position of mouse, if it is within selection bar then move pointer
IF MOUSE(1)<15 OR MOUSE(1)>325 THEN RETURN
IF MOUSE(2)<70 OR MOUSE(2)>90 THEN RETURN
LINE(20+(magni-.5)*200,72)-STEP(0,16),30
magni=.5+(MOUSE(1)-20)/20
LINE(20+(magni-.5)*200,72)-STEP(0,16)
RETURN

```

Flood:

```

Open a window
WINDOW 2,,(80,100)-(420,220),2
PRINT: PRINT: PRINT SPC(14);"Calculating levels"
CALL TEXTFONT(0)
PRINT: PRINT SPC(16);"Please wait"
Find highest and lowest levels present within the array
min%=10000
max%=-10000
FOR x%=1 TO xmax%
FOR y%=1 TO ymax%

```


To:— Tom, Dick & George



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PROGRAM FILE

```

IF c%(x%,y%)<min% THEN min%=c%(x%,y%)
IF c%(x%,y%)>max% THEN max%=c%(x%,y%)
NEXT
NEXT
CLS
CALL TEXTFONT(1)
CALL TEXTSIZE(9)
Draw flood level selection bar
LINE(17,70)-(323,90),b
LINE(18,71)-(322,89),b
Put scale markings and labels on selection bar
div%=(max%-min%)\10: IF div%=0 THEN div%=1
FOR i%=min% TO max%
scalex%=20+(i%-min%)*300/(max%-min%)
IF i% MOD div%=0 OR i%=max% THEN LINE (scalex%,90)-STEP(0,6)

IF i% MOD (div%*5)=0 OR i%=min% OR i%=max% THEN CALL MOVETO(scale
x%-10,110): PRINT i%

NEXT
CALL TEXTSIZE(12)
CALL TEXTFONT(0)
CALL MOVETO(50,50): PRINT "Select required water level";
BUTTON 1,1,"OK",(270,10)-(320,40),1
level%=ml%-min%
IF Flood had been previously selected, the old level may now be outside
the present level range - adjust if necessary
IF flood%=0 OR level%<0 THEN level%=0
IF level%>max%-min% THEN level%=max%-min%
Draw pointer on selection bar to show current water level
allow it to move with the mouse until the OK button is pressed
LINE(20+level%*300/(max%-min%),72)-STEP(0,16)
WHILE DIALOG(0)<>1
IF MOUSE(0)>0 THEN GOSUB Mouseflood
WEND
ml%=min%+level%
Set flood flag if chosen flood level is not zero
IF level%>0 THEN flood%=1
WINDOW CLOSE 2
Re-draw grid with new flood level
GOSUB Plot
MENU
RETURN

Mouseflood:
Find position of mouse, if it is within selection bar then move pointer
IF MOUSE(1)<20 OR MOUSE(1)>320 THEN RETURN
IF MOUSE(2)<70 OR MOUSE(2)>90 THEN RETURN
LINE(20+level%*300/(max%-min%),72)-STEP(0,16),30
level%=(MOUSE(1)-20)/(300/(max%-min%))
LINE(20+level%*300/(max%-min%),72)-STEP(0,16)
RETURN

Shade:
IF x%=1 OR y%=ymax% THEN RETURN
Count number of corners in each grid square which are below flood level
corner%=0
maglev%=INT(magn!*ml%)
IF c%(x%,y%)<ml% THEN corner%=1
IF c%(x%-1,y%)<ml% THEN corner%=corner%+1
IF c%(x%,y%+1)<ml% THEN corner%=corner%+1
IF c%(x%-1,y%+1)<ml% THEN corner%=corner%+1
No shading if less than 3 corners are below flood level
IF corner%<3 THEN RETURN
Prepare array for Toolbox FILLPOLY subroutine
poly%(1)=yo%+(x%-1+y%)*4-maglev%
poly%(2)=xo%+(y%-x%)*7
poly%(3)=poly%(1)+8
poly%(4)=poly%(2)+14
IF 3 corners wet shade triangle. If all 4 wet shade whole square
IF corner%=3 THEN GOSUB Trishade ELSE GOSUB Squareshade
CALL FILLPOLY(VARPTR(poly%(0)),VARPTR(patt%(0)))
RETURN

Trishade:
poly%(0)=22
Find which of 4 possible triangles needs shading
IF c%(x%,y%)>ml% THEN GOSUB Tri1: RETURN
IF c%(x%-1,y%)>ml% THEN GOSUB Tri2: RETURN
IF c%(x%,y%+1)>ml% THEN GOSUB Tri3: RETURN
GOSUB Tri4
RETURN

```

```

Tri1:
poly%(5)=poly%(1)
poly%(6)=poly%(2)+7
poly%(7)=poly%(3)
poly%(8)=poly%(6)
poly%(9)=poly%(1)+4
poly%(10)=poly%(4)
poly%(2)=poly%(6)
RETURN

```

```

Tri2:
poly%(5)=poly%(1)+4
poly%(6)=poly%(2)
poly%(7)=poly%(3)
poly%(8)=poly%(2)+7
poly%(9)=poly%(5)
poly%(10)=poly%(4)
poly%(1)=poly%(5)
RETURN

```

```

Tri3:
poly%(5)=poly%(1)+4
poly%(6)=poly%(2)
poly%(7)=poly%(1)
poly%(8)=poly%(2)+7
poly%(9)=poly%(5)
poly%(10)=poly%(4)
poly%(3)=poly%(5)
RETURN

```

```

Tri4:
poly%(5)=poly%(1)+4
poly%(6)=poly%(2)
poly%(7)=poly%(3)
poly%(8)=poly%(2)+7
poly%(9)=poly%(1)
poly%(10)=poly%(8)
poly%(4)=poly%(8)
RETURN

```

```

Squareshade:
poly%(0)=26
poly%(5)=poly%(1)+4
poly%(6)=poly%(2)
poly%(7)=poly%(3)
poly%(8)=poly%(2)+7
poly%(9)=poly%(5)
poly%(10)=poly%(4)
poly%(11)=poly%(1)
poly%(12)=poly%(8)
RETURN

```

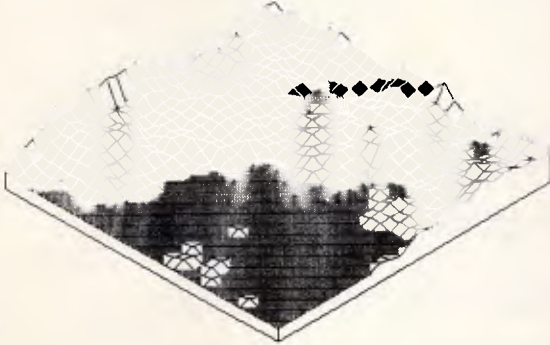
```

Endless:
WHILE 1<2: WEND
RETURN

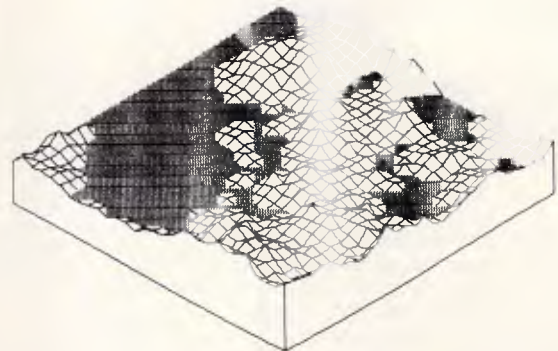
```

c%	2-D array holding heights of all grid points
ca%	Temporary variable used in drawing grid
cb%	Temporary variable used in drawing grid
cc%	Temporary variable used in drawing grid
corner%	Sum of grid-square corners which are below water level
d%	2-D array used when rotating c% array
div%	Size of divisions on flood level selection bar
flood%	Flag - set to 0 if flooding off, set to 1 if flooding on
g%	Loop counter for current generation
gen%	Number of generations to be done
gs%	Starting generation - set to 1 at start, set to gen%+1 if continuing after gen% is reached
i%	General-purpose loop counter
k	Offset of line on Y-axis - equation of line is $y=m*x+k$
level%	Height of flood water level above lowest point on grid
m	Slope of line - equation of line is $y=m*x+k$
maglev%	Flood water level modified by vertical magnification
magn!	Vertical magnification
max%	Highest level present on grid
menuitem%	Number of item in menu selection
menunumber%	Number of menu bar selection
min%	Lowest level present on grid
ml%	Flood water level
ortho%	Flag - set to 1 if line is parallel to Y-axis in order to prevent division by zero when calculating m
patt%	Array used by Toolbox routine FillPoly
plot%	Number of generations between re-plotting grid

poly% Array used by Toolbox routine FillPoly
 press% Which button pressed
 q% Value of level shift to be added to points above the line
 scalex% Positions of scale markings on flood level selection bar
 side% Array containing the two sides intersected by the line
 x% X co-ordinate of current grid point
 x1% X co-ordinate of first corner in current grid square
 x2% X co-ordinate of second corner in current grid square
 xmax% Extent of grid along X-axis
 xo% Screen X co-ordinate of grid point (xmax%,0) - taken as the origin for plotting purposes
 xx% Array containing X co-ordinates of intersections between the line and the grid sides



y% Y co-ordinate of current grid point
 y1% Y co-ordinate of first corner in current grid square
 y2% Y co-ordinate of second corner in current grid square
 y3% Y co-ordinate of third corner in current grid square
 ymax% Extent of grid along Y-axis
 yo% Screen Y co-ordinate of grid point (xmax%,0) - taken as the origin for plotting purposes
 yp% Y co-ordinate of the line at current X position
 yy% Array containing Y co-ordinates of intersections between the line and the grid sides



Spectrum Intelligent Logic Processor

by Mike Biddell

This program assists in the design of combinational logic circuits using TTL chips. When a circuit has been entered into the computer, it can be saved to tape (along with the program). To use the program, first design the circuit you wish to simulate and test in the computer. Gates and inputs to, and outputs from, gates should be numbered in a logical progression, passing from the inputs to the circuit through to the outputs. The gate types and inputs and outputs are then entered into the computer, which checks that they are consistent with a possible circuit. The circuit can then be simulated by entering different possible inputs; the computer works out what the outputs will be and displays the result. This allows truth tables to be generated.

The program should be typed in as shown, then the example of an XNOR gate should be entered as shown here. The program can then be saved, and when reloaded will automatically have

the XNOR circuit ready. This can be changed to a new circuit at any time.

The operation of the program for a single XNOR gate is as follows. Input and output lines should be numbered, starting at two and running in sequence. The program generates a set of questions, and you should enter the replies given to set up the single XNOR gate.

Number of inputs into this logic system? 2

Number of outputs? 1

How many gates? 1

Gate number 1

Gate type? XNOR

Number of inputs for this gate? 2

Input line numbers? 2

3

Output line number for this gate? 4

Fan out? 1

Do you want a printout of the circuit data, Y or N? N

The computer then checks the data for consistency and indicates accor-

dingly. It enters the simulation mode and requests the values for each input line. For each combination of these, it produces the correct output.

The only question from those previously stated that needs an explanation is what 'fan out' is: it is asking for the number of inputs that are to be drawn from this output. This is normally one, but it may need to go more than one gate, in which case you should give the correct number.

Some additional points to note are that you should always be logical in your line-numbering sequence. Do not couple outputs back to inputs as the circuit cannot stabilise oscillation. Systems with large numbers of inputs may cause problems with the screen display and may have to be split up into sections.

Circuits are saved with the program. When you reload, start the program with GOTO 221 instead of RUN, or old circuit data will be wiped out.

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```

1 LET A$="1": POKE 23609,255
2 BORDER 0: PAPER 0: CLS : GO SUB 9900
3 INK 6: CLS
5 LET P=0
6 LET Q=0
7 PRINT AT 5,0: PAPER 4: INK 0: " N.B. Throughout this section ".,." please
press ENTER after each ".,." question. "
8 PAUSE 200: CLS
10 PRINT "Number of inputs into this logic system?"
20 INPUT A$: GO SUB 9900: IF A$=1 THEN GO TO 10
21 LET S=VAL (A$): PRINT S: PAUSE 100: IF S<1 OR S>10 THEN GO SUB 4000
25 CLS
30 PRINT "Number of outputs?"
35 INPUT A$: GO SUB 9900: IF A$=1 THEN GO TO 30
36 LET T=VAL (A$): PRINT T: PAUSE 100: IF T<1 OR T>6 THEN GO SUB 4050
40 CLS
50 PRINT "How many gates?"
55 INPUT A$: GO SUB 9900: IF A$=1 THEN GO TO 50
56 LET G=VAL A$: IF S+T>9*G THEN GO SUB 4100: PRINT G
60 CLS
65 DIM G$(G,4)
70 DIM I(G+1)
72 DIM F(G+1)
75 DIM L(8*G)
80 DIM O(10*G)
85 DIM P(8*G)
86 DIM M(8*G)
87 DIM N(10*G)
88 DIM C(8*G)
90 FOR J=1 TO G
100 CLS
110 PRINT "Gate number: ";J
111 PRINT
115 PRINT "Gate type? (Lower case please.)"
116 INPUT H$: IF H$="" THEN GO TO 116
117 GO SUB 4200
118 PRINT H$
120 LET G$(J)=H$
130 PRINT "Number of inputs for this gate?"
140 INPUT C$: GO SUB 8000: IF C$=1 THEN GO TO 140
142 LET I=VAL C$
145 PRINT I
146 LET I(J)=I
150 PRINT "Input line numbers?"
152 PRINT "Type ENTER after each number"
155 FOR K=1 TO I
160 INPUT C$: GO SUB 8000: IF C$=1 THEN GO TO 160
161 LET V=VAL C$
162 IF V<2 THEN GOTO 5,-10: IF V<2 THEN GO TO 160
165 PRINT V: " ";
166 LET P=P+1
170 LET L(P)=V
172 LET M(P)=V
175 NEXT K
180 PRINT
185 PRINT "Output line number for the gate?"
190 INPUT C$: GO SUB 8000: IF C$=1 THEN GO TO 190: LET O=VAL C$
191 LET O=VAL C$: PRINT O
192 PRINT "Fan out?"
193 INPUT C$: GO SUB 8000: IF C$=1 THEN GO TO 193: LET FAN=VAL C$
194 LET FAN=VAL C$: PRINT FAN
195 LET F(J)=FAN
198 FOR K=1 TO FAN
199 LET Q=Q+1
200 LET O(Q)=O
202 LET N(Q)=O
204 NEXT K
205 FOR Y=1 TO 35
206 NEXT Y
210 NEXT J
215 GO TO 221
220 CLS : GO SUB 9900
221 PAPER 0: INK 4: BORDER 0: CLS : PRINT "Do you want a print out of the circuit data (Y or N)?"
222 IF INKEY$="n" OR INKEY$="N" THEN GO TO 225
223 IF INKEY$="y" OR INKEY$="Y" THEN GO SUB 5000
224 GO TO 222
225 CLS
230 PRINT "Input data received-thank you I will check it for errors and report it"
231 FOR K=1 TO 235
233 NEXT K
235
300 FOR I=1 TO P
305 IF L(I)=0 THEN GO TO 326
310 FOR J=1 TO P
311 IF N(I)=0 THEN GO TO 320
312 IF N(I)=0 AND N(I)=M(J) THEN LET N(I)=0
313 IF N(I)=0 THEN LET M(J)=0
314 IF J>I AND L(I)=M(J) THEN LET M(J)=0
320 NEXT J
325 NEXT I
326 LET F=0
327 LET H=0
330 FOR I=1 TO P
335 IF M(I)<>0 THEN LET F=F+1
336 IF N(I)<>0 THEN LET H=H+1
340 NEXT I
341 CLS
342
345 IF F=S AND H=T THEN GO TO 395
350 CLS
355 PRINT "Data entry error - restart"
360 FOR J=1 TO 150
365 NEXT J
370 GO TO 1
395 CLS
396 PRINT "Data consistent - will process"
397 FOR J=1 TO 170
398 NEXT J
399 CLS
400 PRINT AT 0,0: PAPER 6: INK 0: "
410 PRINT PAPER 5: INK 0: "I N P U T S
TRUTH-TABLE
O U T P U T S"

```


PROGRAM FILE

```

415 LET X=2
416 LET Y=0
420 FOR I=1 TO P
422 IF M(I)=0 THEN GO TO 440
425 PRINT AT X,Y;M(I)
430 LET Y=Y+2
440 NEXT I
445 LET Y=19
450 FOR I=1 TO P
455 IF N(I)=0 THEN GO TO 470
460 PRINT AT X,Y;N(I)
465 LET Y=Y+3
470 NEXT I
480 FOR I=1 TO P
490 LET C(I)=O(I)
495 LET P(I)=L(I)
500 NEXT I
505 LET Y=0
510 FOR I=1 TO P
515 IF M(I)=0 THEN GO TO 544
516 PRINT AT 19,0; INK 4;"2=copy 3=clear data 4=new"
520 PRINT AT 21,0;"INPUT:";M(I);" (1 OR 0)?"
525 IF M(I)<>0 THEN INPUT C$
526 GO SUB 0000: IF f=1 THEN GO TO 525
527 LET Z=VAL C$
528 IF Z=2 THEN COPY
529 IF Z=3 THEN GO TO 399
530 IF Z=4 THEN GO TO 1
531 IF Z=2 THEN GO TO 480
532 IF Z>4 THEN GO TO 525
535 LET P(I)=Z
536 FOR J=1 TO P
537 IF L(I)=P(J) THEN LET P(J)=Z
538 NEXT J
542 PRINT AT X+1,Y;Z
543 LET Y=Y+2
544 NEXT I
547 LET B=0
548 LET C=1
549 LET A=1
550 FOR I=1 TO G
552
560 IF G$(I)="and " THEN GO SUB 2000
570 IF G$(I)="nand" THEN GO SUB 2020
580 IF G$(I)="or " THEN GO SUB 2040
590 IF G$(I)="nor " THEN GO SUB 2060
600 IF G$(I)="xor " THEN GO SUB 2080
610 IF G$(I)="xnor" THEN GO SUB 2100
620 IF G$(I)="not " THEN GO SUB 2120
622 IF G$(I)="high" THEN GO SUB 2140
625 IF G$(I)="low " THEN GO SUB 2160
630 LET C=C+I(I)
635 LET A=A+P(I)
700 NEXT I
701 LET B=B+1
702 IF B<3 THEN GO TO 548
703 LET t=0
704 FOR I=1 TO P
705 IF O(I)=0 THEN GO TO 709
707 IF C(I)>1 THEN GO TO 6000
708 LET t=t+5
709 NEXT I
710 FOR I=1 TO P
711 IF P(I)>1 THEN GO TO 6000
712 NEXT I
713 LET Y=19
714 FOR I=1 TO P+1
715 IF N(I)=0 THEN GO TO 730
720 PRINT AT X+1,Y;C(I)
725 LET Y=Y+3
730 NEXT I
740 LET X=X+1
750 GO TO 480
2000 FOR K=C TO C+I(I)-1
2010 IF P(K)=0 THEN GO SUB 7000
2011 IF C(A)=0 THEN GO SUB 3000
2015 NEXT K
2016 IF C(A)=0 THEN RETURN
2017 GO SUB 7200
2018 IF C(A)=1 THEN GO SUB 3060
2019 RETURN
2020 FOR K=C TO C+I(I)-1
2022 IF P(K)=0 THEN GO SUB 7200
2023 IF C(A)=1 THEN GO SUB 3060
2024 NEXT K
2025 IF C(A)=1 THEN RETURN
2026 GO SUB 7000
2027 IF C(A)=0 THEN GO SUB 3000
2030 RETURN
2040 FOR K=C TO C+I(I)-1
2042 IF P(K)=1 THEN GO SUB 7200
2043 IF C(A)=1 THEN GO SUB 3060
2044 NEXT K
2046 IF C(A)=1 THEN RETURN
2048 GO SUB 7000
2049 IF C(A)=0 THEN GO SUB 3000
2050 RETURN
2060 FOR K=C TO C+I(I)-1
2062 IF P(K)=1 THEN GO SUB 7000
2063 IF C(A)=0 THEN GO SUB 3000
2064 NEXT K
2066 IF C(A)=0 THEN RETURN
2068 GO SUB 7200
2069 IF C(A)=1 THEN GO SUB 3060
2070 RETURN
2080 IF P(C)=1 AND P(C+1)=0 OR P(C)=0 AND P(C+1)=1 THEN GO SUB 7200
2081 IF C(A)=1 THEN GO SUB 3060
2082 IF C(A)=1 THEN RETURN
2084 GO SUB 7000
2085 IF C(A)=0 THEN GO SUB 3000
2086 RETURN
2100 IF P(C)=1 AND P(C+1)=0 OR P(C)=0 AND P(C+1)=1 THEN GO SUB 7000
2101 IF C(A)=0 THEN GO SUB 3000

```

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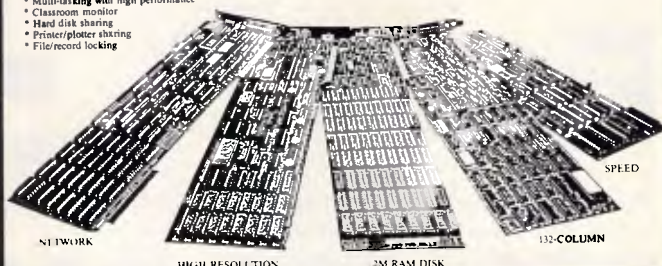
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PROGRAM FILE

```

9041 IF INKEY$<>" " THEN GO TO 9041
9060 CLS
9080 PRINT AT 21,0; PAPER 6;" Press any key to continue. "
9100 LET n=INT (RND*32)
9110 LET m=INT (RND*21)
9120 LET j=INT (RND*8)
9130 LET k=INT (RND*8)
9140 LET f=INT (RND*2)
9150 LET b=INT (RND*2)
9160 LET i=INT ((RND*12)+130)
9200 PRINT AT m,n; BRIGHT b; FLASH f; PAPER j; INK k;CHR$ i
9250 IF INKEY$="" THEN GO TO 9100
9260 RETURN
9900 PAPER 0: INK 5
9902 PRINT : PRINT " ";

```

```

9908 LET beep=RND*40+20
9909 FOR j=1 TO beep STEP beep/8
9910 BEEP RND*100/1000,j
9920 NEXT j
9925 LET f=0
9926 IF s$="" THEN LET f=1
9927 IF s$="" THEN LET s$=" "
9930 FOR k=1 TO LEN s$
9940 IF CODE s$(k TO k)>57 OR CODE s$(k TO k)<48 THEN LET f=1
9945 IF f=1 THEN PRINT
9950 IF f=1 THEN PRINT PAPER 7; INK 2;"illegal input - try again"
9952 IF f=1 THEN PRINT
9955 IF f=1 THEN RETURN
9960 NEXT k
9970 RETURN

```



BBC Cave By RW Wills

**MICROTEX
666**

Still keying in programs? Forget it!
This program is available for
teletext software downloading on
Microtex 666 (page *6663#.)

The object of this game is to descend into a three-level labyrinth of tunnels, and collect gold and magical treasures while avoiding hostile creatures. Eventually you have to successfully escape to the surface. The cave is mapped out onscreen as you explore, and your options are displayed as a menu with each action associated with a single key press.

You begin on level one. If you go up from here, you will return to the outside world and be able to boast of your exploits. Taking stairs downward leads you into deeper and more dangerous sections of the cave; at the centre of the deepest level is the hoard of treasures, closely guarded by a mighty dragon.

Your object in exploring the dungeon should be to gain as many points as possible. Your score depends on how well you feel and how much gold you have acquired. There are bonuses for

slaying monsters and carrying magical items.

Dying gets you a large negative score, so stay alive!

Your fitness is expressed as a percentage which is altered as you become injured. Trolls and goblins guard most caves, and trolls are the fiercer of the two. There are several other events that may occur, but these are left to be discovered by intrepid explorers. Just watch out for flooding!

The game is self-explanatory, except that the display graphics are as follows: A blue staircase with the letter U is an upward staircase.

A blue staircase with a D is a downward staircase.

A red rectangle with two exclamation marks above it is a trap.

A yellow bar with a number in yellow is that amount of gold.

A smallish green creature is a goblin.

A blue, square-headed creature is a troll.

A red, heraldic creature is a dragon.

A multi-coloured character with a tall hat is the wizard.

The program uses direct POKEs to memory and so may not work with a second processor. The program moves HIMEM down to &774C and uses the extra space for data storage. This is split up as follows: &774C to &79A5 describes the shape and occupants of cave locations; and &79A6 to &7BFF shows how much gold is in each location. The byte describing the shape and occupant of the player's current address is given by C%?P%, and the one giving the amount of gold is G%?P%.

```

10REM CAVE game.
20:
30REM (c) 1985 R.W.Wills.
40:
50ON ERROR GOTO 130
60MODE7:HIMEM=&774C
70PROCinit:PROCscreen
80:
90REM Main game loop.
100REPEAT:PROCTurn:PROCDisplay:PROCOption:UNTIL FALSE
110:
120REM Error handling.
130VDU26,30:G%:=10:REPORT:PRINT " at line ";ERL:END
140:
150DEF PROCinit
160REM Initialise variables and data area for the CAVE.
170PRINT "CHR$(141);"CAVE"CHR$(141);"CAVE"
180I:=RND(1-TIME)
190REM Global variables
200C%:=&774C:G%:=&79A6:I%:=1:S%:=14:O%:=14*2
210REM Clear data area
220FOR I%=&774C TO &7BFF
230I%:=0
240NEXT I%
250REM Generate cells
260FOR levelI%:=3 TO 1 STEP -1
270G%:=1:PRINT "Initialising level ";levelI%
280FOR aI%:=1 TO 13
290FOR sI%:=1 TO 13
300P%:=I%*I%+sI%*S%+(levelI%-1)*D%
310IF FNprob(0.6) OR FNup(P%+D%) THEN PROCopencell
320NEXT sI%
330NEXT aI%
340NEXT levelI%
350REM Entrance
360P%:=7*I%+7*S%
370C%?P%:=A$B:PROCsetgold(P%,0)
380C%?(P%+D%)=(C%?(P%+D%))AND&F7
390REM Hoard
400Q%:=P%+2*D%:PROCsetgold(Q%,20):C%?Q%=(C%?Q%)*DRAA3
410REM Wizard's cell
420W%:=I%+O%:PROCwizard
430REM Data
440S%:=7*I%+7*S%:levelI%:=1
450killI%:=0:aliveI%:=100:goldI%:=0:poisonI%:=0:flasksI%:=0:lampI%:=TRUE
460floodI%:=FALSE:waterI%:=0:depthI%:=0
470carpetI%:=FALSE:vandI%:=FALSE:swordI%:=FALSE:staffI%:=FALSE
480moveI%:=0

```

```

490ENDPROC
500:
510DEF PROCopencell
520REM Create an open area at aI%,sI%,levelI%
530P%:=I%*I%+sI%*S%+(levelI%-1)*D%
540REM Cavern or tunnel.
550IF FNprob(0.5) OR FNup(P%+D%) THEN C%?P%:=A$0 ELSE C%?P%:=A$0:ENDPROC
560REM For cavern, set up occupant and gold.
570PROCsetgold(P%,RND(3)-1):PROCsetgold(P%,RND(4)*levelI%)
580IF FNup(P%+D%) OR FNprob(0.6) THEN ENDPROC
590REM Up staircase or trap.
600IF FNprob(0.9) OR levelI%:=3 OR (NOT FNopen(P%+O%)) THEN C%?P%=(C%?P%)+O% ELSE C%?P%=(C%?P%)+O%+10
610ENDPROC
620:
630DEF PROCwizard
640REM Move the wizard to a new location.
650PROCsetgold(W%:=I%+O%,0)
660W%:=I%+O%+(RND(3)+5)*S%*(RND(3)+5)+D%*RND(2)
670C%?W%:=I%*(I%+O%)+S%*(RND(3)+5)+D%*RND(2)
680C%?W%:=I%*(I%+O%)+S%*(RND(3)+5)+D%*RND(2)
690ENDPROC
700:
710DEF PROCscreen
720REM Set up the control codes on the screen.
730LOCAL Y%
740PROCcol(32,0,15,132)
750FOR Y%:=0 TO 12 STEP 4
760PROCcol(33,Y%,2,157)
770NEXT Y%
780PROCcol(34,0,2,134):PRINTTAB(35,0);"LEVEL";
790PROCcol(34,4,2,135):PRINTTAB(35,4);"SCORE";
800PROCcol(34,8,2,133):PRINTTAB(35,8);"ALIVE";
810PROCcol(34,12,2,131):PRINTTAB(35,12);"GOLD";
820PROCcol(0,21,4,132):PROCcol(1,21,4,157):PROCcol(2,21,4,135)
830PROCinfo
840ENDPROC
850:
860DEF PROCturn
870REM "Housekeeping" to be done once a turn.
880IF aliveI%<0 THEN PROCend("You are dead.",-1000)
890REM Poison
900aliveI%:=aliveI%-poisonI%
910IF aliveI%<0 THEN PROCend("You have been poisoned.",-1000)
920REM Flood
930IF (NOTfloodI%) AND FNprob(0.005) THEN floodI%:=TRUE:waterI%:=0
940IF floodI% THEN waterI%:=waterI%+RND(1):depthI%:=waterI%+6*(levelI%-3) ELSE waterI%:=0:depthI%:=0

```


PROGRAM FILE

```

950IF depthI=6 AND Fnuip(PZ) THEN PROCwindow:PRINT"you are forced upst
air by""";PROCwait(2);depthI=depthI-6;moveI=-D;PROCmov:I
F moveI=0 THEN depthI=depthI+6
960IF depthI=6 THEN PROCend("You are drowned",-1000)
970REM Pick up gold?
980IF Fnuoc(PZ)=0 AND Fngold(PZ)<0 AND depthI<1 AND lampI THEN PROCw:
ndow:PZ=3:PRINT"you have picked up";CHR$131;Fngold(PZ);" gold pieces.";V
DU26:PROCwait(2);goldI=goldI+Fngold(PZ);PROCsetgold(PZ,0)
990ENDPROC
1000:
1010DEF PROCdisplay
1020REM Display the current situation.
1030PROCinfo
1040VDU28,0,20,30,0,12,26
1050IF NOTlampI THEN PRINTTAB(6,7);"It's dark in here!";ENDPROC
1060FOR aI=-1 TO 1
1070FOR zI=-1 TO 1
1080PROCdispcell
1090NEXT zI
1100NEXT aI
1110ENDPROC
1120:
1130DEF PROCdispcell
1140REM Display the cell at offset aI,zI from the current location, and
1150REM its contents.
1160LOCAL IX
1170QI=PZ+eI*I+eI*S
1180IF ((C7QI)AND40)=0 OR ((C7QI)AND80)=0 THEN ENDPROC
1190QI=11+10*aI;YI=7+7*zI
1200IF aI=0 AND zI=0 THEN nb$=CHR$8+CHR$151+CHR$157 ELSE nb$=CHR$8+CHR$
150+CHR$157
1210bb$=CHR$156
1220REM Centre
1230PRINTTAB(XI+4,YI+3);nb$;SPC1;bb$;
1240REM South tunnel
1250IF Fnuopen(QI+S) THEN FOR IX=YI+4 TO YI+6:PRINTTAB(XI+4,IX);nb$;SPC
1;bb$;NEXT IX
1260REM North tunnel
1270IF Fnuopen(QI-S) THEN FOR IX=YI TO YI+2:PRINTTAB(XI+4,IX);nb$;SPC1;
bb$;NEXT IX
1280REM Cavern
1290IF Fncav(QI) THEN FOR IX=YI+1 TO YI+5:PRINTTAB(XI+1,IX);nb$;SPC7;bb
$:NEXT IX
1300REM East tunnel
1310IF Fnuopen(QI+E) THEN PRINTTAB(XI+6,YI+3);SPC4;bb$;
1320REM West tunnel
1330IF Fnuopen(QI-W) THEN PRINTTAB(XI,YI+3);nb$;SPC4;
1340REM Trap
1350IF Fnuap(QI) THEN VDU31,XI+2,YI+1,129,33,33,8,8,10,145,255,255
1360REM Stairs up
1370IF Fnuip(PZ) THEN VDU31,XI+2,YI+1,148,176,85,8,8,10,148,255,244
1380REM Stairs down
1390IF levelI<3 AND Fnuip(QI+D) THEN VDU31,XI+2,YI+1,148,68,224,8,8,1
0,148,248,255
1400REM Goblin
1410IF Fnuoc(QI)=1 THEN VDU31,XI+3,YI+3,146,224,252,176,8,8,10,146,
184,255,228,8,8,10,146,250,163,245
1420REM Troll
1430IF Fnuoc(QI)=2 THEN VDU31,XI+2,YI+3,148,32,188,188,8,8,10,148,1
90,255,255,237,8,8,8,10,148,225,183,235,178
1440REM Dragon
1450IF Fnuoc(QI)=3 THEN VDU31,XI+2,YI+3,145,172,246,180,248,190,177,8,8
,8,8,10,145,179,255,255,166,8,8,8,10,145,167,251,179,251
,233
1460REM Wizard
1470IF Fnuoc(QI)=7 THEN VDU31,XI+3,YI+3,146,240,245,176,8,8,10,148,
254,254,180,8,8,10,145,250,239,176
1480REM Gold
1490IF Fngold(QI)<0 THEN QI=3:PRINTAB(XI+5,YI+1);CHR$131;Fngold(QI);
VDU31,XI+5,YI+2,147,175,175,165
1500ENDPROC
1510:
1520DEF PROCinfo
1530REM Display information in the right hand side information boxes.
1540LOCAL IX,VDU26
1550FOR IX=1 TO 13 STEP 4
1560PRINTAB(35,IX);SPC5;
1570NEXT IX
1580QI=1:PRINTAB(37,1);levelI;
1590QI=5:PRINTAB(35,5);Fnscore;
1600QI=3:PRINTAB(35,9);aliveI;"%";
1610QI=5:PRINTAB(35,13);goldI;
1620IF depthI<1 THEN VDU28,32,18,39,16,12,26:ENDPROC
1630PROCool(32,16,3,134)
1640PROCool(33,16,3,157):PROCool(34,16,3,132)
1650QI=1:PRINTAB(35,16);"WATER";TAB(35,17);"DEPTH";TAB(35,18);depthI;"
ft.";
1660ENDPROC
1670:
1680DEF PROCoption
1690REM Display the list of options, accept the choice and carry it out
1700PROCwindow:PRINT"OPTIONS:";
1710XI=0;YI=0;list$=STRINGS(14,"-");list$=""
1720emptyI=(Fnuoc(PZ)AND3)=0
1730IF (emptyI OR moveI=0) AND Fnuopen(PZ-S) THEN PROCsetopt("N Go Nort
h")
1740IF (emptyI OR moveI=0) AND Fnuopen(PZ+E) THEN PROCsetopt("S Go Sout
h")
1750IF (emptyI OR moveI=0) AND Fnuopen(PZ+E) THEN PROCsetopt("E Go East
")
1760IF (emptyI OR moveI=0) AND Fnuopen(PZ-W) THEN PROCsetopt("W Go West
")
1770IF (emptyI OR moveI=0) AND Fnuip(PZ) THEN PROCsetopt("U Go up")
1780IF (emptyI OR moveI=0) AND levelI<3 AND Fnuip(PZ) THEN PROCsetopt
("D Go down")
1790IF moveI<0 AND (NOTemptyI) AND Fnuopen(PZ-moveI) THEN PROCsetopt("R
Retreat")
1800IF NOTemptyI THEN PROCsetopt("F Fight")
1810IF Fnuoc(PZ)=7 THEN PROCsetopt("A Approach")
1820IF emptyI AND Fncav(PZ) AND (goldI-Fngold(PZ)<0) THEN PROCsetopt("G
Get/drop")
1830IF emptyI AND carpeI THEN PROCsetopt("B Use carpet")
1840IF emptyI AND wandI THEN PROCsetopt("M Break wand")
1850IF emptyI AND flaskI=0 THEN PROCsetopt("K Drink")
1860IF emptyI THEN PROCsetopt("I Inventory")
1870PROCsetopt("Q Quit")
1880VDU26
1890QI=Fngot(list$)
1900IF opt$="N" THEN moveI=-S;PROCmov
1910IF opt$="S" THEN moveI=S;PROCmov
1920IF opt$="E" THEN moveI=E;PROCmov
1930IF opt$="W" THEN moveI=W;PROCmov
1940IF opt$="U" THEN moveI=D;PROCmov
1950IF opt$="D" THEN moveI=D;PROCmov
1960IF opt$="R" THEN PROCretreat
1970IF opt$="F" THEN moveI=0:PROCFight
1980IF opt$="A" THEN moveI=0:PROCapproach
1990IF opt$="G" THEN moveI=0:PROCgetdrop

```

```

2000IF opt$="M" THEN PROCfly
2010IF opt$="B" THEN PROCbreak
2020IF opt$="K" THEN moveI=0:PROCDrink
2030IF opt$="I" THEN moveI=0:PROCIvent
2040IF opt$="Q" THEN PROCend("You gave up",-999)
2050ENDPROC
2060:
2070DEF PROCsetopt(text$)
2080REM Add the given option to the list of valid options, and put the
text
2090REM on the screen.
2100list$=list$+LEFT$(text$,1)
2110YI=YI+1:IF YI=4 THEN YI=0;XI=XI+12
2120PRINTAB(XI,YI);text$;
2130ENDPROC
2140:
2150DEF PROCmov
2160REM Move in the direction moveI.
2170QI=PZ+moveI
2180REM If not in a cavern, may find something.
2190IF (NOT Fncav(PZ)) AND (NOT Fncav(PZ)) AND Fnpob(0.04*levelI) THEN
N PROcfind
2200REM Set "explored" flag in new location.
2210QI=PZ-(C7PZ)DRA0
2220REM Make sure the value of levelI is correct.
2230IF moveI=D THEN levelI=levelI+1
2240IF moveI=-D THEN levelI=levelI-1
2250IF levelI=0 THEN PROCend("You have escaped from the cave.",Fnscore)
2260REM The previous area may cave in.
2270caveinI=Fnpob(0.005*levelI) AND (moveI<0)
2280IF caveinI THEN PROCwindow:PRINT"The roof has caved in behind you:"
"you cannot go back.";VDU26:PROCwait(2);C7PZ=PZ-moveI=0
2290IF caveinI AND moveI=D THEN C7PZ=(C7PZ)AND47
2300IF caveinI AND moveI=W THEN C7PZ=(C7PZ)AND47
2310REM If there is a trap, fall down.
2320IF Fnuap(PZ) THEN PROCwindow:QI=1:PRINT"you have fallen down a tra
p"" to level";levelI+1;VDU26:aliveI=aliveI-RND(10);PROCwait(2);moveI=D
I:PROCmov:moveI=0
2330REM A lot of gold may attract a dragon.
2340IF Fncav(PZ) AND (Fnuoc(PZ)AND3)<3 AND Fnpob(goldI*levelI/1000) TH
EN PROCdragon
2350ENDPROC
2360:
2370DEF PROCdragon
2380REM Cause a dragon to appear.
2390PROCwindow:PRINT"A dragon has been attracted by your""treasure.";P
ROCwait(2)
2400PROCsetocc(PZ,3)
2410IF Fnpob(levelI/20) THEN PRINT""It attacks you!";:PROCwait(2):PROC
fight
2420VDU26
2430ENDPROC
2440:
2450DEF PROCfind
2460REM Find something.
2470IF (NOTwandI) AND Fnpob(0.5) THEN PROCfindwand:ENDPROC
2480IF NOTstaffI THEN PROCfindstaff
2490ENDPROC
2500:
2510DEF PROCfindwand
2520wandI=TRUE:PROCwindow
2530PRINT"you have found a fragile wand."
2540VDU26:PROCwait(2)
2550ENDPROC
2560:
2570DEF PROCfindstaff
2580staffI=TRUE:PROCwindow
2590PRINT"you have found an ornate""carven staff.";
2600VDU26:PROCwait(2)
2610ENDPROC
2620:
2630DEF PROCfight
2640REM Fight the occupant of the cavern.
2650IF Fnpob(0.5) THEN aliveI=aliveI-1
2660PROCwindow
2670IF goldI>0 THEN PRINT"to fight, you have to drop all""your gold.";
PROCwait(2);PROCsetgold(PZ,Fngold(PZ)-goldI);goldI=0:CLS
2680IF Fnuoc(PZ)=1 THEN PROCfightgoblin
2690IF Fnuoc(PZ)=2 THEN PROCfighttroll
2700IF Fnuoc(PZ)=3 THEN PROCfightdragon
2710IF Fnuoc(PZ)=7 THEN PROCfightwizard
2720VDU26
2730ENDPROC
2740:
2750DEF PROCfightgoblin
2760winI=Fnpob(0.833*aliveI/100)
2770IF winI THEN PRINT"you slay the goblin.";killsI=killsI+1:PROCsetocc
(PZ,0) ELSE PRINT"Snarl! Kick!";aliveI=aliveI-RND(15)
2780PROCwait(2)
2790IF winI AND (NOTlampI) THEN PRINT"Using his tinder box you re-light
"" your lamp.";:lampI=TRUE:PROCwait(2)
2800ENDPROC
2810:
2820DEF PROCfighttroll
2830winI=Fnpob(0.833*aliveI/100)
2840IF winI THEN PRINT"you slay the troll.";killsI=killsI+2:PROCsetocc
(PZ,0) ELSE PRINT"Smash! Crunch! Pow!";aliveI=aliveI-RND(30)
2850PROCwait(2)
2860IF winI AND Fnpob(0.666) THEN PRINT"you find that the troll was c
arrying""a flask of elixir.";:flaskI=flaskI+1:PROCwait(2)
2870ENDPROC
2880:
2890DEF PROCfightdragon
2900IF Fnpob(0.714*aliveI/100) DR swordI THEN PRINT"you slay the drago
n.";killsI=killsI+5:PROCsetocc(PZ,0) ELSE PRINT"Snort! Scorch! Sizzle!
";aliveI=aliveI-RND(45)
2910PROCwait(2)
2920ENDPROC
2930:
2940DEF PROCfightwizard
2950IF Fnpob(0.5) THEN PRINT"you slay the wizard!";killsI=killsI+10:PR
OCsetocc(PZ,0);PROCwait(2);ENDPROC ELSE PROCend("You have been turned in
to a toad",-100)
2960:
2970DEF PROCretreat
2980PROCwindow:dropI=(goldI*RND(1))/DIV3
2990IF dropI>0 THEN EX=3:PRINT"while retreating you have dropped""dropI
"" gold pieces.";:PROCwait(2);goldI=goldI-dropI:PROCsetgold(PZ,Fngold(PZ)
-dropI)
3000IF lampI AND Fnpob(0.1) THEN CLS:PRINT"The draught has blown your
lamp out."" you will need a goblin's tinder box""to re-light it.";:PROC
wait(3);lampI=FALSE
3010VDU26:moveI=-moveI:PROCmov
3020ENDPROC
3030:
3040DEF PROCapproach
3050REM Approach wizard; randomly determine what he does.
3060PROCwindow
3070IF staffI THEN PROCaggie:PROCwizard:VDU26:ENDPROC

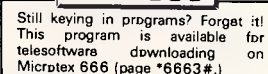
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Abstract

```

1 alive.":PROCwait(1)
2 poisonI% THEN poisonI:=0.PRINT"It also cures you of the effects"
3 "of the poison.":PROCwait(2)
3770VDU26:ENDPROC
3780:
3790DEF PROCinvent
3800REM Inventory of everything carried.
3810PROCwindow:PRINT" You are carrying.":PROCwait(1)
3820PRINT"Backpack. Dagger. Lamp.":IF lamp THEN PRINT"(lit).":PR
OCwait(1) ELSE PRINT"(not lit).":PROCwait(1)
3830IF goldI% THEN I%:=3:PRINT"goldI% gold pieces.":PROCwait(1)
3840IF flaskI% THEN PRINT"A flask of elixir.":PROCwait(1)
3850IF flaskI% THEN I%:=2:PRINT"flaskI% flasks of elixir.":PROCwait
(1)
3860IF swordI THEN PRINT"A magic sword.":PROCwait(1)
3870IF carpetI THEN PRINT"A magic carpet.":PROCwait(1)
3880IF wandI THEN PRINT"A magic wand.":PROCwait(1)
3890IF staffI THEN PRINT"An ornate carved staff.":PROCwait(1)
3900PROCwait(1):VDU26
3910ENDPROC
3920:
3930DEF PROCend(text$,acI)
3940REM End of game: report results and start a new game.
3950VDU26:CLS:PRINT"text$
3960IF acI=0 THEN I%:=3:PRINT"You are ",aliveI%,"I alive""and have "I%g
oldI%,"gold pieces."
3970I%:=5:PRINT"You score: "I%I%:"Press the space bar for another game
"
3980key$=FNget(" ")
3990REM
4000:
4010REM Useful functions.
4020DEF FNopen(P%)=(( (CI?P%)AND480)>0)
4030DEF FNexp1(P%)=(( (CI?P%)AND440)>0)
4040DEF FNcap(P%)=(( (CI?P%)AND420)>0)
4050DEF FNtrap(P%)=(( (CI?P%)AND410)>0)
4060DEF FNup(P%)=(( (CI?P%)AND8)>0)
4070DEF FNocc(P%)=(CI?P%)AND7
4080DEF FNgold(P%)=GI?P%
4090:
4100DEF PROCsetgold(P%,gI):GI?P%=FNmin(255,gI):ENDPROC
4110DEF PROCsetocc(P%,ocI):CI?P%=(CI?P%)AND48:(CI?P%=(CI?P%)OR(ocIAND
7):ENDPROC
4120:
4130DEF PROCwindow:VDU26,3,24,39,21,12:ENDPROC
4140:
4150DEF FNprob1(pr)=(pr/RND(1))
4160:
4170DEF PROCwait(secs)
4180REM Wait for the specified number of seconds, and then until the sp
ace bar
4190REM is released.
4200time=TIME+100*secs
4210REPEAT:UNTIL TIME>time
4220REPEAT:UNTIL NOT INKEY(-99)
4230ENDPROC
4240:
4250DEF PROCool(XI,YI,WI,AI)
4260REM Starting at position (XI,YI), put ASCII character AI% on the scr
een
4270REM in a column WI characters high.
4280LOCAL I%
4290FOR I%=0 TO WI-1
4300PRINTTAB(XI,YI+I):CHR$(AI);
4310NEXT I
4320ENDPROC
4330:
4340DEF FNmin(aI%,bI%):IF aI%<bI% THEN =bI% ELSE =aI%
4350:
4360DEF FNget(list$)
4370REM Get a single character from the keyboard: must be one in the gi
ven
4380REM list, and upper case.
4390*FX21,0
4400REPEAT:key$=GET$
4410IF ASC(key$)>97 THEN key$=CHR$(ASC(key$)-32)
4420UNTIL INSTR(list$,key$)>0
4430SOUND 1,-8,50,1
4440=key$
4450:
4460DEF FNinput
4470REM Integer input from the keyboard.
4480LOCAL I:I%=0
4490REPEAT
4500dig$=FNget("0123456789"+CHR$(13)):PRINTdig$;
4510IF ASC(dig$)<13 THEN I%:=10*I%+EVAL(dig$)
4520UNTIL ASC(dig$)=13
4530=I%
4540:
4550DEF FNscore
4560REM Return the current score.
4570LOCAL S%
4580S%=aliveI*goldI/DIV100+killI%
4590IF carpetI THEN S%:=S%+10
4600IF swordI THEN S%:=S%+10
4610IF wandI THEN S%:=S%+10
4620IF staffI THEN S%:=S%+10
4630=S%

```



The way the program works is thoroughly documented at the start, but it should be noted that it is wise to save a full copy of a program before using the Shrink command.

PROGRAM FILE

```

10 REM *****
15 REM ***
20 REM ***
25 REM ***
30 REM ***
35 REM ***
40 REM *****
50 REM
100 REM *** DUMP
110 REM DUMPS ALL VARIABLES EXCEPT ARRAYS
120 REM INDICATES VARIABLE TYPE AND VALUE
130 REM
140 REM SYS 49152,D
150 REM WILL DUMP TO SCREEN
155 REM
160 REM OPEN 1,4:CMD 1:SYS 49152,D
170 REM WILL DUMP TO PRINTER
180 REM
190 REM PRESS CONTROL TO SLOW OUTPUT
192 REM PRESS SHIFT TO PAUSE OUTPUT
194 REM PRESS SHIFT-LOCK TO FREEZE OUTPUT
196 REM
200 REM *** OLD
210 REM RECOVERS BASIC PROGRAM AFTER CRASH, NEW OR RESET
220 REM
230 REM SYS 49152,O
240 REM
300 REM *** SHRINK
310 REM REMOVES ALL UNECESSARY SPACES AND REMS FROM
320 REM BASIC PROGRAM. NB. CAN TAKE A WHILE
330 REM
340 REM SYS 49152,S
350 REM
400 REM *** AUTO
410 REM PROVIDES AUTO LINE NUMBERING FACILITY
420 REM
430 REM SYS 49152,A,L,I
435 REM
440 REM L=START LINE NUMBER
450 REM I=LINE NUMBER INCREMENT
460 REM
470 REM E.G. SYS 49152,A,1000,10
480 REM
490 REM PRESS RETURN ON EMPTY LINE TO EXIT
492 REM
500 T=0:FOR I=0 TO 566:READ A:T=T+A:POKE 49152+I,A:NEXT
510 IF T<>79524 THEN PRINT "ERROR IN DATA STATEMENTS.":END
600 INPUT "SAVE MACHINE CODE (Y/N) ";K$
610 IF K$="N" THEN END
620 INPUT "SAVE TO TAPE OR DISK (T/D) ";K$
630 DV=1:IF K$="D" THEN DV=8
640 POKE 251,PEEK(45):POKE 252,PEEK(46):POKE 253,DV
650 POKE 43,0:POKE 44,192:POKE 45,54:POKE 46,194
660 SAVE "MINI-KIT",PEEK(253),3
670 POKE 43,1:POKE 44,8:POKE 45,PEEK(251):POKE 46,PEEK(252):END
680 REM
1000 DATA 32,253,174,133,251,32,115,0
1010 DATA 165,251,201,68,208,3,76,41,192
1020 DATA 201,79,208,3,76,235,192,201
1030 DATA 83,208,3,76,3,193,201,65
1040 DATA 208,3,76,206,193,76,8,175
1050 DATA 166,45,164,46,134,251,132,252
1060 DATA 165,252,197,48,208,7,165,251
1070 DATA 197,47,208,1,96,160,0,177

```

```

1080 DATA 251,201,128,176,64,32,202,241
1090 DATA 200,177,251,201,127,176,15,32
1100 DATA 215,192,165,251,164,252,32,162
1110 DATA 187,32,188,170,208,90,41,127
1120 DATA 32,202,241,169,36,32,215,192
1130 DATA 169,34,32,202,241,160,2,177
1140 DATA 251,133,35,136,177,251,133,34
1150 DATA 136,177,251,32,36,171,169,34
1160 DATA 32,202,241,208,48,41,127,32
1170 DATA 202,241,200,177,251,201,127,176
1180 DATA 15,32,215,192,169,70,32,202
1190 DATA 241,169,78,32,202,241,208,21
1200 DATA 41,127,32,202,241,169,37,32
1210 DATA 215,192,160,1,177,251,170,136
1220 DATA 177,251,32,205,189,32,215,170
1230 DATA 24,165,251,105,5,133,251,144
1240 DATA 2,230,252,32,228,255,32,225
1250 DATA 255,208,1,96,173,141,2,201
1260 DATA 1,240,240,76,49,192,32,202
1270 DATA 241,169,61,32,202,241,24,165
1280 DATA 251,105,2,133,251,144,2,230
1290 DATA 252,96,160,1,152,145,43,32
1300 DATA 51,165,24,165,34,105,2,133
1310 DATA 45,165,35,105,0,133,46,76
1320 DATA 37,193,165,43,133,193,165,44
1330 DATA 133,194,160,0,152,24,101,193
1340 DATA 133,193,144,2,230,194,160,0
1350 DATA 177,193,208,13,200,177,193,208
1360 DATA 8,32,51,165,104,104,76,96
1370 DATA 166,32,51,165,169,0,133,251
1380 DATA 160,4,177,193,201,143,208,42
1390 DATA 160,0,177,193,133,172,200,177
1400 DATA 193,133,173,160,0,177,172,133
1410 DATA 174,200,177,172,133,175,160,0
1420 DATA 32,153,193,177,193,197,174,208
1430 DATA 245,200,177,193,197,175,208,238
1440 DATA 240,180,200,177,193,208,3,200
1450 DATA 208,162,201,34,208,6,165,251
1460 DATA 73,255,133,251,166,251,208,234
1470 DATA 201,32,208,6,32,153,193,24
1480 DATA 144,225,201,143,208,220,136,152
1490 DATA 170,177,193,240,7,169,32,145
1500 DATA 193,200,208,245,138,168,208,203
1510 DATA 198,45,165,45,201,255,208,2
1520 DATA 198,46,165,194,133,253,152,170
1530 DATA 24,101,193,133,252,144,2,230
1540 DATA 253,160,1,177,252,136,145,252
1550 DATA 230,252,208,2,230,253,165,252
1560 DATA 197,45,208,237,165,253,197,46
1570 DATA 208,231,138,168,96,32,253,174
1580 DATA 32,107,169,165,20,164,21,133
1590 DATA 251,132,252,32,253,174,32,158
1600 DATA 183,134,253,169,238,141,2,3
1610 DATA 169,193,141,3,3,173,0,2
1620 DATA 240,55,166,251,165,252,134,99
1630 DATA 133,98,162,144,56,32,73,188
1640 DATA 32,223,189,133,20,132,21,160
1650 DATA 0,177,20,240,6,153,119,2
1660 DATA 200,208,246,200,169,32,153,119
1670 DATA 2,132,198,24,165,251,101,253
1680 DATA 133,251,144,2,230,252,76,131
1690 DATA 164,169,131,141,2,3,169,164
1700 DATA 141,3,3,76,131,164

```



Amstrad PCW8256 PROGEDIT

by Alan Dunlop-Walters

The Basic on the PCW8256 allows programs to be saved in ASCII format as well as the more usual tokenised format. ASCII format is, basically, exactly the same as the way in which a listing of a program appears onscreen. This format can be easily modified by other programs. To save a program in ASCII format, append 'A' to the Save command.

PROGEDIT loads the ASCII format of a program into memory and allows it to be modified in the following ways: expanded program listings; string searching; global search and replace; string search with confirmed replace; and REM statement removal.

The expanded program listing lists the program to the printer, with each statement on a multi-statement line

appearing on a separate line. Lines containing REMs are printed bold, italic and 10-pitch, and GOTOS, GOSUBs and RETURNs are flagged B, S or R in the left-hand margin.

The searches and replaces are done as might be expected, with phrases found being highlighted. Sometimes the program seems to produce extra copies of lines after a long phase of

PROGRAM FILE

searching and replacing; these can be cleaned up by saving back the program, and loading it in as a normal program

without PROGEDIT. Basic will then automatically eliminate all occurrences of extra lines. It is sensible to load and

resave all programs after they have been put through PROGEDIT.

```

10 REM Program Editing Utility
20 REM By Alan Dunlop-Walters
30 REM called PROGEDIT.BAS
40 OPTION STOP:REM disable STOP and speed it up
50 DIM as(2000)
60 emc$=CHR$(27):home$=emc$+"H":cls$=emc$+"B"+home$:rev$=emc$+"p":revoff$=emc$+"
q":REM set up cls, etc.
70 PRINT cls$:TAB(30):"PROGEDIT - Program Editing Utility"
80 PRINT:PRINT:PRINT>Note : Program to be edited should previously have been saved
in ASCII format.
90 PRINT:LINE INPUT "ENTER to continue or 'A' to abort ":r$=r$+UPPER$(r$)
100 IF r$="A" THEN OPTION STOP:END:REM Re-enable STOP key
110 PRINT:LINE INPUT "Enter name of file to process. Include extension ":prog$:
PRINT
120 checks=PI$(s$(prog)):IP checks="" THEN PRINT CHR$(7):"No such file (!":GOTO 11
0
130 checks=STRIP$(checks):REM ditch any attribute bits
140 PRINT:PRINT>Loading file"
150 OPEN "I":l$.prog:REM open as plain ordinary SEQ
160 FOR x=l TO 2000
170 LINE INPUT a$,as(x):REM INPUT alone would stop at colon
180 IF ROP(1) THEN 210
190 NEXT x
200 PRINT:PRINT CHR$(7):"Program has too many lines. Aborted.":CLOSE :OPTION ST
OP :END
210 CLOSE l$:let=x:emend=0
220 confirm:0:PRINT:PRINT"S - Search and display G - Global search/replace C
Search and confirm replace":PRINT"R - ReMark remove
X - Expanded listing E - End
230 PRINT:LINE INPUT "Operation ":ops:ops=UPPER$(ops)
240 ON INSTR("SGCERR",ops) GOTO 280,370,460,640,550,720
250 PRINT CHR$(7):GOTO 230
260 PRINT cls$:Search and display facility":PRINT
270 LINE INPUT "Search string ":as$
280 n=0
290 FOR x=l TO let
300 as$=as(x):IP as$="" THEN 350:REM copy lines to as for fiddling with
310 p=INSTR(p$1,as$):IF p=0 THEN 350
320 bs$=LEFT$(as,p-1)+rev$+MID$(as,p,LEN(as))-revoff$+MID$(as,p,LEN(as)):PRINT
bs$:PRINT:n=n+1
330 IF n=10 THEN PRINT:LINE INPUT "ENTER to continue":etc$:PRINT cls$:.....cont
inued.":PRINT:n=0
340 GOTO 310:REM recycle this 'line
350 NEXT x
360 GOTO 210:REM take next line
370 PRINT cls$:Global search and replace facility":PRINT
380 LINE INPUT "Search string ":as$
390 LINE INPUT "Replace by ":rs$
400 FOR x=l TO let
410 as$=as(x):IF as$="" THEN 470
420 p=INSTR(p$1,as$):as$="" IF p=0 THEN 470
430 bs$=LEFT$(as,p-1)+rev$+MID$(as,p,LEN(as))-revoff$+MID$(as,p,LEN(as)):PRINT
bs$:n=n+1
440 as$=LEFT$(as,p-1)+rs$+MID$(as,p,LEN(as))
450 IF confirm THEN 510
460 as(x)=as$:PRINT as$:PRINT:emend=1:GOTO 420
470 NEXT x:GOTO 220
480 confirm:1:REM enables us to utilize same code as global repince

```

```

900 PRINT cls:"Global search and confirmed replace facility":PRINT
500 GOTO 380
510 PRINT as:LINE INPUT "R to replace as shown / I to ignore":wells
520 wells=UPPER$(wells) IF wells="" THEN as=a$(x):GOTO 420
530 IF wells="R" THEN 460
540 PRINT CHR$(7):GOTO 510
550 PRINT cls:"REM removal."
560 FOR x=1 TO last
570 as=a$(x) IF INSTR(as,"REM ") THEN amend=1:GOSUB 590
580 NEXT x:PRINT:PRINT"Finished":GOTO 220
590 p=INSTR(as,"REM ")
600 as=LEFT$(as,p-2)+VAL$(as)
610 IF LEN(as)<6 THEN as(x)="X" ELSE as(x)=as:REM distinguished between all rem or
embedded
620 IF as(x)<"X" THEN PRINT"Line",e,"deleted":REM all rem lines become X and ar
e then ignored in other logic
630 RETURN
640 PRINT cls:"End."
650 IF amend THEN 660 ELSE PRINT"No amendments so no reave.":OPTION STOP:END
660 PRINT"Reaving program"
670 OPEN "Q",p:prg=REM just plain SEQ type
680 FOR x=1 TO last
690 IF as(x)="X" THEN 710
700 PRINT xl,as(x)
710 NEXT:CLOSE:OPTION STOP:END
720 PRINT cls:"Expanded Listing."
730 LINE INPUT "Load printer, set quality and PO defeat, then press ENTER ":pap
er3
740 PRINT:PRINT"Running"
750 PRINT CHR$(27);CHR$(27);"VI":check=REM 10-pitch and enlarged programe
760 PRINT CHR$(27);"VO":CHR$(27);"M":LPRINT:REM un-enlarge and 12-pitch
770 FOR x=1 TO last:IF as(x)="X" THEN 860
780 as=a$(x):q=0:GOSUB 910:LPRINT as;" "
790 IF INSTR(as,"RE") THEN CHR$(27);"4":CHR$(27);"G":CHR$(27);"P":REM rem-line so it's
1lc, double strike and 10-pitch
800 IF y=1 TO LEN(as):bs=MID$(as,x),1
810 FOR bs=CHR$(34) THEN GOSUB 900:REM these lines enaes quotes and set q to defe
at line feed
820 IF bs=" " AND q=1 THEN ESO
840 IF bs="." AND q=1 THEN LPRINT:LPRINT TAB(10);"."":GOTO 860
860 LPRINT bs;
880 NEXT:LPRINT:LPRINT
890 IF r THEN LPRINT CHR$(27);CHR$(27);"M":CHR$(27);"M":r=0:REM after a rem
line reset to non-italic, non-double-strike and 12-
pitch
900 NEXT x:GOTO 220
910 IF q THEN q=0:RETURN
920 q=1:RETURN
930 ns="" "IF INSTR(as,"REM ") THEN r=1 ELSE r=0:REM this sub finds rema, goto
a stc
940 IF INSTR(as,"GOTO") THEN MID$(ns,1,1)="G"
950 IF INSTR(as,"GOSUB") THEN MID$(ns,2,1)="S"
960 IF INSTR(as,"RETURN") THEN MID$(ns,3,1)="R"
970 IF INSTR(as,"THEN") THEN 970
980 RETURN:REM take back ns with a possible "BSR"
990 p=INSTR(as,"THEN"):j3=MID$(as,p8) IF VAL$(j3) THEN MID$(ns,1,1)="E":REM sene
a difference between "THEN 500" and "THEN=59"
990 RETURN

```



80 columns

by Kevin Riordan



Still keying in programs? Forget it!
This program is available for
teletext downloading on
Microtex 666 (page *6663#.)

Full instructions are included in the listing for this 80-column card simulation. It

features the preservation of the integrity of all zero page pointers making it com-

pletely safe for use by both Basic and machine code programmers.

```

1800 REM *****
1801 REM **                                BRCOL.GEN                                **
1802 REM **                                **                                **
1803 REM **                                **                                **
1804 REM **                                A SOFTWARE SOLUTION TO THE COMMODORE 64                                **
1805 REM **                                **                                **
1806 REM **                                1800-CHARACTER SCREEN LIMIT                                **
1807 REM **                                **                                **
1808 REM **                                (KEVIN RIDDAN 1985)                                **
1809 REM **                                **                                **
1810 REM *****
1811 |
1812 |
1813 REM
1814 REM
1815 REM
1816 REM
1817 REM
1818 |
1819 REM THE PROGRAM HIDES ITSELF UNDER BASIC ROM AND PLACES ITS SWITCHING
1820 REM CODE IN THE AREA $02A7-$02E9. THE LATTER MAY GET IN THE WAY OF
1821 REM SOME AUTORUN APPLICATIONS WHICH LOAD TO $02A7, IN WHICH CASE
1822 REM THE SWITCHING CODE MAY QUITE EASILY BE RELOCATED IN THE TAPE
1823 REM BUFFER OR UP IN HIGH MEMORY AT $0B80 OR ABOVE.
1824 |
1825 REM IN THE DATA LINES BELOW, PROGRAM INITIALISATION RUNS FROM LINE
1826 REM 2000 (ITEM 1) TO LINE 2008 (ITEM 9): THE SWITCHING CODE RUNS
1827 REM FROM LINE 2008 (ITEM 10) TO LINE 2012 (ITEM 13); AND THE REST
1828 REM IS COPIED INTO RAM FROM $0B80 UPWARDS. THE FIRST TWO SECTIONS
1829 REM CAN BE DISASSEMBLED BY HAND AND REWRITTEN IF RELOCATION OF THE
1830 REM SWITCHING CODE IS REQUIRED FOR SOME PARTICULAR PURPOSE.
1831 |
1832 REM THE PROGRAM SUPPORTS BOTH UPPER AND LOWER CASE, A 'PRINT CHR$(14)'
1833 REM STATEMENT ENRAGES LOWER CASE, WHILE UPPER CASE IS ENGAGED BY
1834 REM 'PRINT CHR$(142)'. NOTE THAT THE USUAL 'SHIFT C' METHOD OF
1835 REM SWITCHING CASES IS NOT AVAILABLE. HOWEVER, TO OFFSET THIS
1836 REM MINOR DISADVANTAGE, IT IS POSSIBLE, SINCE THE PROGRAM USES A
1837 REM BITMAP SCREEN, TO SHOW BOTH UPPER AND LOWER CASE AND GRAPHICS
1838 REM CHARACTERS ON THE SCREEN AT THE SAME TIME. THESE FACILITIES
1839 REM LEND THEMSELVES IDEALLY TO THE PREPARATION OF FORMATTED
1840 REM SCREENS FOR SPECIALISED APPLICATIONS AND - ONE I MENTION 'EM?
1841 REM ADVENTURE GAMES...
1842 |
1843 REM SO COME ON, ALL YOU C64 GAMERS! HOW ABOUT SOME CONTRIBUTIONS
1844 REM WITH LOTS OF EDUCATIVE LOCATION DESCRIPTIONS? LET YOUR
1845 REM IMAGINATIONS RUN RIOT - YOU CAN'T ANY LONGER PLEAD LACK OF
1846 REM SCREEN SPACE!!
1847 |

```

```

1049 REM ENTER LINES 1500- 80LOW EXACTLY AS SHOWN, TAKING SPECIAL CARE TO
1050 INCLUDE LEADING ZEROS IN DATA ITEMS WHERE THEY OCCUR, AND THEN
1051 RUN THE PROGRAM. SINCE THE DATA IS ENCODED IN HEXADECIMAL, THE
1052 PROGRAM TAKES SEVERAL MINUTES TO CHECK YOUR DATA ENTRIES AND
1053 THEN TO CREATE THE MACHINE CODE FILE '80CDL' ON YOUR DISK.
1054
1055 REM DON'T WORRY IF YOUR DRIVE APPEARS TO HANG DURING THE FILE-CREATION
1056 PHASE. THE PROGRAM IS STILL WORKING AND YOUR RED LIGHT WILL
1057 EVENTUALLY SWITCH OFF. YOU CAN THEN TYPE 'LOAD '80CDL',@,1' AND
1058 'SYS 49152' TO ENTER 80-COLUMN MODE. IF, LIKE ME, YOU USE A
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PROGRAM FILE

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2016 DATA0,40,A9,01,80,5F,AC,60,20,32,A1,A9,00,80,5F,AC,60,00
2017 DATA5,C6,F0,FC,70,20,84,E5,C3,63,00,10,A0,00,80,5F,AC,60,00
2018 DATA6,80,E6,EC,80,75,02,CA,00,77,F9,EA,C3,00,00,01,46,00
2019 DATA0,07,28,A7,A7,01,FB,40,40,AC,B1,FB,20,07,A7,A0,01,00
2020 DATA4F,04,00,20,A7,01,FB,40,40,AC,B1,FB,20,07,A7,A0,01,00
2021 DATA04,C8,A0,00,04,03,04,04,A5,CA,30,3A,05,03,C5,C8,50,00
2022 DATA08,34,00,5E,A5,00,00,05,A5,00,00,05,CA,AD,4C,AC,05,15,00
2023 DATA03,05,06,AC,CB,A0,20,07,A7,4C,00,01,A0,07,20,A7,65,00
2024 DATA07,01,FE,40,40,AC,B1,FB,20,07,A7,A0,01,00,00,00,00
2025 DATA0A,40,A5,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2026 DATA07,A7,29,3F,00,07,24,07,10,02,00,00,00,00,04,AD,47,00
2027 DATA08,04,70,02,00,00,00,00,00,00,00,00,00,00,00,00,00
2028 DATA00,1A,A9,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2029 DATA00,03,F0,03,20,32,A1,A9,00,20,07,A7,05,07,60,AA,60,07
2030 DATA00,A9,AC,07,C0,DE,00,02,00,FF,10,00,48,A5,0A,C9,75,00
2031 DATA03,00,04,60,00,32,A1,4C,05,01,40,00,01,AC,00,48,22,07
2032 DATA0A,40,A9,00,00,57,AC,20,4E,A1,20,C0,A0,20,05,A7,70,00
2033 DATA08,AA,60,AA,60,00,51,AC,20,04,EE,AD,51,AC,C9,91,00
2034 DATA20,00,50,C9,60,00,13,C9,40,00,3C,C3,00,00,00,00,00,00
2035 DATA0A,51,AC,00,40,00,00,00,00,00,00,00,00,00,00,00,00
2036 DATA0A,00,00,37,00,00,30,AD,51,AC,00,20,00,00,51,AC,00,10,00
2037 DATA10,C9,C0,00,00,30,AD,51,AC,00,40,00,51,AC,00,00,AA,07
2038 DATA10,01,AC,00,00,00,51,AC,00,5E,AC,00,00,00,00,00,00,00
2039 DATA0C,60,AD,5C,AD,00,00,00,00,00,00,00,00,00,00,00,00
2040 DATA00,1F,AD,51,AC,C9,20,00,00,00,00,00,00,00,00,00,00
2041 DATA04,A5,AD,00,35,AD,5E,AC,00,30,00,00,00,00,00,00,00
2042 DATA52,AD,5C,AD,00,41,80,5D,AC,00,3C,AD,51,AC,C9,00,DA,00
2043 DATA00,35,C9,94,00,00,00,00,00,00,00,00,00,00,00,00,00
2044 DATA20,30,AD,51,AC,00,40,00,51,AC,AD,5E,AC,00,00,A5,07,07
2045 DATA04,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2046 DATA09,00,00,57,AC,00,70,AA,01,00,57,AC,00,00,50,5C,07
2047 DATA0C,05,DA,AD,51,AC,C9,20,00,00,00,00,00,00,00,00,00
2048 DATA0C,91,02,C9,03,00,00,00,00,00,00,00,00,00,00,00,00
2049 DATA40,20,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2050 DATA00,00,EE,4C,AD,40,20,00,00,00,00,00,00,00,00,00,00
2051 DATA0C,5C,AD,00,00,00,00,13,00,11,00,00,00,00,00,00,00
2052 DATA0C,40,20,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2053 DATA09,40,20,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2054 DATA0C,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2055 DATA08,AC,C9,91,00,00,00,00,00,00,00,00,00,00,00,00,00
2056 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2057 DATA0B,A2,00,C9,94,00,00,00,00,00,00,00,00,00,00,00,00
2058 DATA0C,00,40,20,00,00,00,00,00,00,00,00,00,00,00,00,00
2059 DATA0F,AC,00,00,AC,00,00,00,00,00,00,00,00,00,00,00,00
2060 DATA0B,00,FA,EE,07,AC,AD,07,AC,00,00,00,00,00,00,00,00
2061 DATA09,00,FF,00,1E,FA,05,00,00,00,00,00,00,00,00,00,00
2062 DATA0A,5F,AC,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2063 DATA00,37,FA,CA,10,00,00,00,00,00,00,00,00,00,00,00,00
2064 DATA00,10,FA,CA,10,00,00,00,00,00,00,00,00,00,00,00,00
2065 DATA0C,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2066 DATA00,4F,AC,AC,AC,00,00,00,00,00,00,00,00,00,00,00,00
2067 DATA00,00,FA,EE,07,AC,AD,07,AC,00,00,00,00,00,00,00,00
2068 DATA05,FC,AA,00,29,01,FB,00,00,00,00,00,00,00,00,00,00
2069 DATA00,00,FF,00,1E,FA,05,00,00,00,00,00,00,00,00,00,00
2070 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2071 DATA0F,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2072 DATA0C,20,25,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2073 DATA0F,AC,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2074 DATA00,07,07,AE,4C,AC,00,17,00,00,01,00,31,AE,05,02,00,00

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2076 DATA00,5C,AC,20,00,00,00,00,00,00,00,00,00,00,00,00,00
2077 DATA00,00,00,AD,01,00,00,00,00,00,00,00,00,00,00,00,00
2078 DATA0F,AC,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2079 DATA01,FB,30,A5,FB,00,00,00,00,00,00,00,00,00,00,00,00
2080 DATA00,20,01,00,17,01,FB,20,00,00,00,00,00,00,00,00,00,00
2081 DATA01,FB,20,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2082 DATA10,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2083 DATA04,AC,AD,5A,AC,00,00,00,00,00,00,00,00,00,00,00,00
2084 DATA00,AD,54,AC,00,00,00,00,00,00,00,00,00,00,00,00,00
2085 DATA00,4A,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2086 DATA04,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2087 DATA07,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2088 DATA0C,CE,53,AC,00,00,00,00,00,00,00,00,00,00,00,00,00
2089 DATA0C,AC,00,17,00,00,00,00,00,00,00,00,00,00,00,00,00
2090 DATA00,AA,AA,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2091 DATA00,4F,01,FB,00,00,00,00,00,00,00,00,00,00,00,00,00
2092 DATA07,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2093 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2094 DATA07,01,FB,20,00,00,00,00,00,00,00,00,00,00,00,00,00
2095 DATA00,40,40,AC,00,00,00,00,00,00,00,00,00,00,00,00,00
2096 DATA00,AA,AA,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2097 DATA0C,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2098 DATA00,AC,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2099 DATA00,AC,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2100 DATA00,FF,00,1E,FA,05,00,00,00,00,00,00,00,00,00,00,00
2101 DATA00,CA,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2102 DATA00,EE,55,AC,CE,53,AC,00,00,00,00,00,00,00,00,00,00
2103 DATA00,FC,60,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2104 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2105 DATA01,FB,20,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2106 DATA00,AC,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2107 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2108 DATA00,FE,30,AA,00,00,00,00,00,00,00,00,00,00,00,00,00
2109 DATA00,CA,10,FE,00,00,00,00,00,00,00,00,00,00,00,00,00
2110 DATA07,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2111 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
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2113 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2114 DATA00,FB,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2115 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
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2118 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2119 DATA00,FF,00,1E,FA,05,00,00,00,00,00,00,00,00,00,00,00
2120 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2121 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
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2128 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2129 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2130 DATA00,FF,00,1E,FA,05,00,00,00,00,00,00,00,00,00,00,00
2131 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2132 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00
2133 DATA00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00,00

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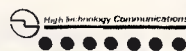
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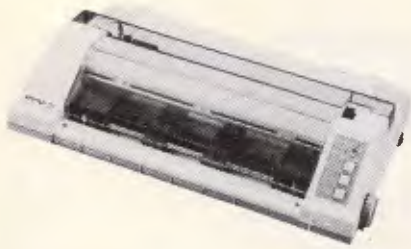


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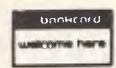
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