Australian Personal Computer

APC has a chat with HAL

ISSN 0725—4115 NZ $5.15 INCL. GST
REGISTERED BY AUSTRALIA POST PUBLICATIONS VBP 3691

FEBRUARY 1987 $3.50

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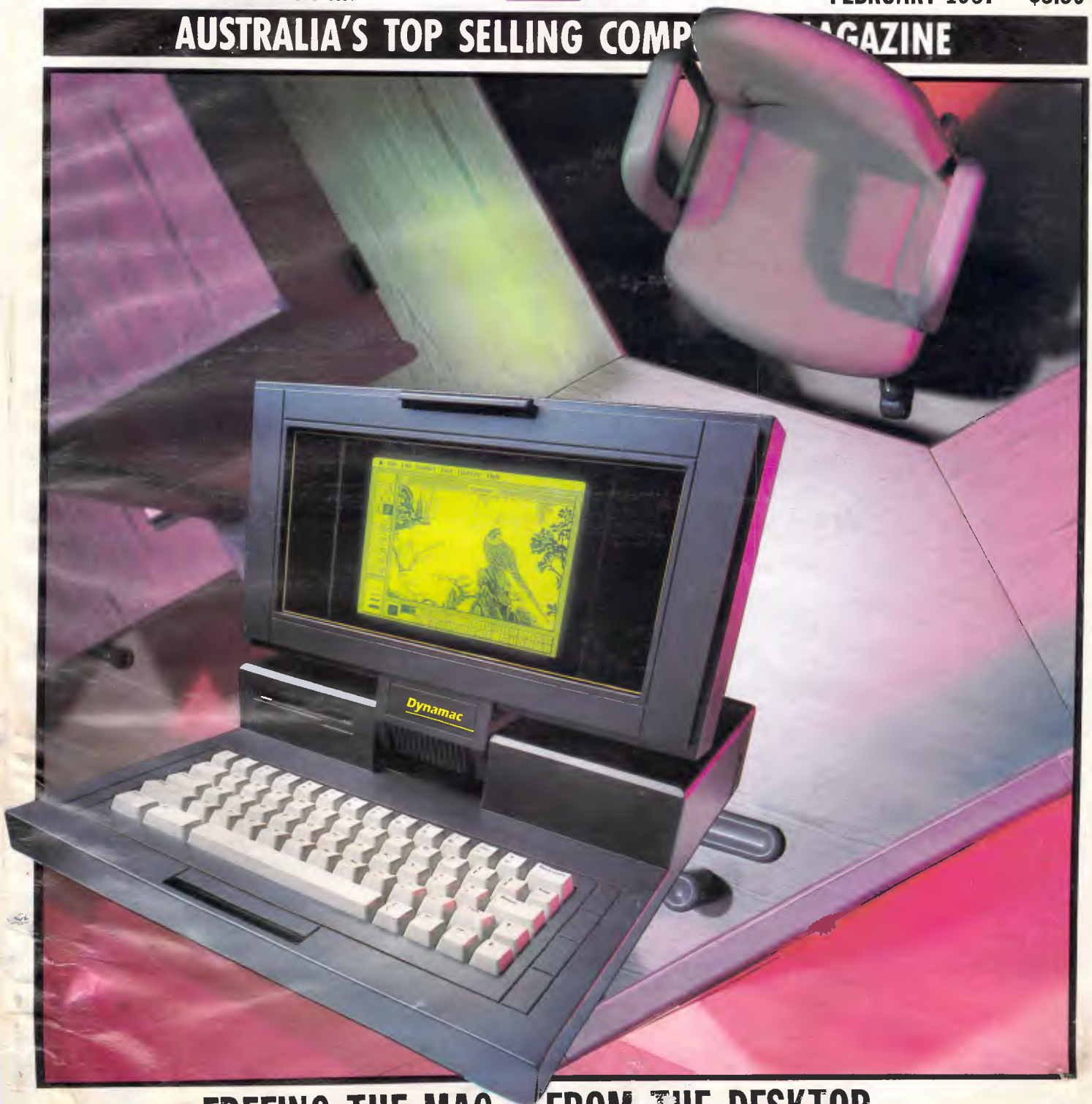

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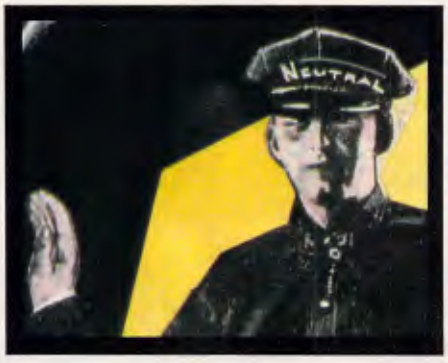

Editorial *Managing Editor Sean Howard:* **Assistant Editor** Maria Bokic; *Consultant Editors* Steve Withers, Ian Davies. **Advertising** *Advertising Manager* Mark Reiss; *NSW and Qld Sales Manager* Michael Komoroski. *NSW and Qld Sales Executive* John Nuutinen (02) 264 1266; *Vic, SA, WA and Tas Sales Manager* Gerard Kohne (03) 531 8411. **Production** Graphic Heart Pty Ltd. **Distribution** *Subcription Manager* Judy Welsh (02) 264 1266; *Subscription rates Australia* $42 per annum, overseas A$70 (surface) A$160 (airmail); *Newstand sales:* Network Distribution Co. 54 Park Street, Sydney 2000.

Publishers Computer Publications Pty Ltd (a subsidiary of Consolidated Press (Holdings) Ltd).

Sydney Office: 215 Clarence Street, Sydney 2000; telephone (02) 264 1266; telex AA 20514 CONPRES. **Melbourne Office:** 77 Glenhuntly Road, Elwood 3184; telephone (03) 531 8411; telex AA 30333 'AMJ'.
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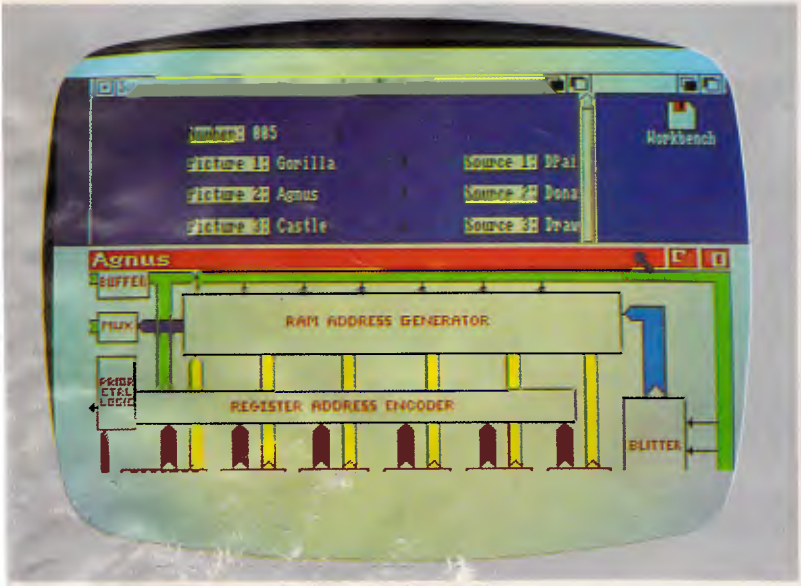

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APC price rise, damage minimal.

Now listen here you lot. We're not going to beat about the bush. The cover price of *APC* is going up to $3.95 from the April issue. (The price is actually going to $5.95 for the March issue, but that's another story — it'll be a bumper edition of *APC* with more than a few surprises. Don't miss it). We all know that inflation continues to drive up the price of all the essentials in life, like beer, Isaac Asimov reprints and *APC*. Last year we put the price up 55¢, so count yourself lucky we've been able to show some restraint this year.

To show we're not all made of silicon here in the *APC* mausoleum, we're delaying putting up the subscription price for a further month. So if you're quick you can get twelve issues of *APC*, which would normally cost you $47.40, for a mere $42. Cripes — you don't need to be a Cobol programmer to realise what good value that is. So get your pencil out of your ear and fill in the subs card now. You know it makes sense!

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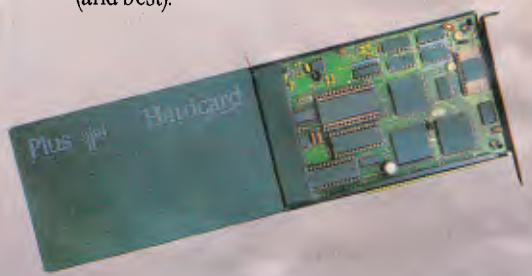

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Interface/TP0073

It looks as if the Eighth Australian Personal Computer Show is to be the venue for major product launches from Apple, Commodore and Atari. Details in this month's news column . . .

Lace in excellent condition

Apricot has succumbed to pressure and produced an IBM PC/AT-compatible conversion unit for its Apricot PC and Xi micros.

The cost is virtually that of an AT without disks, which is right and proper — because that is what you are buying.

For $2500 odd, you get a new motherboard. It has a new processor chip, and new memory chips. That's what we, in the trade, call a computer. You get a changed keyboard, and a changed monitor. You keep the disks.

Your new machine will not run Apricot software any more, but it will use Apricot disks.

I'm irresistibly reminded of the legendary small-ad in a shop window: 'For Sale: one second-hand football. Outer, leather casing needs replacing. Bladder missing. Lace in excellent condition'.

Guy Kewney

Too hard to please

(As an introduction to this item, readers should be aware that Guy Kewney has received considerable ribbing over a piece he wrote in another publication — prior to the Amstrad PCs release — describing just how Amstrad should configure its micros — Ed).

The fuss over the specification of the Amstrad PC has come home to roost. Alan Sugar has said if people think his PCs overheat, then he'll fit fans. If they think the machines will work better with pink spots, he'll supply those, too. His advice to people who have fans fitted is: disconnect them. They use power, putting an extra strain on the power supply, and adding to the heat . . .

Judging from comment in other magazines, the office Amstrad (complete with pink spots, having been upgraded by myself) is the only one in the world which isn't imitating Three Mile Island.

I gather this is the machine showing its gratitude to me, personally. I rang an ex-colleague, the other day, to try and find out where she got a report on Amstrad PC failures. It was she who gave me the clue: 'You aren't writing stories on the Amstrad, are you?'

Yes, I said, I am.

'But you designed it, and you get a royalty on the sales. Don't you think that is unethical?'

I don't really know what to think about this. On the one hand, flattered. Surely people don't really think a journalist could design a computer! On the other hand, annoyed: would I design a computer that wouldn't work in high resolution graphics? But then again, flattered that a mere purveyor of gossip should become the subject of gossip. And again, annoyed that an old friend should believe this sort of thing.

But why shouldn't she? I believe this sort of thing myself.

At last year's Comdex (see the report in the January issue) I was told (by a colleague) that a certain opinionated pundit, writing for a very popular US computer magazine, was a contract retainer to PCs Limited, the *uppest and comingest* American clone maker.

I believed it.

I didn't ring him up and ask, because I had no information beyond my colleague's gossip to check out. But then, neither did my colleague — he said he'd been told that he would be shown cancelled cheques, but he hadn't actually seen them.

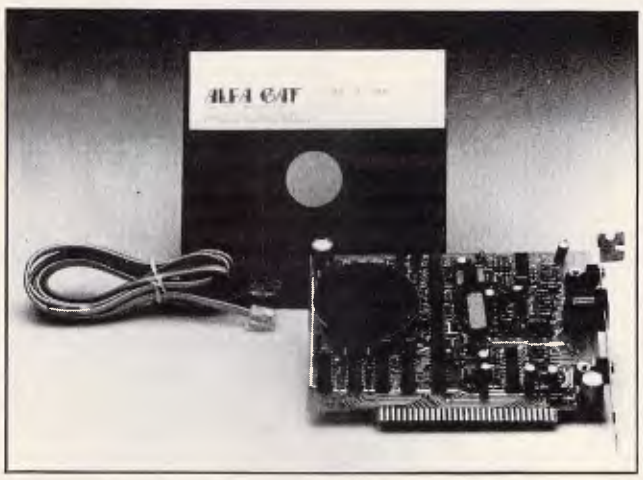
Nonetheless, I believed it.

Grounds for believing it are, almost exclusively, that this pundit has mentioned the company, PCs Limited, enthusiastically in his column.

But his opinion, to be frank are rather less enthusiastic than my own. I think the company has done amazing things, and deserves to be mentioned more often.

Even so, I was indignant, and when I bumped into him at a party, I snubbed him.

Enough philosophy and head-shaking over the irrationality of humankind, already. To the point, to the point: did I design the Amstrad? Do I get a royalty?



This little card does all the phone-managing you might want, according to its suppliers, Alfa Gat, in Tel-Aviv.

Samples weren't available at press time, but for $US350, you get a PC-compatible card which can wait until a line is free, then dial a complex sequence of numbers (coping with PABX problems if necessary) and open up a little window on your screen when the number is about to ring, adding a little note saying who it is, and any other important details you may have noted about them (account number, for example, or first name). It's called Mul-T-Dial, and I have no information about approvals for use in Australia, but if you want to call Israel, the number is given as 03-284743, 284084, and Oded Gottfried is the contact.

No. Had I designed the Amstrad PC, I would now be able to retire and write my novel. And the Amstrad PC would be different. It would have had:

- an intelligent keyboard which you could carry around like a lapheld computer;
- a single expansion slot, not three; or maybe a plug for the bus, with the option of attaching an expansion box;
- a standard IBM keyboard that fitted into its socket;
- a built-in modem and bundled foolproof comms software for the modem;
- a printer, for one model; and
- EGA and even PGA colour cards.

As a result, the machine would have cost twice as much, been launched six months late (at least) and nobody would have even looked at it.

And the editor would have fired me.

Guy Kewney

Tutorial time

There is obviously a need for something to take the pain out of learning to use a micro. MS-DOS, even with Gem or Windows, is not the answer. And with low-cost, PC compatibles taking hold, there are many micro users around, making it theoretically possible to sell to a mass consumer market.

The problem facing the industry, however, is a subtle one: it is the difference between 'training' and 'salesmanship'.

Take for example an excellent program called Javelin, launched last year at over $1100. Hardly anybody bought it.

The reason was hard to explain, but simple to grasp. Javelin turned out to be 'just what I wanted' for many people, but only after a couple of hours' tutorial to explain what it actually did. (No, I am not going to explain what it does, here.)

The authors couldn't follow their preferred route of putting up the price. 'If we'd put it put to $3000, then people would have been prepared to spend time selling it to prospective customers', they said. 'But you can't ask $3000 for something that used to cost $1100, not even if the people who have bought it say it would be worth twice that'.

So it sells, in America, for $100, at which price people don't mind buying it in the vague hope it may be sort of useful. Then they tell their friends, and so on, and it is now selling, people say, very well thank you.

Once they have bought the software, some of the users will spend $3000 of their company's money on a training course to learn how to use it. But that's a special, unique program. No-one in their right mind would consider spending even half that amount for a training course on (say) First Choice, when the program costs $250, and the computer to run it under $1500.

Computer-based tutorials are attractive, because they can follow you — theoretically, at least. PC Tutorial from Cedarhurst Computing, for example, is memory-resident. You can jump into it while running things like WordStar and dBase, and back out. You get 20 diskettes, and it starts you off from scratch. It costs $120.

More to the point, there is some chance of seeing this sold in shops. The shopkeeper makes a profit selling it, instead of wasting time and keeping other customers waiting while trying to explain something face to face. And in all probability, the shopkeepers will be trying to explain something they probably don't understand all that well themselves.

I haven't seen PC Tutorial, yet, but unless it is very different from anything else I have seen I remain sceptical about how many people will actually have the patience to use it to learn what they are about.

Guy Kewney

Ignorance is not bliss

Would any other industry put up with the level of ignorance the micro business accepts in its sales staff and managers?

I rang the managing director of a company which had launched an 80386-based supermicro. 'Who should I talk to', I asked, 'for technical questions?'

He responded: 'I'm your man'.

'Good', I said, 'what I want to know is — since there is no purpose-written operating system for desktop use of that chip — will you be buying a networking operating system?

'Ah, now you've got me', he said. 'You'll have to ask one of my techies'.

If one were announcing the awards 'for Manager of the Year in Micros', this chap would be second on the list — announcing the recipients in traditional 'Miss World' reverse order. He's dim.

On the other hand, the managing director of one of the country's largest hardware distributors is not dim at all. He's brilliant. But he is also a man who honestly believes that it is impossible to get data on his firm's central computer onto his desktop PC, which is functioning as a dumb terminal. The data is on his screen as we speak, but he is convinced that he can't 'download' it. Yes, he is using Sidekick — why do I ask?

He isn't unfit for his job, just untrained. The requirements for his job are not technical wizardry, but honesty, and understanding of the financial pressures on an international corporation, and an ability to select and motivate his fellow directors.

But having got the job, in any other business, he would be fed into a period of three to six months of intensive training.

In a baking group, he'd be sent round all the sites, sent on seminars by baking equipment manufacturers, be expected to roll his sleeves up and get flour under his nails.

In the airline business, he'd have to visit several agencies with the sales staff, noting how tickets are made out and learning the major routes covered by his carrier. Perhaps he wouldn't be able to hear a flight number, and immediately tell you what time it left which airport —

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We're having a party! It's a going away party. And, it's for IBM. But, shhhhh! Don't tell them. We want it to be a surprise!

Why a party? Well, it's because we've been told that more than a few of IBM's customers have been "going away" ever since we introduced our A★Star™ PC/AT compatible microcomputer. Now that we've announced our new A★Star II, we figure a lot *more* of their customers will be going away. That's because the A★Star II is the *only* "network ready" PC/AT compatible that can operate at 6, 8, 10 *and* 12 MHz. And because it's now available locally in a super selection of low cost models.

The A★Star II is not just another clone, it's better...*much* better! Not only is it faster and more powerful than IBM's model, it's also incredibly less expensive. Better yet, the A★Star II is built and backed by Wells American - a company that's been making microcomputers *longer* than IBM. (We bet that surprises even you!) But more than just an AT compatible, the A★Star II is both a single *and* a multi-user system. Each unit is factory equipped for network operation with up to 254 other A★Star, IBM or compatible computers!

If you'd like to be a part of our IBM going away party, clip and return the coupon or call us at one of the numbers below. But don't tell IBM! If they find out how many of their customers are going away, they might just go away themselves! Of course, that would be okay with us. We never *really* invited them anyway!

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but he'd know which book to pick up and find out.

But computing, it seems, is 'too hard' to be learned like this.

Well, what nonsense! No-one is so stupid that they couldn't go on a one-week assembly language course and come away with a detailed, if not skilled, grasp of how a particular chip works, with its support circuits. And a manager who spent an afternoon being trained in the theory and rudiments of disk formatting, and didn't come away with a clear understanding, would be incapable of buying a bus ticket.

Passing over the fact that I do know a couple of senior managers whom I would never trust to buy a bus ticket, I have to ask: why?

Snobbery is part of it. The aforementioned MD illustrated this, perhaps unwittingly, perhaps not, when he advanced the 'you'll have to ask one of my techies' as an excuse for not understanding a problem I was having with a piece of hardware.

As boss of the outfit, he has to be tactful about what he says in print. Quoted as saying: *'The buffering on the card is not up to the standard of other boards we make, but we can get away with it most of the time, and it is a cheap card, what do you expect?'* he could anticipate losing that particular franchise before he'd collected his royalties.

When he says you have to ask one of his techies, he is just making an acceptable excuse. In fact, it holds no water for those who know him: he has an Honours degree in electronic engineering, and vast experience of the micro business, both hardware and software.

What I find unacceptable, is the fact that this *is* regarded as an OK excuse.

It isn't. For a senior manager to be unskilled at the more esoteric arts of his business is forgiveable, but to be ignorant of essentials is an error which should be remedied. For managers to actually boast of ignorance of the simple nuts and bolts of his trade is pathetic.

It is a habit of our business, a custom which has become established through cowardice and laziness It should be ended.

Guy Kewney

Over-ambitious project

It is two years (or so) since IBM frightened the knickers off the software business by launching a whole range of own-label applications packages. It was going (said observers at the time) to literally take over the whole retail software business. No-one could compete. Even Lotus would go out of business.

Olivetti now says it is going to dominate the software business, with the Olisoft label.

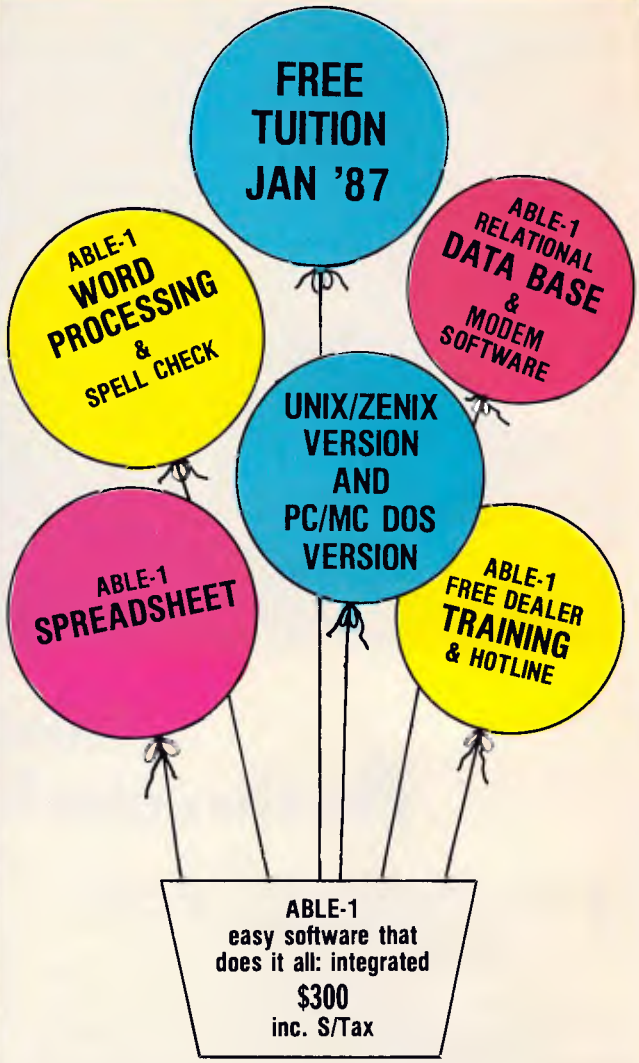
Don't waste time laughing. What Olivetti actually means is something less ludicrous. It means it is going to actively promote Unix-compatible DOS software.

Software which runs under PC-DOS and MS-DOS is only theoretically capable of running in a 'DOS partition' of Xenix. You tell Xenix that part of the time it has to obey DOS commands, and load your DOS programs into that part of the computer.

Olivetti, 25 per cent owned by America's AT&T, which has a close, not to say family relationship with Unix-owning Bell Labs in its turn, has been deeply committed to making Unix a popular operating system.

The idea, put forward when the company announced the 3B2 minicomputer, was that you could connect your micros to the 3B2, and it would work both as network and as a multi-user Unix system.

If it were a network, the 3B2 would be a fast file



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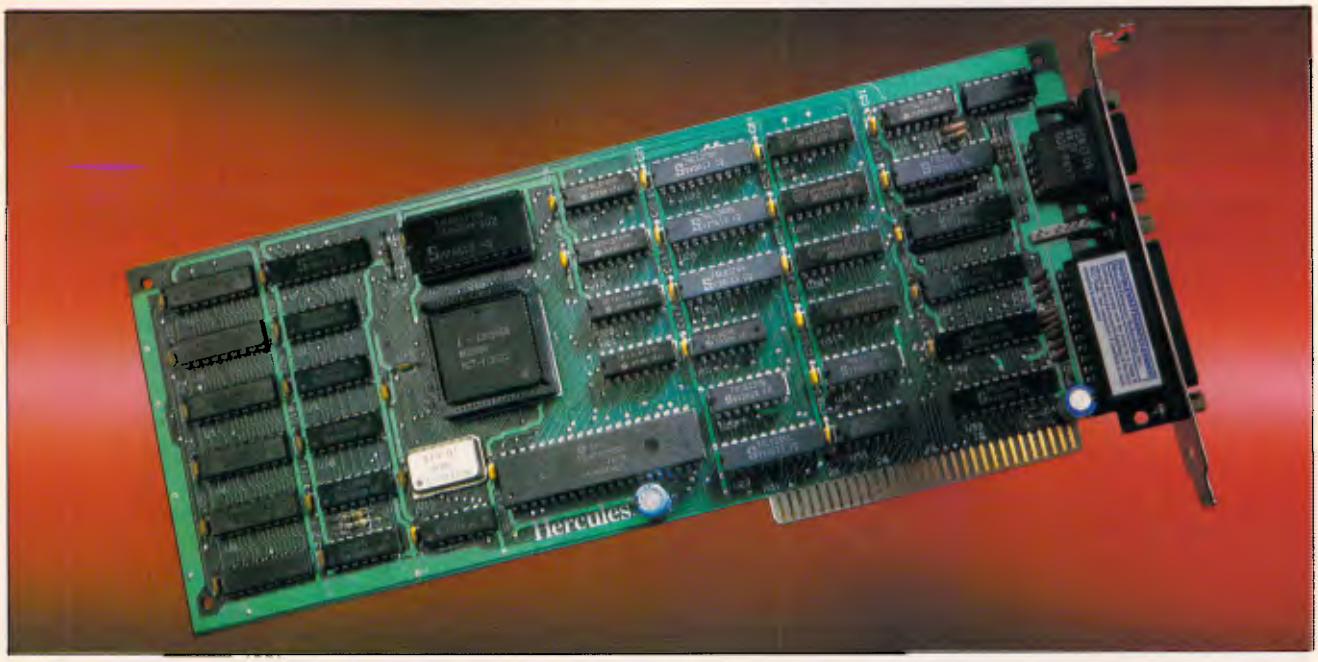


Introducing The Hercules Graphics Card Plus

It's 100% compatible with our original card and costs 40% less. And that's not even the reason to buy one.

The reason is RamFont, an entirely new mode of operation that is unique to the Graphics Card Plus.

The idea for RamFont first occurred to Hercules co-founder and chief engineer Van Suwannukul, two years ago.

At the time he was working with Microsoft engineers on their new word processor, later known as Microsoft Word.

Microsoft's engineers knew that soon there would be very high resolution laser printers offering multiple typefaces.

VAN SUWANUKUL AND KEVIN JENKINS, CO-FOUNDERS HERCULES

They reasoned that if you could print italics and boldface, you should be able to see italics and boldface on the display.

Unfortunately, the Microsoft engineers were ahead of their time.

It was not possible, with the graphics cards that existed at the time, to get both the flexibility to display multiple typefaces, and the speed that is essential to a word processor.

Van knew that to solve Microsoft's problem, new hardware would be needed.

So he invented RamFont.

Word 3 – Three times faster.

Two years later, the Hercules Graphics Card Plus was ready.

What Van had developed was RamFont, an new mode that could store, and then display at lightning speed, 3072 programmable characters.

By this time, Microsoft's engineers had used every trick in the book to speed up Word, and succeeded in making Word 3 considerably faster than earlier versions.

However, for many users it still wasn't fast enough.

So you can imagine how delighted Microsoft's engineers were when they saw Word 3 running over three times faster on the Hercules Graphics Card Plus.

At last their word processor could really process.

1-2-3 Release 2 fulfills its promise

At Hercules, we knew that this was just the tip of the iceberg. RamFont was a revolution waiting to happen.

The more we used it, the more possibilities opened up.

Take 1-2-3 Release 2 for example.

Release 2 has an optional character set that nearly doubles the size of the viewable spreadsheet.

It's a great idea... until you try scrolling up and down or right and left. It takes forever.

As RamFont has the ability to display characters ranging in size from 8 by 4 to 9 by 16, it was easy to adapt Release 2's smaller characters.

The result is that now you can scroll a far larger spreadsheet as fast as version 1A could scroll a smaller one.

Then another idea occurred to us.

If RamFont could be programmed to display characters, why couldn't it be programmed to display graphics?

LOTUS 1-2-3 RELEASE 2

Well, it turned out it could.

So we did a bit more work and now you can draw 1-2-3 graphs in a window on top of your spreadsheet, and view your data in the background.

(Or, you can still view a graph on a full screen if you prefer.)

We liked what RamFont did for Word and 1-2-3 so much we did the same thing for Symphony and Framework.

Can a graphics card be a work of art?

Van will tell you that the Hercules Graphics Card Plus is the best monochrome graphics card he's ever designed.

Which is significant because 1) Van is not given to exaggeration, and 2) his three previous designs have met with a certain degree of success.

What makes the Graphics Card Plus so good is a chip Van designed called the V112.

The V112 does three things.

First, it runs every single one of the thousands of programs written for the IBM Monochrome Display/Printer Adapter.

Second, it runs every single program written for the famous Hercules 720 × 348 graphics standard.

And third, it makes RamFont possible.

Survival of the fittest

Actually, chips like the V112 do something else. They make our products even more reliable.

One chip manufacturer was astonished when we told him that we test 100% of the nodes on a chip. He said 93% was common.

By testing each chip individually to such high specifications, we are able to weed out weak V112s before they go to assembly.

V112

Then we subject the survivors to more testing at temperatures above 70°C, weeding out whatever weaklings are left.

After the V112 has been thoroughly tested, we insert it into a fully assembled Graphics Card Plus. (Incidentally, all our PC boards are 100% tested, which is another rarity.)

Then batches of the finished product are heated in ovens to greater temperatures than you are ever likely to encounter.

While still hot, the Graphics Card Plus is placed in a PC just like the one you use, and we run special software that exhaustively tests all functions.

Then, as a final precaution, each tested unit is carefully placed in an anti-static bag to protect it during shipment.

Free software, and parallel ports.

Hercules has become famous for the software we include with each monochrome graphics card.

And the Graphics Card Plus has the best software yet.

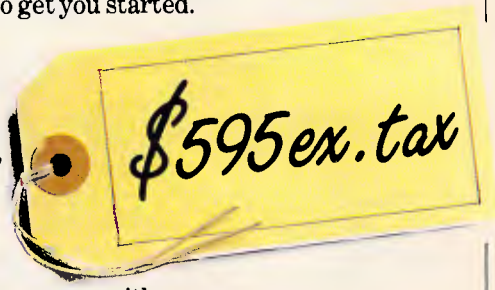
You get a program to extend the life of your monitor.

And to print graphics.

Then Fontman, a program that makes it easy to create your own RamFont characters.

Plus 25 fonts to get you started.

Plus everything you need to run 1-2-3 Release 2, Microsoft Word 3, Symphony 1.1, and Framework II.



And the Graphics Card Plus comes with a parallel printer port that you can disable. (Some PC compatibles require this.)

What price perfection?

With the RamFont breakthrough, 100% compatibility with our original card, free software, a parallel printer port, and the Hercules Graphics Card Plus should cost at least $1200.

Surprise. Its suggested list price is only $595 ex. tax.

If you think that the Graphics Card Plus must be the ultimate monochrome card, you're not alone.

John Dvorak, *PC magazine* columnist, said this about the Graphics Card Plus:

"If you intend to buy an IBM or clone and want to run a monochrome system, this is the card to get. I wouldn't even think about anything else."

Neither would we.

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server. And if it were a multi-user mini, the PCs would be terminals.

If you could get software which ran under PC-DOS on a network, and the same program prepared to run under Unix or Xenix, then the user need never know which operating system was running.

That was the theory. It fell down on a simple point: the failure of software publishers to rush out new diskettes of their programs, guaranteed to run under Unix.

What Olivetti is trying to do is not take over the software retailing market, but to actively sponsor retailing of dual-standard programs.

Having said all that, I should add feel free to laugh, anyway. It isn't going to happen.

Guy Kewney

New Commodore PCs

It's rumoured that a cheap Amiga will be unveiled at PC '87 which will see the keyboard and the processor housed in the one box, (not unlike the C128). The 3½in disk drive will be moved to the side of the machine (as to which side is still unknown), and is expected to be priced considerably cheaper than the current Amiga 1000 (as it is now known), which sells for $2495. We also believe it will plug directly into a TV.

The second surprise is expected to be a 'drop in box' concept, where instead of attaching the bulky Sidecar to an Amiga to achieve IBM compatibility, it will be possible to install a card which will give standard XT compatibility.

An original criticism of Sidecar, when it was first released, was the lack of file transfer ability between MS-DOS and AmigaDos. This has since been rectified by a utility on the Amiga Enhancer (recently released by Commodore), aptly called PC-Utility.

The third product is believed to be a PC-compatible, called the PC 5. It is expected to be a single drive system with an 8088 processor and 512k RAM. The price is rumoured to be under $1500 — a blatant attack on the Amstrad PC1512's ground.

Typical Telecom

Computer users who access remote bulletin boards, Viatel or other services down their telelphone line are in for a shock, if a planned Telecom initiative goes ahead. Telecom has proposed the introduction of timed local calls for data communications purposes.

The proposals introduce an STD way of being charged for local calls, with callers being charged 18 cents for every three minutes of a call involving transmission of digital data. In addition, the party at the receiving end of the line will be charged $6 per hour in city areas, and $7 per hour in country areas, for receiving such calls.

This of course raises the question of how Telecom will be able to differentiate between voice and data calls. Unless it has some technology that has been classified top secret, there seems to be no way to do this. This raises the likelihood of timed local calls being introduced for all subscribers, dramatically upping the cost of telephoning.

One proposal being suggested by Telecom is that private telephone subscribers be required to furnish an affidavit to the effect that their telephone line will only be used for voice calls, if they wish to avoid the timed local call charges. Another suggestion is that all business subscribers be charged the STD-like rates, regardless.

One of the reasons for the proposals is that Telecom is reportedly upset at the number of subscribers, in the business community, who, instead of installing an expensive leased line between computers, use a standard Telecom line, and simply keep it open all day, at the cost of 18 cents per day. It may be a case of using a sledgehammer to crack an acorn.

Assuming the proposals go through, and there has already been a great deal of protest, it's going to mean more expensive data communications.

For instance, subscribers to Viatel, which with a 75 Baud send rate is hardly the fastest service around, are going to have their telephone bills increased substantially. They'll have to develop some pretty nifty search techniques to keep the time of a call down, and the temptation will be to keep browsing to a minimum, which will of course make service providers less than happy.

For bulletin board subscribers, what was once a low cost hobby, after the purchase of a modem and communications software, will suddenly become a costly practice. If you can talk faster than you can type, it will be cheaper to telephone than use a bulletin board.

In short, the Telecom proposals, if accepted, will do more harm to the newly booming datacommunications user than anything else imaginable.

To look on the bright side for a moment though, it might mean a boom in 1200 and 2400 Baud modems, to keep the data transmissions time down to a minimum. But then, if Telecom's phone lines and exchanges stay the way they are, we might as well all go back to writing letters.

New Atari PCs

Atari has launched a PC clone with in-built EGA at last month's Consumer Electronics Show in Las Vegas.

It has also announced an AT-level machine, using the 80286, a low cost laser printer and a new 'mega' version of the ST.

Atari has long hinted that it would produce a laser printer and plans to sell it with the previewed four megabyte ST as a cut price desktop publishing system.

The printer will cost $US1500 but no prices have yet been set for the Mega ST, which is available in one, two or three megabyte memory capacities.

The IBM clone will have 512k RAM expandable to 640k, a dual speed 8088 CPU, serial, parallel and external drive ports and EGA standard graphics output. A mouse, high resolution monochrome monitor and a single 5¼in disk drive are included in the price of $US699. The machine does not have any expansion slots but Atari is working on an external box.

There's no official word yet on an Australian launch date or price, but sources suggest we'll see the machine in Sydney at the *APC* Show in March, and it should be available in retail stores around July with a price 'which is fiercely competitive with that of Amstrad's PC'.

Guy Kewney

Clever disk

In the US, 3M is selling its preformatted diskettes with *real* (not demo) software. The program only runs a dozen times, however, then scrambles itself. If you like it, you phone 3M and it gives you a 'key' number which resets the counter, while 3M rushes you the official program with manual, direct from supplier.

There . . . that's our useful tip for the marketing boys this month. END

C&PA

With computer aided design and computer graphics moving into more fields, the need for precision input and output devices becomes greater. Houston Instrument is a world leader in computerised graphics equipment. With 26 years' experience, they are renowned for quality, reliability and innovation. Plotters range from small desktop to large, high output models. Whether it's business graphics or CAD, there's a Houston Instrument model that will do the job. Here's a small sample of the range.

The DMP-51/52 MP Series plotters

Precision drafting plotters designed to increase productivity. That sums up Houston Instrument's DMP-51/52 MP series. With features like automatic changing of up to 14 different pens, constant velocity control for uniform inking and automatic pen capping.

Whatever your application, the DMP-51/52 MP series handles it easily. They can handle plots up to 508x813mm (51 MP) or 546x864mm (52 MP) at plotting speeds of up to 550 mm/sec with a resolution of 0.1mm. Ideal for complex jobs like detailed engineering and architectural drawings and PC board layouts.

The DMP-56

Here's the throughput and flexibility you need in an oversize A0 plotter. Capable of handling 18 different media sizes up to 914 x 1219mm with plot areas of up to 884mm x 1189mm. And at an extremely affordable price.

Whether you're producing architectural drawings, mechanical designs, electrical schematics or overhead transparencies, the DMP-56 is a fast, quiet, accurate and intelligent tool.

Based on the proven reliability of the Houston Instruments DMP-51/52 series plotters, the DMP-56 combines an excellent resolution of 0.025mm with a maximum plotting speed of 430mm/sec. This low cost, servo driven plotter can be operated with any computer using a standard RS-232C compatible interface.

TRUE GRID Digitizers

Houston Instruments TRUE GRID digitizers make high performance and low price a reality. This flexible and intelligent series is designed specifically to offer system builders a versatile collection of powerful graphics input tools. The graphics capabilities and low price of these superior new digitizers make them a natural choice over keyboard entry, joysticks, mice or light pens.

Whether you need a digitizer for menu selection or as part of a computer aided design system, these electromagnetic digitizers let you choose the resolution, accuracy and position sensor to suit your needs.

"To be really productive, a CAD system needs input and output devices that are totally accurate, reliable and simple to use."

The low cost TRUE GRID 1000 series are ideal for less demanding applications like cursor control and menu picking. Three sizes give you active areas of 125x125mm, 280x280mm or 280x430mm. And you have a choice of stylus, single button or four button cursors. All with a resolution of 0.13mm.

The high resolution 8000 series gives you a resolution of 0.03mm on active areas of 280x280, 280x430, 457x610 or 610x915mm. Transducers include three and 16 button cursors. These are the choice for demanding design and graphics applications.

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Houston Instruments has earned a reputation over the years as a quality manufacturer of computer peripherals at reasonable prices. At C&PA we're proud to maintain that reputation in Australia. Every Houston Instrument product is rigorously tested before it leaves the factory. And if you ever need help, C&PA has service and support around the country.

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FARWAGI 7158B

It is rumoured that IBM is about to close the ever-widening gap in the micro world, while graphic workstations are on the horizon for 1988. And our US correspondent, Tim Bajarin, has a few things to say about talking computers. . .

An offer IBM couldn't refuse

If you consider that there is a worldwide market of over ten million IBM PCs and compatibles, and that IBM owns around 70 per cent of the mainframe market, it had to be only a matter of time before IBM realised that it needed to address the issue of making all these computers work together by developing a common link between its mainframe computers, minicomputers and personal computers.

To date, most of these machines operate very much in their own little worlds; and communicating between them has been difficult, if not impossible.

Dealers who have been close to IBM are just beginning to leak information that IBM is about to release the first PCs that will be part of this new line of computers.

The first two machines will appear in early 1987. One of these will reportedly be a PC based on the 8086-2 Intel chip. It will have 256k RAM, a single 3½in disk drive and a suggested list price of around $US1295. This machine could possibly signal that IBM is moving to accept the more durable 3½in format as the way it will handle disk storage in the future. The second machine is what could perhaps be called the small footprint AT, designed to conserve desk space and be more upgradable.

Dealers have confirmed that any machines released during 1987 will be part of a new line of PCs that could implement proprietary technology at any time. Such technology will be designed to be 'hard to clone'. Dealers also believe that 1987 will be the year when IBM begins to give us the common thread that ties its whole range of computers together. This will have a dramatic effect on the personal computer industry.

No matter what machines IBM does release in 1987, you can be sure that they will all be part of IBM's grand scheme to recapture the parts of the computer market that have escaped its clutches.

Amiga provides the spur

When Dave Morris, founder of the original Amiga Company, gave sneak previews of the Amiga graphics chip at the Consumer Electronics Show in Chicago during the summer of 1984, it was the talk of the show. Soon afterwards, Commodore made Mr Morris an offer he couldn't turn down and very soon the Commodore Amiga Personal Computer was born.

The graphics chips at the heart of the Amiga have helped to define what excellence in screen management should be, while at the same time spurring industry giants like Intel and Texas Instruments to develop industrial-strength versions of these types of chips. As a result, you should expect to see graphic workstation products in 'general' offices by the late 1980s.

It was considered strange that the Amiga chip seemed destined to be an enhancement to the world of entertainment, because although the Amiga has software for almost every type of application, it is always positioned more for the consumer market than the potential serious business user.

One of the reasons for this is that Commodore is not a business name, but has traditionally kept itself in the heat of the consumer computer wars. However, Commodore is now hoping to break out of that mould with a new version of its Amiga PC.

Sources close to the company believe that it has a new version of the Amiga graphics chip that will rival any of the industrial-strength products already released. It appears that Commodore will also base the new computer on the more powerful Motorola 68020 processor. This chip runs at 16MHz which means that programs literally race through their paces, instead of crawling along.

The new Amiga will cost around $US1995. If Commodore does release this machine, watch how companies who have traditionally provided graphic workstations take note. Maybe we will even see graphic workstations get a stronghold in the business market as early as 1988!

Micros should be seen, not heard. . .

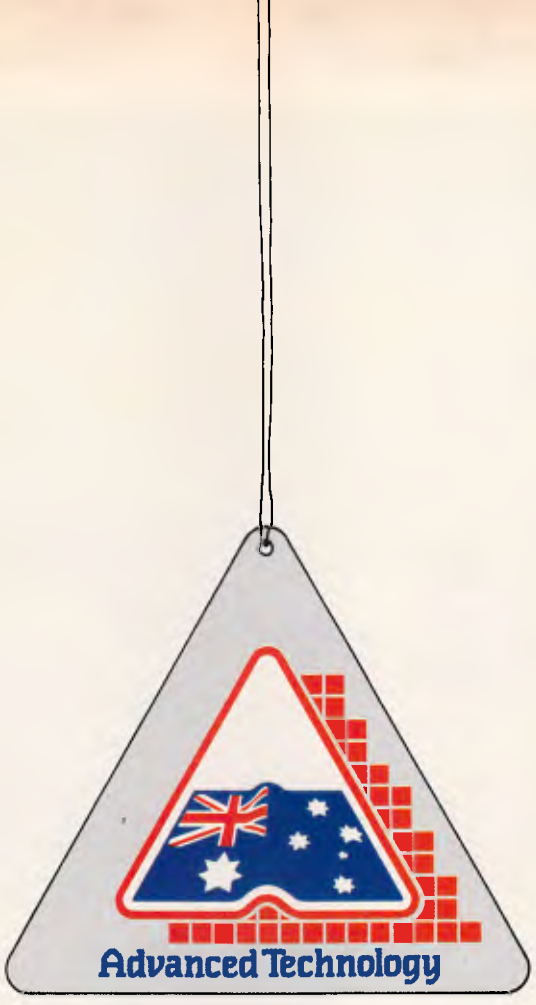
Although voice synthesis is no longer new, getting a computer to talk back to a user properly requires a lot of memory and good programming technique to be effective. But a new product from Microphonics Technology in Auburn, Washington could change all that.

Pronounce Plus is a voice-controlled product that allows IBM PC users to develop 'Voice-Macro' commands and add voice-control to most spreadsheet, word processing, database management, CAD and accounting programs running under PC-DOS or MS-DOS.

No programming is required because Pronounce Plus runs concurrently with applications programs, and memorises keystrokes and instructions as they are actually performed, storing up to 256 commands at any one time.

This is the first *practical* program for voice commands I have had the chance to use.

Pronounce Plus is priced at $US795 complete, and includes a plug-in board, 68k of concurrent software, a microphone and documentation.



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*Hypertec featured in the first four places in no less than three hardware categories in the 1986 PC World Class Awards.

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But our portable PC is not only smaller than the IBM, it's lighter. And more powerful. Our 80C86 microprocessor lets you zip through work at up to twice the speed. And our maximum memory capacity is 640K of RAM. Their's is only 512K.

The T1100 PLUS has other things the IBM doesn't. Like serial, parallel and CRT ports that are built-in standards. Not add-on extras. And a high resolution LCD display screen that tilts to many convenient viewing angles. Not just a few.

Of course, the Toshiba T1100 PLUS does have a few things in common with the IBM portable. Like complete IBM compatibility. And two built-in 720K 3.5" disk drives. It's just that it has these things in a smaller, lighter, faster, more portable, more affordable package.

And see why being smaller than IBM is going to make us one of the biggest names in PCs.

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Conroy Carpenter/TCP 0161

THE WEST COAST

The customer reaps the benefits in the cut-price computing war

With PC clones being in great supply, a scenario reminiscent of petrol stations undercutting each other's prices to attract customers is being acted out in the States. The result is an all-out pricing war.

All over the US, computer dealers are using every trick in the book to get customers to come in. They offer low prices, and in some instances even throw in a case of floppy disks or memory expansion cards just to get the customer to buy.

One company that has offered cut-rate prices on a wide range is Tandy. You can buy the model 1000 with 256k RAM, for $US799 — and that includes a colour monitor.

One of the leading Korean manufacturers, Hyundai, has just released a computer called the Blue Chip PC. This particular model is sold through mass merchandisers such as Caldor and Target stores in the Eastern US. For about the same price as the Tandy model 1000, you get a dual-disk system with 512k RAM, a monochrome monitor and free software.

In high-tech areas like Boston or Silicon Valley, you can get even better deals; CCT Computers of Sunnyvale, California will sell you a personalised system configured to your own specification. The CCT-286 AT-compatible runs at 8MHz, with 640k, seven DMA channels, a 1.2Mbyte floppy and a controller for hard and floppy disk drives. This system sells for $US995.

One of the most interesting places to buy low-cost clones can be found in the heart of Solicon Valley. Fry's Electronics is actually part of a large valley grocery chain, and is the only store where you can buy potato chips on one rack, and 256k DRAM chips on another! Although Fry's carries some smaller brands, it is known for its ability to get real IBM PCs, Compaqs and Apple products and sell them at incredible discounts.

As you can imagine, any new player entering the US computer market will be up against some tough competition.

Balancing the books

AppleWorks has been one of the most successful packages ever released for the Apple II line of PCs. And, just like Lotus 1-2-3, there is a great market for software that works as companions with 'base' products.

Broderbund Software of San Rafael, California, has just introduced a financial management package that works with AppleWorks. The package, called On Balance, lets you record and reconcile bank and credit transactions, create and track budgets and print out reports and cheques.

The program updates cheque registers automatically and warns when payments are overdue. The On Balance files can also work with the AppleWorks spreadsheet.

On Balance is a nifty product that gives new life, power, and functionality to your AppleWorks program. It costs $US99.95.

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Dynamac

The Dynamac embodies the state-of-the-art in microcomputer technology and embraces many of the attributes of the Mac Plus. But despite the power and prestige of this innovative, lapheld micro, the search for the ultimate in portable computing continues. Nick Walker assesses the machine's attractions.

It's a commonly accepted fact that microcomputer technology progresses at a meteoric rate. For example, in 1980 $1500 would buy you a 16k, 8-bit machine; in 1982 a 64k, 8-bit machine; in 1984 a 128k, 8-bit machine; and in 1986 a 640k, 16-bit machine. In reality, however, the facts are not so simple. While it is undoubtedly true that chip-level technology progresses at a meteoric rate, the same cannot be said of many microcomputer-related technologies. Disk drive technology, screen technology and especially software technology are three areas which are currently limiting microcomputer design, an excellent example of which is the Dynabook concept. Developed in the late 60s and early 70s by Xerox at the Palo Alto Research Centre, the Dynabook was designed on the basis that by the time the software was developed, the hardware would be available to implement it. The final specification called for a flat machine — about the size of a hard-back book — with a graphical display and touch-screen control. Much of the graphical display technique was later used by the same Xerox team, now at Apple, in the creation of the Apple Lisa and the Apple Macintosh.

The processing power and memory needed for the Dynabook are now available, as is the software in the form of the Apple Macintosh. But two slow-developing technologies have prevented the Dynabook from becoming a reality. First of all, in the field of screen design, many manufacturers have been working for years to find a flat screen of decent resolution and contrast that is capable of being battery-powered. Secondly, in the field of hard disk design, the problem has been making a hard disk which is capable of taking the sort of knocks a book-sized machine will inevitably receive. Although hard disks are of a suitable size, I have yet to find a hard-disk manufacturer willing to accept my hard-disk challenge: assuming that the worst damage a lapheld micro would sustain would be a fall from someone's lap to the floor, that the hard disk should also be capable of withstanding such an onslaught while operating.

The danger for any manufacturer producing a lapheld version of the Macintosh is that it will inevitably be compared with this *mythical* Dynabook, and not the current crop of IBM PC-compatible laphelds. But, despite this drawback, two 'flat-Macs' have been produced.

The first of these to reach *APC*, and the subject of this review, is the 'Dynamac', which provocatively invites direct comparison with the Dynabook. A second machine, known as the Colby Mac and specifically designed for rugged applications, is in the pipeline awaiting launch. Certainly, the Dynamac has a specification beyond that found on the majority of laphelds: 1Mbyte of RAM, a 40Mbyte hard disk, a larger than normal Macintosh screen and a built-in 1200-baud modem. It's undeniably an achievement to fit all this technology into a lapheld machine, but it would have been a major leap forward if it had all been contained within a Dynabook-size case.

At 640×400 pixels, the Dynamac's power-hungry electroluminescent screen is 46 per cent bigger than the standard Macintosh unit

Hardware

My first impression of the Dynamac was one of style and quality. The design is similar to the majority of laphelds on the market, with the screen hinging back to uncover a keyboard and disk drive, but the Dynamac's matt black finish with an amber/gold screen and a high-quality poly-carbonate casing combine to provide an extremely classy-looking and elegant machine.

Although the Dynamac is significantly smaller than the standard Macintosh, it is — in lapheld terms — a large machine. At 40cm × 35cm × 7cm it is considerably larger than a similarly-specified, IBM-compatible machine such as the Toshiba 3100. In addition, the Dynamac is strictly mains-power only and has a footprint significantly larger than the average user's lap! It doesn't take too long to realise that this machine is best treated as a very portable desktop machine — or 'luggable' as it is otherwise known.

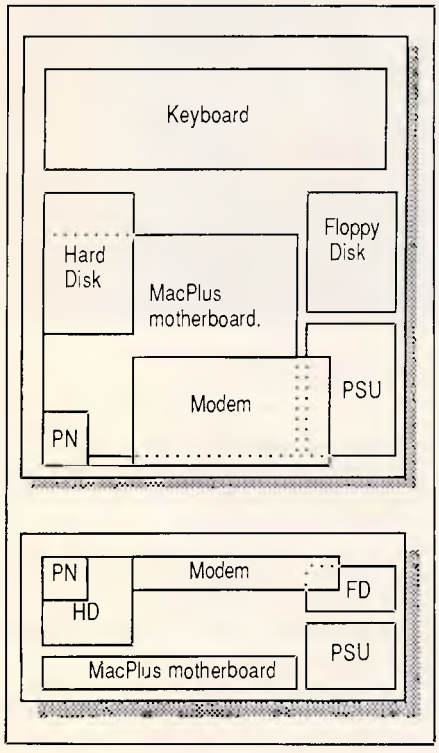
According to Dynamac Corporation the machine should weigh 6.3kg, but because the review machine had a prototype hard disk it was half a kilo overweight. My humble bathroom scales put the weight of the Dynamac at 9.9kg — I hope it's Dynamac which is at fault, or I desperately need to shed a few pounds.

In order to obtain a Macintosh motherboard, Dynamac is currently utilising the Mac Plus for the necessary parts and throwing the rest away. Negotiations are taking place with Apple for the purchase of motherboards alone which would obviously bring the price of a Dynamac down.

The Dynamac's rear panel is a definite contender for the maximum number of ports in the smallest space 'competition'. This 35cm × 7cm rear sliver contains, from left to right, the following: a mini-phono sound output; a mouse port; a SCSI external disk connection; a Macintosh external disk connection; processor interrupt and reset buttons; an external keypad; an external keyboard; a telephone jack out; a modem volume control; a telephone jack in; S5/8 DIN-style sockets for printer and modem; an E-machine output; a composite video output; an on/off switch; a mains power in and a 120/230v switch for the power supply. Also on the back in gold writing is the legend 'Designed by EJ'.

As the majority of these ports have been 'inherited' from the Macintosh Plus, the S5/8 DIN sockets are also the non-standard ones used on the Macintosh

Plus and unfortunately lack a power out line. For the majority of peripherals this is unimportant as they have their own power supply. But some modems and unusual peripherals can't be used. More significant is the fact that Apple is flagrantly ignoring the new international S5/8 RS232 standard which was set up to solve the problems of different RS232 configurations. The port labelled E-machine will allow the Dynamac to work with a 'larger than Macintosh' external screen.



The internal design of the Dynamac is the epitome of high-end, lapheld design. All the individual components are separated by heavy-duty aluminium alloy plating to stop interference. The only remaining space, in the centre of the machine, has already been accounted for; an optional tape streamer will be available to fill it

When I received the Dynamac, I was given strict instructions not to attempt to get inside it. This is understandable, as it required removing no less than 18 screws and that only gets you as far as a shielding plate. If you were to remove this shielding plate, you would be confronted with the ominous sight of a Mac Plus system board, 1Mbyte of RAM, a 40Mbyte hard disk and a 1200-baud modem complete with external casing.

It's worth describing briefly the Dynamac's architecture, though the use of a genuine Mac Plus motherboard means that it is virtually identical to the Mac Plus. The processor is a 68000 running at 8MHz. The 1Mbyte of RAM can be upgraded to 2, 2.5 or 4Mbytes. An extra megabyte of RAM costs $US540, or going straight to 4Mbytes will cost $US1500.

'Although the Dynamac is significantly smaller than the standard Macintosh, it is — in lapheld terms — a large machine'.

The power supply in the Dynamac is not the one from the Mac Plus, as this would occupy too much room. In addition to being smaller, the Dynamac power supply is also dual voltage (115v/230v) which means you can use it worldwide provided you have the right mains plug adaptor. The standard Macintosh speaker sounds feeble under the casing of the Dynamac, though the possibility of including a larger speaker is under consideration. A small, powerful and extremely quiet fan is included to keep the machine cool.

The review machine was fitted with the 800k floppy from the Mac Plus and an internal 20Mbyte, 3.5in Rodime hard disk, but production models will have just the floppy or the floppy and a 40Mbyte hard disk. Dynamac has an interesting way of demonstrating the durability of this hard disk. At certain computer shows in the States, the Dynamac has been seen operating while held in an electric drinks shaker. All very impressive, true; but nothing like the g force it would receive falling from someone's lap. For some reason Dynamac was unwilling to disclose the manufacturer of this hard disk, but the company did mention that it weighs a puny 0.5kg, is voice-coil activated and has an average access time 28.29 milliseconds, so it should be very fast.

The Dynamac's screen is an amber, electroluminescent device. Unlike LCD displays electroluminescent displays emit light, so they don't need to be in direct light in order to be readable. However, that said, there is a price to pay for the 'readability' of an electroluminescent display, and that is in power. Dynamac estimates that the machine could be run from batteries for approximately three hours with an LCD screen, but with the electroluminescent display this is reduced to less than 15 minutes — and so the mains-only restriction. One feature that all flat screens presently lack is sufficient contrast, and this is particularly noticeable on the Dynamac because most Mac applications operate with black text on a white background. The 'black' pixels of a Dynamac are in fact a slightly *darker* shade of amber. While this is fine for a block of black pixels, it makes distinguishing single-pixel lines, such as the letter "l", difficult.

The refresh rate of an electroluminescent screen is slightly slower than that of a cathode ray tube. On all applications except those that have very fast animation, this is totally unnoticeable; the only thing I noticed it on was a game called Racquet Ball. This refresh rate does cause one very nasty problem: under incandescent light (light bulbs and the sun) it's fine; however, a fluorescent light interferes terribly with the screen, causing a really bad flicker. Gas-Plasma technology, as used on the competitive Colby Mac cures the screen flicker problem but was rejected for the Dynamac as it can only generate in a dark red glow, and it's also very fragile.

Apart from being electroluminescent, the screen is very interesting in another way: in pixel terms, it is 46 per cent bigger than a standard Macintosh screen, at 640 × 400 pixels compared with 512 × 342 pixels. This has been achieved by replacing the video display with a small PCB and running a cable from this PCB to a clip attached to the 68000 to intercept video calls. The circuitry is the same as that of the Mega-screen and the E-machine, both of which are extra-large screens for the Macintosh. An additional

Technical specifications

Processor:	Motorola 68000 running at 8MHz
RAM:	1Mbyte (plus 128k for screen)
ROM:	128k
Mass storage:	800k, 3.5in floppy drive; 40Mbytes Winchester
Display:	640×400 monochrome, electroluminescent
Keyboard:	59 keys, full-stroke
Standard interfaces:	Mini-phone sound output; mouse port; SCSI external disk; Macintosh external disk; processor; external keypad; external keyboard; telephone jack out; telephone jack in; S5/8 DIN-style sockets for printer and modem; PhoneNet; E-machine output; composite video
Operating system:	Apple Macintosh

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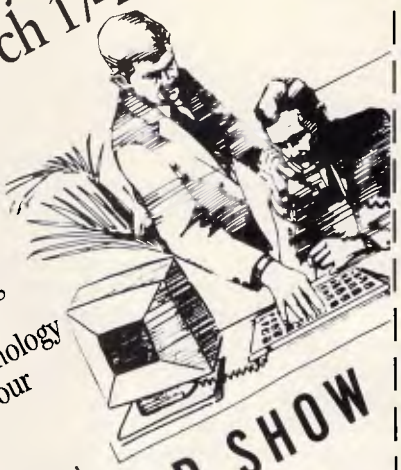

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The rear of the Dynamac has been utilised to the limit. Most ports have been inherited from the Mac Plus, with additional slots for an internal modem and networking facilities

128k of screen memory is included, so the Mega-screen actually frees some memory for application use. The beauty of this arrangement is that it will automatically work with the maximum resolution of the screen it is attached to — up to a maximum of 1024 × 1024 pixels. For example, a Dynamac can be attached straight to a 1000 × 800 pixel E-machine screen and will automatically utilise the extra area.

It is a tribute to the original software design of the Apple Macintosh that most Macintosh applications will take advantage of this extra area. Everything I tried which used re-sizeable windows took advantage of the extra screen area, and it proved very useful on such packages as Pagemaker and MacWrite. Packages such as MacPaint which use a fixed-size screen, and games that totally ignore Macintosh windows, will also run quite happily but only in the top left-hand 512 × 342 pixels. The only program that absolutely refused to run was Microsoft Flight Simulator. It seems ironic that the classic test of compatibility for an IBM should be the same for the Macintosh. Possibly, Microsoft has sold more Flight Simulators for its compatibility value and has purposefully written the code in a particularly convoluted way as a result. There is also, apparently, an odd bug with the Microsoft Excel spreadsheet, whereby it will work perfectly on the screen providing you don't exceed A4 size — one pixel under A4 is fine; one pixel over and the system crashes.

The keyboard is basically a standard Mac Plus keyboard with the numeric keypad removed. The Enter key from the numeric keypad has been retained and grafted on to the right-hand side of the second row on the keyboard, and the Return key has been reduced from an L shape to a standard key to accommodate this. In terms of 'feel' I find the Macintosh very hollow and lacking the positive click of the better IBM and compatible keyboards. In an effort to keep the thickness of the Dynamac down, its keyboard has been mounted without the ergonomic slant of most keyboards. This gives the unusual feeling of typing into a valley, and I'm sure any competent touch-typist will hate it.

The Dynamac comes complete with an internal 1200-baud modem. To avoid problems with Telecom in Australia, the modem will have to be removed and replaced with an approved modem. It's nice to see that Dynamac has still included the external modem socket should you wish to use your own.

Occupying less than four cubic centimetres in the casing is a PhoneNET local area network controller. This is compatible with Apple's own Appletalk network but can run through an existing office telephone wiring without interfering with your telephone system — so most of the wiring is already installed.

I couldn't finish the hardware section without mentioning the carrying case that will be supplied with the production machines. Dynamac assures me that it will be finished in highest quality calves' leather with a ballistic lining — surely an indication of the kind of customers at which the machine is aimed!

Software

As the Dynamac uses a genuine Mac Plus motherboard, in system software terms it is absolutely identical to the Mac Plus. Except for the problems with the larger screen, there is no way in which it could be incompatible. This means that the whole range of Mac Plus applications will work on the Dynamac. A number of major changes were made to the system software when the Mac Plus was introduced, and it is probably worth briefly recapping on these.

The system now formats all disks to 800k and the true hierarchical filing system (HFS) unless otherwise specified. The ROMs in the Mac Plus now total 128k, and contain HFS and updated version of such things as the QuickDraw routines. This did mean that a few applications didn't work, especially programming tools and public-domain programs. All the packages that failed to work when I reviewed the Mac Plus have now been modified to work with both the Mac Plus and older Macs.

Price

A fully configured Dynamac with 1 Mbyte of RAM, a 40Mbyte hard disk and an internal 1200-baud modem costs $US6785. A basic system with a mere 1 Mbyte of RAM, no modem and no hard disk costs $US4995. The prices converted to Australian dollars, (at the time of going to press) are $10,475 and $7711 respectively.

Documentation

No documentation was supplied with the review machine, and Dynamac was unable to say what form this would finally take. Considering that a complete Mac Plus has been destroyed to create the Dynamac, you should at least expect a standard Apple Mac Plus manual.

Conclusion

It's all very nice, but what is the point of the Dynamac? The machine is not battery-powered so it needs a mains power supply — and for much less, you could configure a Mac Plus to a similar specification. True, the Mac Plus is slightly larger and heavier than the Dynamac, but with a Mac carrying case it is still very much a 'luggable' and it does have a far nicer screen.

Perhaps the most pertinent indication of the kind of market the Dynamac will sell into, can be gauged by the sort of people making enquiries about the machine at a recent Apple show: the two serious enquiries I witnessed were from a managing director of a Swiss Bank and a very wealthy Arab. The Dynamac is desirable in the same way that a Porsche is desirable: there are much cheaper ways of obtaining the same performance, but if image is important to you, then money is no object.

Negotiations are currently taking place to find Australian distributors, however, in the meantime direct your enquiries to: Dynamac Computer Products Inc., Suite 252, 1536 Cole Boulevard, Golden, Colorado 80401. Tel: (303) 233 7626.

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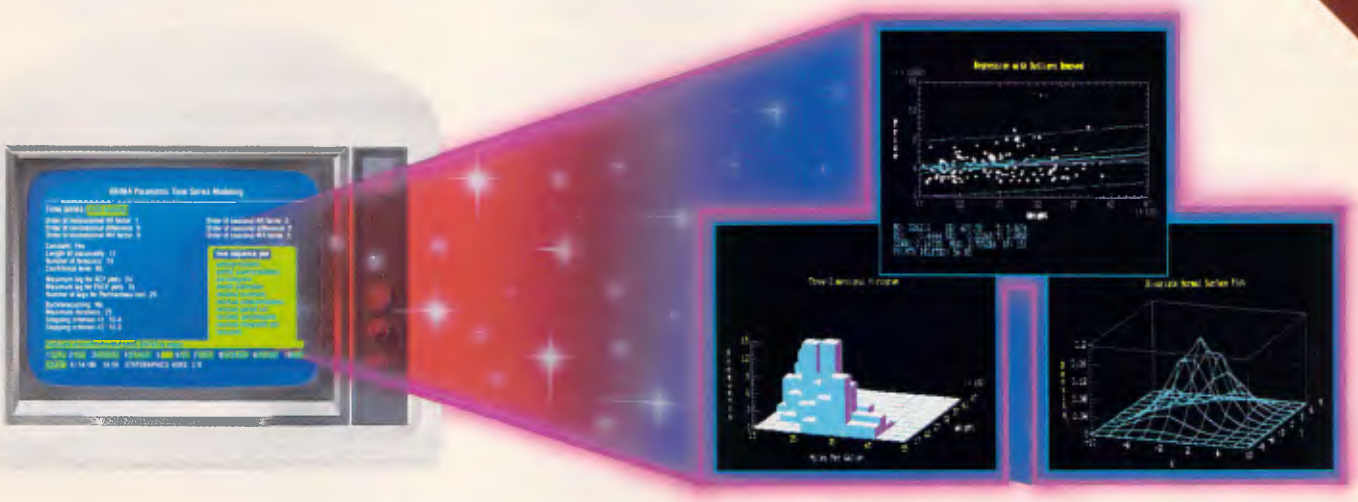

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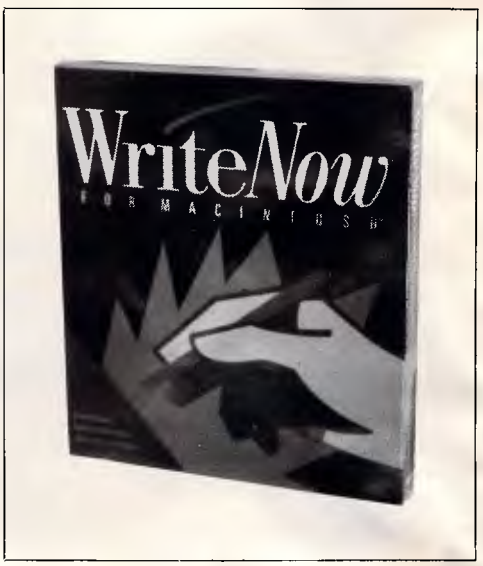

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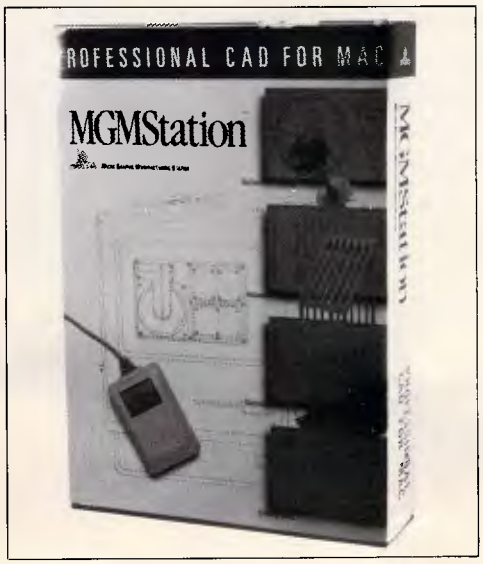

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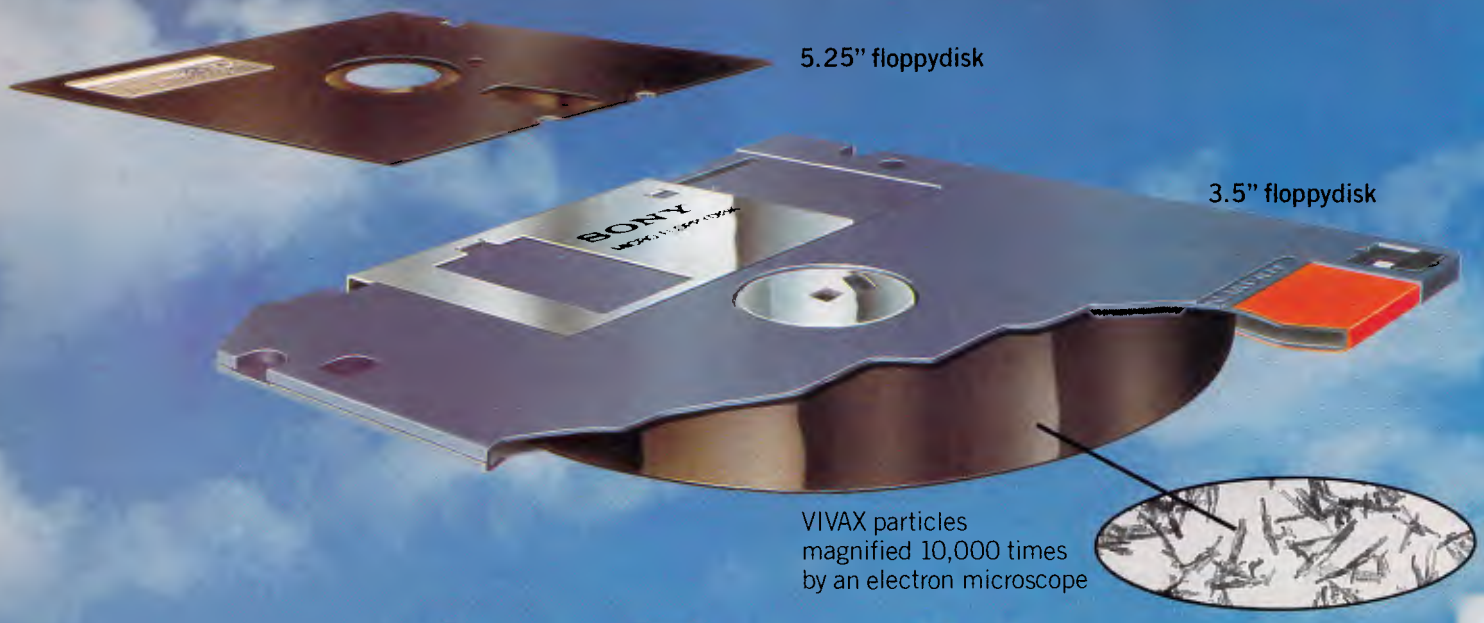

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In living memory

If machine 'intelligence' seems rather far-fetched, how about computers with logic components compiled of molecules rather than silicon? Nick Hampshire presents the history of, and predicts the future for, molecular electronics.

A computer faster and more powerful than any available today, yet no larger than a sugar cube, could be a possibility by the end of the century — a computer made not from silicon or gallium arsenide, but from organic chemicals similar to those found in all living organisms. The use of organic chemicals for the construction of logic devices is a new technology called 'molecular electronics'.

Molecular electronics will allow complex logical devices like computers to be constructed using individual organic molecules to perform the logic functions. Such devices will be very small, three-dimensional and over 800 times faster than any semiconductor logic device. Molecular electronics is a technology which is likely to become the natural successor to the silicon chip.

The reason why

Since the invention of the transistor in 1950 and the integrated circuit about 10 years later, the evolution of electronics has seen the continual miniaturisation of components; every new generation of components being capable of performing increasingly complex functions at greater speeds. Since 1960 the drive for increased speed and complexity has, every 18 months, halved the area on a silicon chip required for a given electronic function. A single integrated circuit .25ins square, such as a microprocessor chip, probably has more components than the most complex electronic device capable of being built 20 years ago.

A powerful driving force behind the process of increased miniaturisation has been the computer industry. New and increasingly complex programs have meant that processing speed and memory size are always proving a limitation to programmers.

This constant increase in complexity and speed cannot go on forever — soon the fundamental laws of physics will prevent further advances. Already these limits are being reached: many scientists believe that it will prove impossible to build memory chips with a capacity greater than 32Mbits commercially. Even the fabrication of 1Mbit RAM chips has proved enormously difficult and is pushing manufacturing technology to the limit to ensure an economic yield of usable devices.

'Molecular electronics is such a new subject that there is still no agreement on calling it molecular electronics — some prefer the name "bioelectrics".'

In the short term, one of the solutions is to move away from the use of silicon as the semiconductor material and use gallium arsenide (GAs). This semiconductor material should, theoretically, allow the complexity and speed of devices to be increased by at least another order of magnitude, but it has proved a very difficult substance to work with and obtain commercial yields from. Consequently GAs devices are very expensive and usually confined to military applications where their low power consumption, speed and radiation hardness have proved attractive.

Although over $1 billion has been spent over the last 10 years on research into GAs, it is only now that scientists have discovered techniques which should allow it to be applied to the volume production of very large-scale integrated circuits. However, eventually, even GAs devices will come up against the limits of both fabrication techniques and the basic laws of physics. This leaves the question: What comes after gallium arsenide? The answer increasingly being given by scientists is molecular electronics.

Molecular electronics is such a new subject that there is still no agreement on calling it molecular electronics — some prefer the name 'bioelectrics'. This technology has grown from the enormous advances made over the last 10 years in organic chemistry and, in particular, biochemistry. Molecular electronics is the fusion of this knowledge with microelectronics, coupled with the realisation that the inherent capacity of biochemicals to transport electrons on a molecular scale offers the best chance to fulfil future needs for denser and faster circuits.

The proposed use of biochemicals and the technology for their synthesis is one of the most revolutionary and far-reaching concepts in its departure from traditional electronics. Not only will it require entirely new academic disciplines in its development, but it will also require the coming together of a whole range of leading-edge technologies.

Foundations

The conceptual possibility of constructing molecular electronic devices, or MEDs, has been around for about 12 years; the initial proposals for molecular devices

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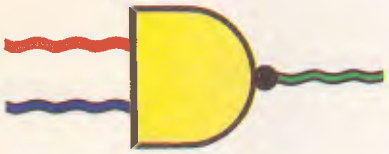
having been made in 1974 by two leading IBM researchers at New York University, Dr Arieh Aviram and Dr Mark Ratner. Like so many technologies, it was impossible to take it beyond a purely conceptual stage until other base technologies had been developed and a thorough knowledge of the principles obtained.

A wide range of academic disciplines which are not often closely associated need to be drawn together — physics, mathematics, computer science, biology and organic chemistry. This is now being done at a number of universities and research organisations, principally in the US and Japan. At the forefront of these groups is the IBM-funded Centre for Molecular Electronics at Carnegie-Mellon University (CMU) in Pittsburgh. This group, under the leadership of Professor Robert Birge, has made the major advances which look set to turn the theory of MED into reality.



INPUT A	INPUT B	OUTPUT C
0	0	1
0	1	1
1	0	1
1	1	0

Fig 1 A conventional and straightforward two-input NAND gate with its associated logic table

Basic elements

The research team at CMU has demonstrated the feasibility of using biochemicals to create the basic logic elements utilised in a computer system. The device which has been constructed is called a NAND gate. The development of this logic element has been a major advance, since NAND gates are the fundamental components from which all other logic elements such as flip flops, counters and eventually whole computer systems can be built.

The key to this advance is a chemical known as a porphyrin. Porphyrins are an important group of organic molecules which incorporate a metal ion in their structure, and are fundamental to many biological energy transfer processes. A porphyrin is one of the essential chemical components of chlorophyll, the chemical which allows plants to convert sunlight, air and water into the whole range of complex organic chemicals from which a plant is built.

Organic chemists have observed that given the proper molecular configuration, a porphyrin molecule could act as a molecular circuit with switching induced by visible light. It is this property which has been utilised by the CMU team to construct the molecular NAND gate.

As can be seen from the simple two-input NAND gate in Fig 1, the gate has two inputs A and B, and one ouput C. The gate will only produce an output, a logic 0, when the two inputs are at a logic 1; any other combination of inputs will produce a logic 1 output.

Architecturally the molecular gate produced by the CMU team is identical to a typical semiconductor gate: it has two inputs A and B on Fig 2; and one output C. The two inputs consist of cyanine dye molecules bonded to a quinone molecule. The joint of the logic gate is a porphyrin molecule; the output is another dye molecule known as a chromaphore. The whole molecular gate structure is less than one hundredth of the size of the smallest theoretical equivalent gate constructed from semiconductor material.

Whereas the inputs to a semiconductor gate are electrical pulses, the inputs to the molecular gate are in the form of pulses of light generated by a laser (as shown in Fig 3). The cyanine dye input molecule absorbs a photon from the laser and, as a result, gains an electron. This electron is transferred from the cyanine via the quinone to the porphyrin molecule. When the porphyrin gains one extra electron it has no effect, but when it gains two electrons — one from each input — it will 'fire' and output an electron to the output chromaphore molecule. This output electron changes the wavelength at which the ouput molecule absorbs photons. The ouput molecule's state can then be interrogated by a laser: if the light is absorbed it's at

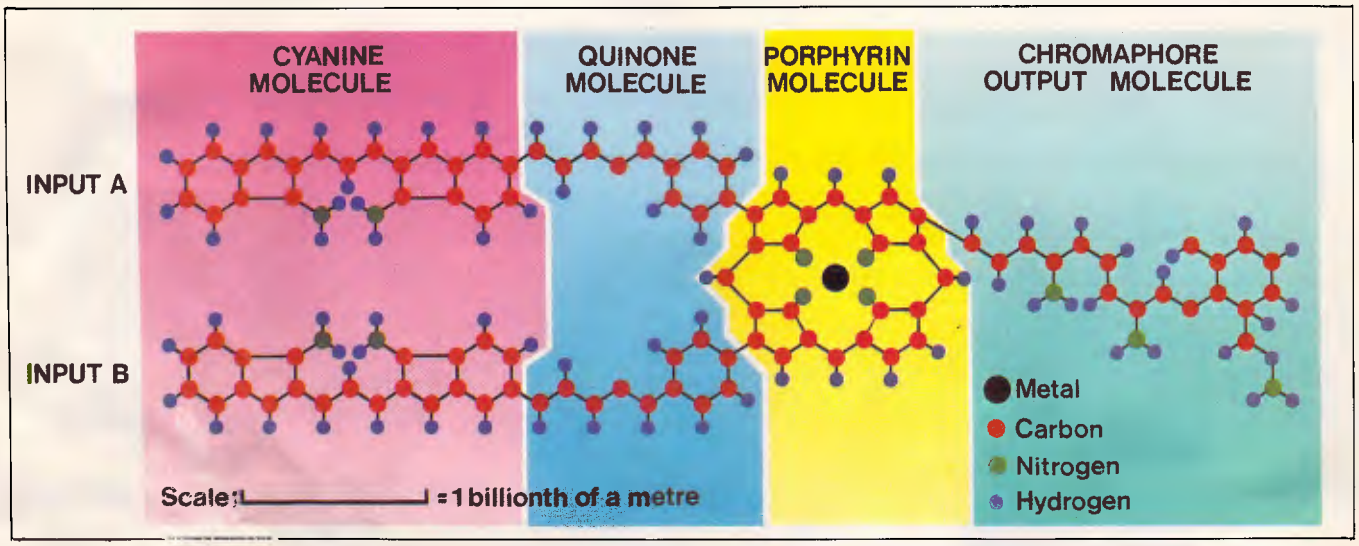


Fig 2 The atomic structure of a molecular NAND gate. The two input molecules are the cyanine/quinone arms marked A and B; light of the correct colour shining on either of these two molecules will generate an electric charge on the molecule. When the porphyrin ring receives two electrons, one from each input molecule, it will output an electron to the output molecule and thereby change its optical characteristics

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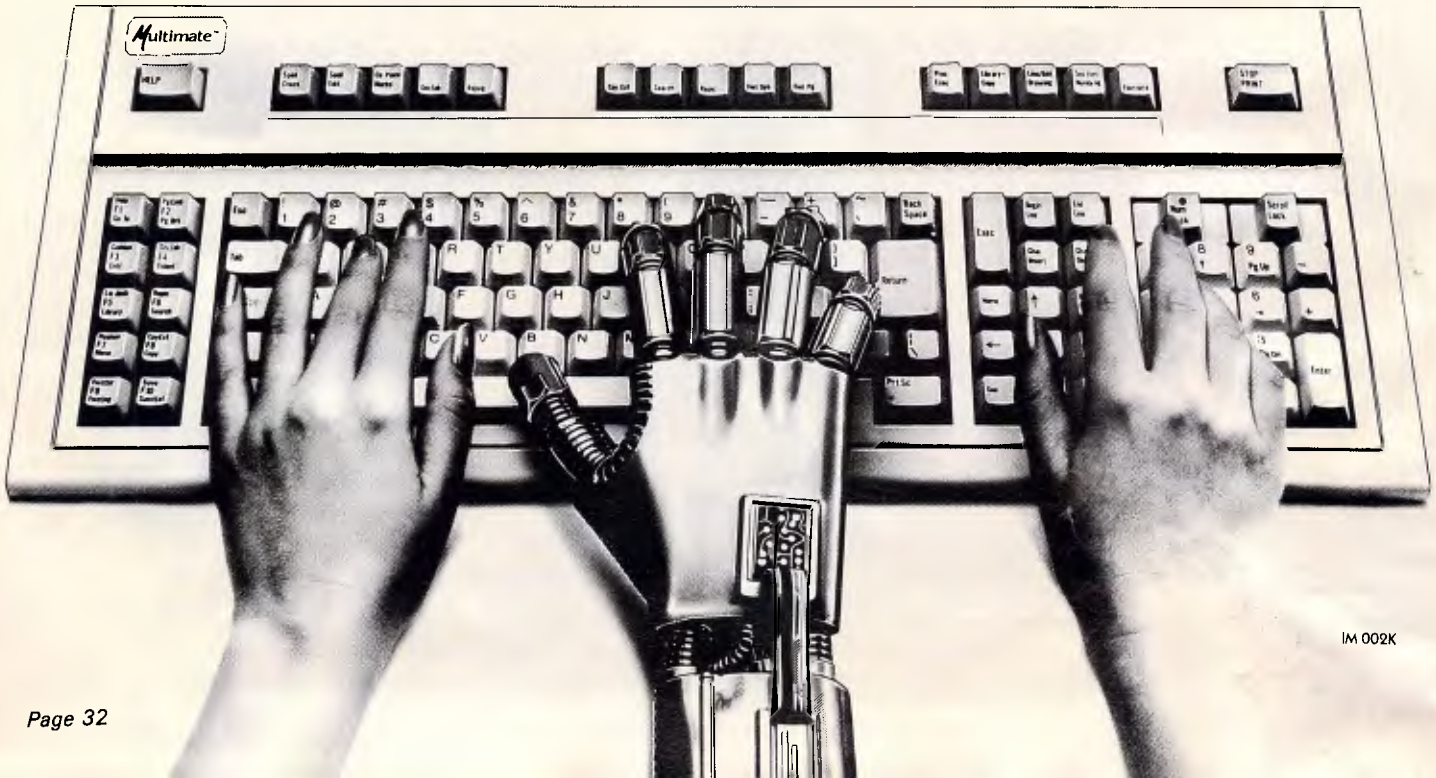

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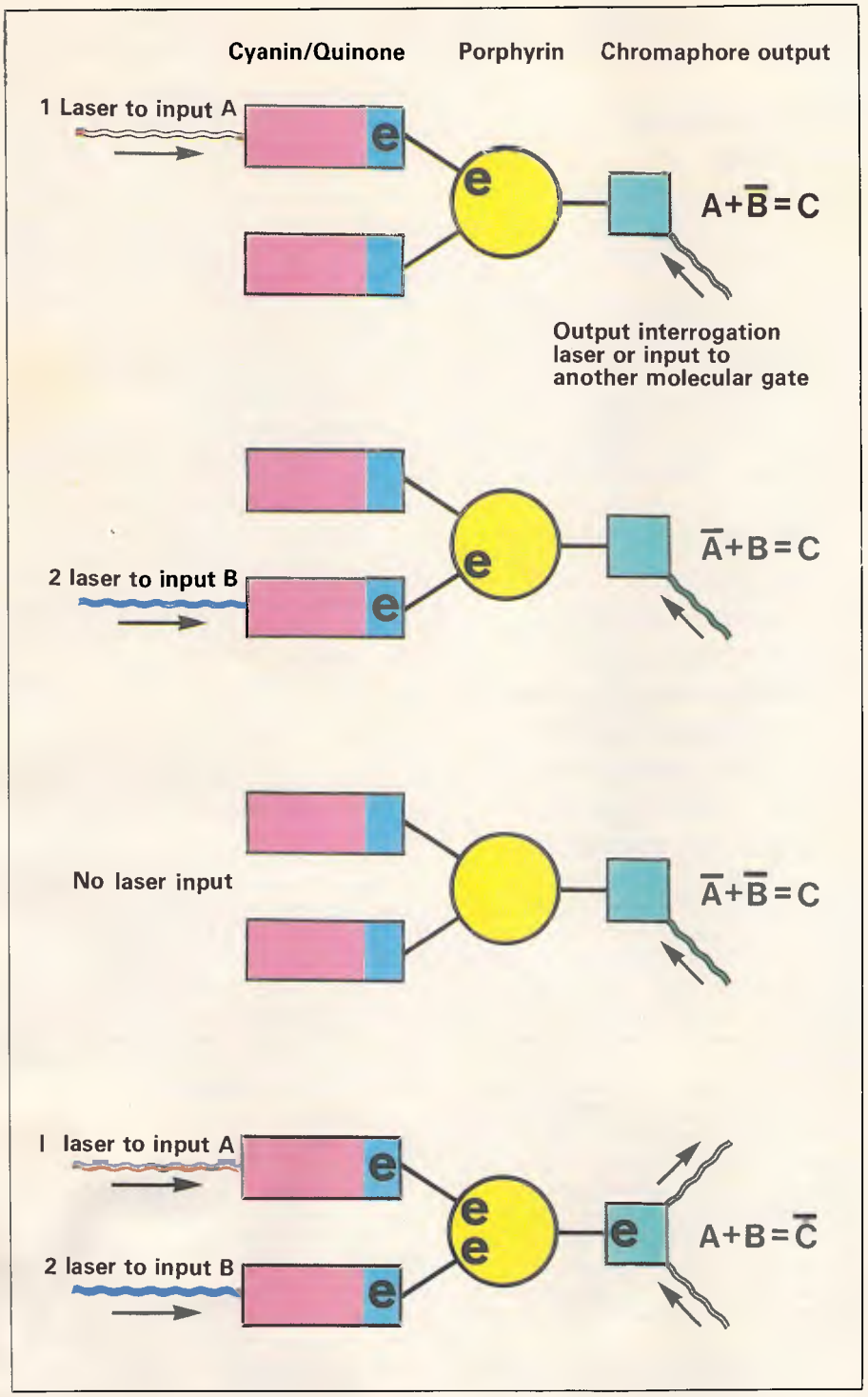

Fig 3 The different input and output states of a molecular NAND gate. Note the two input lasers and the output reference laser. The small 'e' within the molecule denotes the presence of a free electron

one state; and if it's reflected then it's in the other state.

In systems constructed from many gates, the output of one gate will probably be connected to the input of another. Where this occurs there is no need for the ouput chromaphore molecule; neither is there any need for the input cyanine molecule on the gate to which it is connected. There will simply be a direct electron transfer from the ouput of one gate to one of the inputs of the other gate. Where 'wires' are needed to connect two gates, molecules of a polyacetyline organic metal will be used.

One of the major problems in designing the molecule was ensuring that electrons only flow in one direction — it would be useless if electrons were to flow from the output to the inputs. What was needed was a molecular equivalent of a diode. Fortunately, the theoretical work on this problem had been done in 1962 by the Russian scientist Pschenichnov. He proposed a mechanism called electron tunnelling, which allows molecular array only if the electron's energy matches that of each energy barrier within the array. If the electron energy does *not* match, then the periodic molecular array acts as an insulating or sigma barrier. (Pschenichnov's theory was derived from quantum mechanics but was only hypothetical, and was not proved mathematically until 1981).

An electron passing through an electron tunnel can be given the correct energy by the laser input. Only if the laser has the correct frequency will the electron have the necessary energy to pass through the tunnel. Each molecular group within the periodic molecular array that makes up the tunnel has a sigma barrier which not only functions as a one-way valve, but also acts as a delay. The longer the tunnel, the longer it takes for the electron to pass through it. This delay is important in order that device timing can be synchronised: the CMU NAND gate has been designed to have propagation delays of three trillionths of a second. Designing molecules with exactly the right electrical characteristics has required computer modelling of molecular behaviour, and this has been a very important area of development at CMU.

Synthesis

The techniques involved in the synthesis of molecular electronic devices are critical if the technology is to develop beyond the theoretical and computer simulation stage. Even a fairly modest conventional computer will consist of several million NAND gate structures, and the interconnection of these is exceedingly complex — so complex, in fact, that the design of many integrated circuits would be impossible without the use of computer-aided design.

The task of synthesising first the basic NAND gate, and then joining these gates together into a designed structure, makes the task of silicon IC design seem trivial, especially when you consider that molecular devices are three-dimensional structures, unlike their semiconductor counterparts which are strictly two-dimensional.

The success of the CMU group, and one of the major reasons why it is being backed by IBM funding, is its work in molecular electronic synthesis. Dr Johnathan Lindsay has developed a computer-controlled molecular synthesiser which is capable of constructing the complex

molecules which will form the sub-assemblies of any molecular electronic computer.

The synthesiser is based on principles developed in the early 1970s for peptide synthesis, and is known as the Merrifield technique. In this process the base molecule is chemically attached to a small sphere of plastic, and thousands of such spheres are contained in a reaction chamber. A computer and an associated robot are used to add chemicals to this reaction chamber. The computer also controls the temperature, acidity, and so on, and periodically analyses the product to ensure that it is being assembled correctly. Using sequences of chemical reactions, previously calculated using computer simulation, the synthesiser adds new molecules onto the base molecule attached to the plastic sphere. In a process which can take several days the computer will build up very complex molecules, each being an exact copy of the original design held in the computer's memory.

A modular approach is being used in the synthesis process. In the first stage, the different types of molecular gate are synthesised. These gates are then used in the second stage to construct larger assemblies which would roughly correspond to devices such as flip flops, counters, and so on. These sub-assemblies can then be used to construct the final device such as the proposed molecular electronic computer.

The CMU team is intending to use self-organisational processes where possible (self-organisation means that additional components of the molecular assembly will automatically attach themselves to the correct position). Therefore, the product of each reaction will organise itself automatically so that it steers the course of subsequent reactions in a predetermined manner, and will then pack itself in a space-filling manner to fit the substrate on which the system will be built.

Each step in the synthesis requires an exact understanding of the chemical processes and the molecular behaviour. This is impossible without computer simulation and is another area where advances are being made by CMU. Work by John Pople, has allowed the team to run computer simulations of the proposed devices. Such simulation is, however, not easy, since it involves a very large number of variables all acting on each other simultaneously and can quite easily absorb the full power of the most powerful supercomputer. Simulation of even the larger components of the molecular computer will require the new fifth generation computers now being developed. Fifth generation machines running artificial intelligence will also be required to control the large-scale synthesis.

The molecular computer

Any usable computer system must have data inputs and outputs, plus the timing control pulses necessary to synchronise the system's operation. In a molecular computer, all these connections to the computer are made by means of modulated beams of laser light. The molecules can be designed to be sensitive to only one particular frequency or colour of light, therefore the molecule will not confuse the ouput interrogation laser with an input. Similarly each of the two inputs to a gate can be different-frequency laser beams, thereby separating the two input lines. This is important, since the molecule is so small that it would be impossible to directly focus a beam of light onto any one particular portion of the molecule.

'The fifth generation computers . . . with their parallel architectures and artificial intelligence software, are an essential prerequisite to the production of a molecular computer.'

In a workable molecular computer there will be many inputs and outputs to the system, each consisting of a modulated beam of light shining onto a particular portion of the very complex interconnected molecular structure. To work properly, the orientation of the molecular computer will have to register exactly with the optical connections so that these are focused onto the correct input and ouput molecules.

This is no easy task, and can certainly not be performed by any mechanical means since the scale of the structure is too small. The only way to do it is to use the same kind of self-organising chemical process used in the construction of the molecular computer.

The interface consists of a substrate on which the various optical I/O connections are positioned. This substrate could be made from either an organic compound such as a plastic or from a metal. The optical connections in the form of microscopic light guides on the surface of the substrate would be fabricated by the photolithographic processes used to manufacture conventional integrated circuits.

The position of the optical I/O connectors would be determined by the computer simulation of the shape of the assembled molecular device. However, it would be unlikely that all the I/O molecules would directly come into contact with the substrate because the molecular structure would be three-dimensional and the substrate two-dimensional. It would also be very difficult to ensure that the orientation of the molecular device was correct to properly register with the optical I/O connectors.

The solution to the problem is to give the substrate a three-dimensional shape so that it will lock into the molecular device in much the same manner as the way the pieces of a jigsaw puzzle will only fit together in one particular way. The three-dimensional structure would be built up using organic molecules attached to the substrate by means of a laser catalyst.

Once assembled onto the substrate with its optical I/O connected, the molecular device would be mounted in a cryogenic chamber chilled with liquid nitrogen produced by a miniature cryo-generator. Although molecular electronic devices could work at normal temperatures, their efficiency and life are greatly increased by operating at low temperatures. At such low temperatures the molecular structure is frozen, and electrons moving within the structure will encounter little resistance since the system is almost in a superconducting state. This means that the amount of energy required by a molecular computer will be virtually negligible.

Applications

The development of molecular electronics is being taken very seriously by IBM — it has dropped the development of Josephson junction technology in favour of molecular electronics. Industry observers have estimated that IBM is currently spending about $5 million per year on research into molecular electronics and has made it one of the central components of its long-range research. IBM is not alone in its interest in this technology: the US Defence Department is investing heavily in research, as are several other American high-technology companies, and in Japan Sony is known to already have a team working in this area.

The CMU team in association with IBM have a lead in the development of this technology, and have set themselves the goal of producing a thousand-gate device by the end of the decade. If the technology

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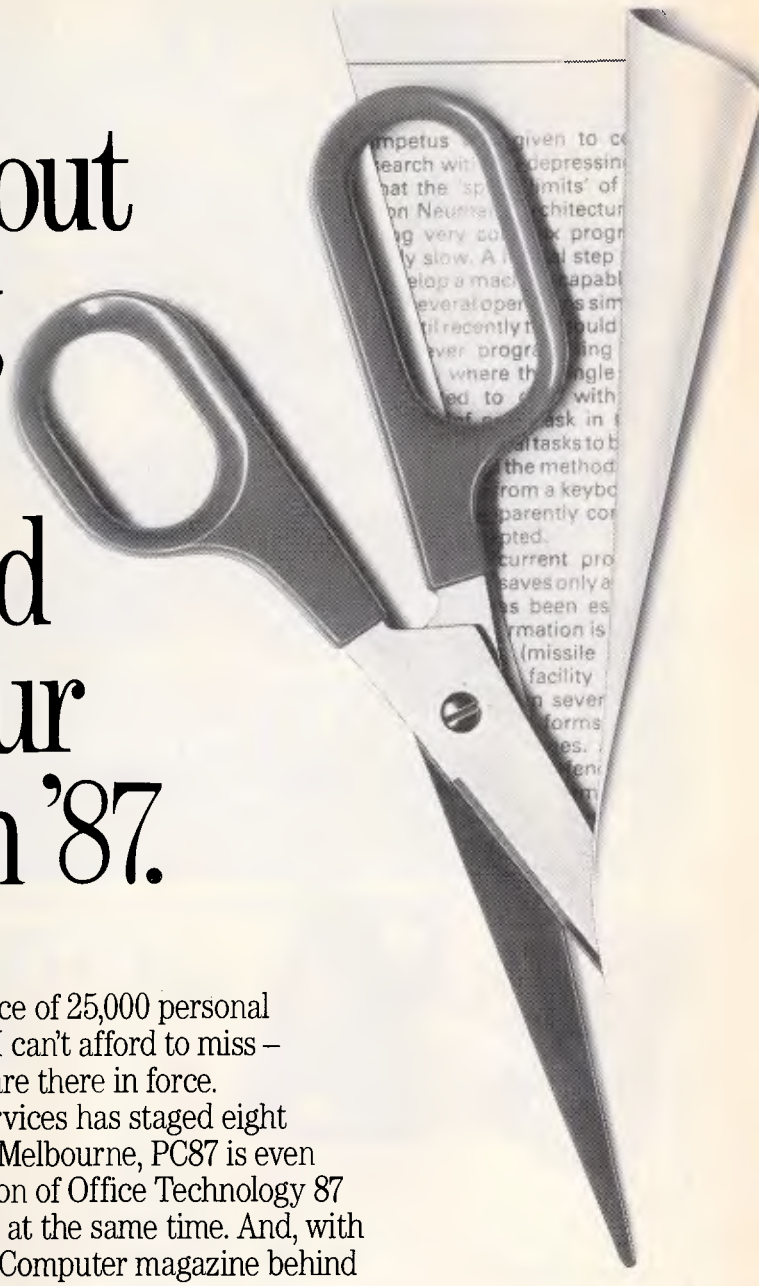

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can be advanced in accordance with this time schedule, and bearing in mind the time taken for comparable advances in semiconductor technology, then we should see the laboratory demonstration of a working molecular computer in the mid 1990s. Commercial products should follow about four or five years later.

The architecture of molecular computers will probably bear little relationship to that of their semiconductor equivalents. They will probably be highly parallel machines with each processor having a small instruction set and a large number of inter-processor communications. The richness of interconnections between processors would not be as constrained as that of a similar semiconductor system, due to the three-dimensional structure of a molecular computer. In addition, since all processors should be contained within the same molecular assembly, the limitations normally imposed by packaging and interconnection would be absent.

Another difference between the proposed molecular computers and their fifth and sixth generation semiconductor counterparts lies in the organisation of the system's memory. Both RAM and ROM-type devices can be assembled using molecular components and, because of the very high component density, there is no reason why the system should not benefit from very large quantities of memory — a gigabyte or more would not be impractical. The three-dimensional structure of molecular computers will give designers the added potential benefit of not being tied to using conventional storage location addressed memory structures. It would be feasible to implement large contents-addressable memories or neural network-type memory systems, both of which would be an enormous aid to the development of advanced artificial intelligence software.

The fifth generation computers currently being designed, with their parallel architectures and artificial intelligence software, are an essential prerequisite to the production of a molecular computer which will belong to the sixth generation. Fifth generation supercomputers will be required to design the molecular computer and will also be needed to develop the software which will run on the molecular computer. It is unlikely that the lower-level operation of a molecular computer will be accessible to programmers since it will probably be designed with built-in, general-purpose, artificial intelligence. This would accept programs in a conceptual form rather than the strictly logical form currently used. It would then build onto and modify the conceptual model using its existing database and data acquired from on-going experience. It would thus be a direct descendant of the rather primitive expert systems in use today.

The application of molecular electronics will also open up a whole range of new technologies. The sensitivity of molecular electronic devices to light will allow scientists to create new classes of intelligent image sensors which will more closely resemble the human eye in function than a conventional TV-type image sensor. Indeed, it has been proposed that it may be possible to create molecular electronic image sensors which would act as a medical implant capable of restoring a kind of vision to the blind. A molecular electronic vision prosthesis has the added advantage that since it is constructed from organic molecules, it should be far easier for doctors to connect to existing nerve cells. In fact, molecular electronics could give doctors a whole new range of neural prosthetic devices.

'The CMU team in association with IBM have a lead in the development of this technology, and have set themselves the goal of producing a thousand-gate device by the end of the decade.'

Molecular electronics devices could also be employed as chemical sensors. In this kind of application the molecular system would have numerous inputs, each of which would be designed to be responsive to one particular type of molecule and *only* that molecule. This input selectivity would be achieved by making the input molecule's shape conform to that of the target molecule so that the two lock into each other and thereby produce an input. This kind of device could find a considerable number of applications — for example, in environmental monitoring, industry and medicine.

A possible medical application for such a chemical sensor would be an implantable body function monitor. This would be capable of detecting any chemical imbalance in the body brought about by illness and advising on the course of action necessary to alleviate it.

Molecular electronics devices are not only sensitive to light, they can also be made to *produce* light. The very small size of molecular devices means that very high-density displays could be produced. By changing the molecular design, it would be possible to output different colours. Displays produced using molecular electronic devices could be the conventional two-dimensional type or a true three-dimensional display. This could be created by arranging the molecules in a three-dimensional matrix, using an optically transparent medium to support the molecular structure.

Conclusion

Molecular electronics is a technology born from the merger of biochemistry with microelectronics, and offers the potential of a quantum advance comparable to that of the development of the transistor. This article is just a brief summary of the advances in molecular electronics being made now, and some ideas for the future.

Most of the technology described in this article is theoretical, since the scientists at CMU have only just succeeded in demonstrating the components of a simple molecular gate. However, the demonstration of this gate is an enormous achievement and should open the doors for a flood of new developments.

Molecular electronics is a technology which still needs an enormous research and development effort to bring much of its potential to fruition. This potential has been recognised and the funding for that R&D effort is now forthcoming. The results of this research effort will probably be more wide-reaching than we can at the moment imagine. END

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IBM PC/RT

The IBM PC/RT is a 32-bit RISC machine which is fast and responsive in single-user mode. But what does it offer that can't be achieved with a Unix multi-user/AT-clone single-user combination? Peter Jackson assesses where its future lies — as a fully-fledged member of the PC family, or as an office-departmental unit.

It's easy to forget, as the analysts pick over the entrails of the XT286 and count how many PC386s can dance on the head of a pin, that IBM is already selling a 32-bit PC.

True, those same anaylsts would deny that the PC/RT is part of the mainstream PC line. But it does have a high-performance 32-bit microprocessor, it does run PC software with a bit of assistance, it does accept standard expansion cards, it does have its basis in an industry-standard operating system — and in one of its incarnations it does come in an AT-style casing and sits on a desktop.

Indeed, if the PC/RT had originally come from IBM's PC division, and if Intel's 32-bit, PC-compatible 80386 microprocessor had been as late and unreliable as the 80286, then the RT would certainly have taken its place in the PC range — despite its non-standard reduced instruction set (RISC) hardware — as the top-end multi-user Unix system. And even though history cannot be rewritten now, the recently enhanced PC/RT is an interesting machine in its own right. With the benefit of hindsight, IBM got it very, very nearly right.

RISC and ROMP

The 'RT' refers to 'RISC Technology', where RISC itself stands for Reduced Instruction Set Computers. Recent RISC developments have been thoroughly described elsewhere, notably in Dick Pountain's excellent introduction to the subject (*APC*, December 1985) and in Hewlett-Packard's background papers to its own RISC project, and do not need extensive rehearsal here.

But put simply, the goal of RISC is faster data processing achieved by cutting down the number of instructions that need to be built into the basic set of a microprocessor. The advantages are smaller processor chips, since they need less on-chip storage for the instruction set; faster signal transfer between devices, thanks to the smaller chip size; and faster instruction execution since the reduced set is designed so that most instructions execute in a single clock cycle.

RISC technology has been a matter for academic discussion for some time, but it's worth taking a brief look at the thinking behind RISC-building from the IBM angle since the engine at the heart of the RT machine is a RISC processor called ROMP — the Research OPD MicroProcessor.

The final acronym, OPD, stands for IBM's Office Products Division, in whose Texas labs the ROMP project started in 1977. A new design was started because it seemed unlikely that any of the mass-market chip makers could come up with a viable 32-bit microprocessor in time to drive the next generation of office systems that was obviously coming, and IBM has never had any qualms about using its own processor designs except for the PC line.

No surprises here — the RT's standard IBM keyboard

In fact, the ROMP was developed in parallel with another IBM RISC design, the 801 minicomputer. Both chips had the same goals: fast execution speeds, high throughput, and architectures tailored specifically for programming in a high-level language rather than in machine code. The language in question was to be PL.8, an enhancement of the old mainframe PL/I, which was also under development to drive the 801 project.

The two designs changed side by side, since the ROMP was meant to be fully compatible with PL.8. For example, when the 801 design moved up from 24-bit processing to full 32-bit, the ROMP had to follow suit.

But in the end the ROMP and the 801 diverged because of cost and performance criteria, and the ROMP ended up with a mix of 16-bit and 32-bit instructions rather than the 801's complete 32-bit set; 16 registers instead of the 801's 32; and a performance of around 1.5 to 2.1 million instructions per second (mips). For comparison the Intel 80386 chip claims to run at around four mips — but remember that the ROMP was running in prototype form in 1978.

The final reduced instruction set of the ROMP holds 118 instructions, more than the 70 or so instructions of later RISC designs like the Inmos Transputer.

Other design changes included the switching of the ROMP's memory management unit (MMU) functions to a separate chip, since there was just not room for a processor and an MMU on one. Still, when the time came to design a 32-bit workstation, the ROMP/MMU combination was ready. The problem was that the PC had taken off by then, and the ROMP, despite its performance, was not compatible with the 8088/8086/80286 processor family. If the new machine was to be anywhere close to the rest of IBM's PC family, then some careful system architecture work needed to be done. It was, and the results can be seen in the RT.

System architecture

In effect, IBM was faced with the same problem that Compaq ran into when it decided to build the DeskPro 386 (see review in *APC*, November 1986). There was a fast, new processor to use in a new design, but it had to be used in such a way that existing software and hardware add-ons could be used with the finished machine.

With similar problems in front of them it's not entirely surprising that both companies came up with similar approaches, although it's tempting to speculate that information could have leaked from OPD's labs over the long development cycle of the RT. Like the DeskPro 386, the RT is really two machines in one. The ROMP/MMU combination and the fast, 32-bit system memory boards form the 32-bit side of the theoretical barrier; on the other side, the RT looks and acts a lot like a PC/AT.

The way across the barrier in the RT is an I/O Channel Converter, or IOCC, that sits between the 32-bit processor bus and a PC-compatible, 16-bit bus holding the familiar PC-standard expansion slots.

Even with the standard bus, though, there's a problem with making the RT run PC software and MS-DOS — the processor incompatibility. IBM's designers got around this simply by building a PC-sized expansion card holding an Intel 80286, and designed to fit in one of the AT-compatible slots of the RT.

This co-processor board was designed to allow PC software to run on the RT as if it were an AT, but also needed to include hardware to protect the host machine from the various 'ill-behaved' PC applications when system resources like main RAM were being shared between two processors (more on the practicalities of this later).

But, in essence, the RT is intended, like the Compaq 386, to accept PC expansion boards and displays, run PC software (in its co-processor with the advantage of fast RAM), and take advantage of full 32-bit applications software as soon as it's been written. Even the intended 32-bit operating system that will control these applications, a version of Unix, is the same in both cases. The difference is that IBM wants the applications in ROMP code instead of 32-bit 80386 code. It will be interesting to see how the software industry commits itself, or fails to commit itself, to one camp or the other.

Hardware

The RT range has two models — the floor-standing 6150 and the desktop 6151, and the differences between them lie in some of the I/O ports and in the storage options available.

The review machine was a 6150, and looked more like one of IBM's bigger System/36 minicomputers than like any member of the PC range. About the size of an AT stood on one end, the box has an almost featureless front panel with a floppy disk drive mounted horizontally at the very top, and a barrel lock and a two-digit digital display about halfway down. Those are all the features there are; the action all goes on internally or in the peripheral devices.

The barrel lock needs to be opened as a first step to getting into the system unit, a security feature that should perhaps be extended to other PCs where protecting plug-in circuit boards and hard disks is more important these days than stopping someone using the keyboard. When that has been done it's simple to remove the entire side panel which would, in a conventional desktop PC, be the top.

Removing the panel reveals that the 6150 has a lot in common with the rest of the PC range; it, too, has a motherboard and an array of expansion slots, although here the physical arrangement is somewhat different. At the bottom of the case the motherboard has four 32-bit expansion slots to hold the ROMP/MMU board, an optional floating-point accelerator board built around the National Semiconductor NS32081 maths chip originally developed to work with the NS32032 32-bit microprocessor, and the system memory boards. Up to two RAM boards, giving a maximum RAM capacity of 4Mbytes, can be fitted in the two slots although the architecture can handle, in theory, up to 16Mbytes. As 1Mbit chip prices fall, and they are used to replace the cheap 256bit chips used on the system memory boards, that 16Mbyte maximum will be reached on the two boards.

Above the 32-bit slots are two 8-bit, PC-style slots and six AT-style, 16-bit slots, all designed to take standard, PC-compatible, plug-in cards. But by no means all of these are free in the minimum configuration. One of them has to take a display adaptor to drive the system monitor; one of them has to be the AT's Winchester and floppy disk controller board, to handle the 6150's mass storage; one of them takes the 80286 co-processor board if fitted; one of them has to provide the parallel printer port if required; and other boards may be necessary, depending on the number of external terminals that will be fitted.

'The recently enhanced PC/RT is an interesting machine in its own right. With the benefit of hindsight, IBM got it very, very nearly right'.

Things are even worse on the desktop 6151, since there the two serial ports provided on the 6150 motherboard are missing and another plug-in adaptor is needed for those vital interfaces. On both versions, though, the keyboard and mouse interfaces, along with the speaker output, are provided on the motherboard.

Because of the wide variety of optional extras, it's hard to define exactly how many slots will be required for any particular configuration. But the review machine, with 3Mbytes of RAM, two 40Mbyte Winchester drives, a single 1.2Mbyte floppy drive, one external terminal, a parallel printer port, a co-processor board, an interface board for a tape streamer, and a console display adaptor, filled three 32-bit slots and five of the eight PC-style slots.

Above the motherboard and its plug-ins is the modular power supply, and above that is the mass storage section with room for up to three horizontally-mounted, full-height Winchester drives and two half height floppies. The standard configurations of the 6150, the Model 20 and the Model 25, have a single 40Mbyte Winchester and a single 70Mbyte Winchester respectively, both with a single 1.2Mbyte floppy unit. The other Winchesters can be either 40 or 70Mbyte units, giving a maximum capacity of 210Mbytes inside the box, while the other floppy drive can hold either 360k or 1.2Mbytes for PC or AT compatibility.

And if that amount of storage is not enough, two SCSI controllers can be fitted in the PC expansion slots to connect up to 14 external hard disk drives holding up to 400Mbytes each, giving a maximum additional disk capacity of 5.6 gigabytes without any CD-ROM assistance.

All of which is a little ironic; the original OPD design specification for the RT suggested that it should be a floppy-only machine, and later designs incorporated hard disks holding only 10 or 20Mbytes each. Within the lifetime of this supposedly 'new' product, technology has driven the maximum available disk space up by a factor of around 90.

The type of console screen depends on the application required. Three new display adaptors and monitors have been produced for the RT, all offering what IBM calls All Points Addressable (APA) displays and what everyone else calls bit-mapped screen. The first adaptor, the 6153, drives a 12in black-and-white monochrome display with a resolution of 720 × 512; the second, an extension of this called the 6154, adds 16 colours from a palette of 64 and drives a 14in monitor; and the third gives a monochrome display of 1024 × 768 dots on a 15in monitor. The first two adaptors give a text resolution of 80 × 25 using the IBM standard 20 × 9 character set, while the third gives 38 lines of 113 characters, each using the same set size.

Of course, any standard PC screen can be attached to the RT using a plug-in monochrome or colour graphics board, but this is only accessible to the 80286 co-processor if fitted, and only then if there's no addressing conflict with the ROMP-controlled displays. Otherwise the co-processor shares the system screen with the ROMP, using the ROMP's extra speed to emulate PC-compatible graphics on its higher-resolution screen.

A variety of standard ASCII terminals can be plugged into the RT using the motherboard's serial ports or a plug-in, four port RS232 or RS422 adaptor, including the IBM 3101, the DEC VT100 and the VT220, and any IBM PC model using a communication board and terminal emulation software. The review machine had a single IBM 3161 terminal.

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Like a lot of IBM equipment, the general air of the RT is one of utility. Inside the box there are few concessions to elegance or attractive design, and the IBM custom boards — like the ROMP/MMU and system RAM modules — are solidly built, but with more attention paid to what's on them than what they look like.

It's hard to explain, but the RT with its case open looks more like a university research lab's electronics system than a piece of office equipment. That's not to run it down since there's no doubt that IBM builds reliable and solid machines, but is just a personal impression.

System software

The RT's native operating system for the ROMP/MMU is called AIX, standing for Advanced Interactive eXecutive, but is more familiar than it sounds. In fact it's just our old friend Unix System V with most of the Berkeley 4.2 enhancements, and with quite a bit of IBM tailoring for the RT environment.

In particular, the tailoring involved the construction of a software Virtual Resource Manager (VRM) for the RT to handle the interface between the Unix kernel and the real hardware it runs on. The VRM was designed to give AIX some virtual memory management help as well as handle the co-processor, disk drives, I/O devices including terminals, and communications over things like IBM's Systems Network Architecture (SNA).

Although the RT's rather unattractive floor-standing system box may look out of place in the IBM range, internally it has a lot in common with IBM's other PCs

The reason for this approach was mainly that the RISC architecture, by its very nature, has minimal special-purpose hardware, and requires software help to do things like integer multiply and divide and string manipulation. This would normally be an operating system problem, but by providing the VRM — like the ROM toolboxes of the Macintosh or the Atari ST's GEM — the RT can accept calls from the operating system at a high, hardware-independent level.

On top of that, the VRM also makes it easier to install different I/O devices without the usual operating system crises. The specification for the new device can be installed in the VRM while it is running, and the right program called and run when the I/O device's particular interrupt arrives, without disrupting the normal running of the RT.

In the future IBM expects the VRM implementation to allow multiple operating systems to run concurrently on the RT, just as future versions of Unix will allow on the 80386. And IBM at least has an example of that on the RT, since the 80286 co-processor and the ROMP can happily process data side by side with the assistance of the VRM.

The virtual memory interface, giving access to up to 1024 gigabytes of virtual memory, is also put in the VRM to provide a standard, high-level interface to the AIX kernel or any other operating system running on the machine.

Changes have naturally been necessary to tune the AIX Unix kernel to the VRM/ROMP/MMU environment. For instance, the kernel has had to be tailored for virtual memory operation and to run on the ROMP without any bottlenecks. But as far as the user is concerned, the major changes are all to do with ease of use and ease of system management, always a problem with Unix.

Even IBM admits that Unix was not designed for use in its target market for the RT, running on a single-user, multi-tasking workstation using a bit-mapped display, and that changes had to be made in the user interface.

For example, most big timesharing Unix systems have a system manager whose job it is to configure the system and keep track of the various users and what they are doing, allocating priorities and controlling which users have access to which files and programs. In AIX, IBM has tried to get round that by adding a set of menu-driven configuration routines that can be handled by the end-user. The

The RT's three new display adaptors and monitors offer bit-mapped screens (shown is the 12in monochrome display), but any standard PC screen can be attached using a plug-in board

'vrmconfig' program is used as described earlier, to add devices to the system dynamically; the 'devices' program lets the user enter the device data for the devices attached to the system in as simple a way as possible; the 'minidisks' program, like MS-DOS' FDISK, allows the system's disk drives to be partitioned; and 'installp' helps to get new applications programs running, automatically installing the new device drivers if required.

On top of that there are other user-friendly front-end packages. A 'DOS shell' is provided for users familiar with MS-DOS, giving the standard A> prompts and directory display, and accepting all the usual MS-DOS commands — including batch files and hierarchical directory handling — by translating them automatically into their Unix equivalents. And a new mouse-driven package called Usability has been designed to let users control the system in a simple way.

The problem with Usability is that it must run on the terminals attached to the RT as well as on the bit-mapped system console, so there's no way of making it into a Macintosh-style window and icon system. Instead, the mouse is used to select items from a menu and then to select an action from a Lotus-style menu at the top of each screen. Pop-up windows, like those provided in SideKick, are used to provide extra option menus once an action has been selected with the mouse.

Attempts have also been made to simplify the use of the co-processor to run PC software. Typing *pcstart* at the Unix prompt initialises the co-processor board and loads MS-DOS, using either the system console or a PC display using a separate plug-in adaptor, and typing

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In perspective

IBM is trying to differentiate the RT from the PC line, partly so that it can pick and choose the upmarket dealers it wants to sell the machine. Systems houses with Unix expertise and a need for a user configurable machine with some MS-DOS compatibility should be tempted. But the price is high compared with some of the AT add-ons that give multi-user Unix a chance on that machine, and with the Compaq DeskPro 386 running Xenix.

There's a feeling that the RT might move even further away from the PC, back into the office or departmental computer market, and leave the PC multi-user business to IBM's new machines.

For now, the competition from 68020 and 80386 machines will be stiff.

Technical specifications

Processor:	32-bit reduced instruction set ROMP; 80286 co-processor optional
RAM:	1Mbyte minimum, 4Mbyte maximum
Mass storage:	Up to three 40Mbyte or 70Mbyte Winchesters; one 1.2Mbyte floppy; one optional 1.2 Mbyte or 360k floppy
Expansion slots:	Four 32-bit, six 16-bit, two 8-bit; various combinations left free
I/O:	Two serial ports (6150 only); two-button mouse; enhanced system keyboard
Display:	One of three bit-mapped screens with 720 x 512 dots in monochrome or 16 colours; or 1024 x 768 dots in monochrome; optional PC displays for co-processor
System software:	AIX, with MS-DOS 3.2 for co-processor

exit in MS-DOS returns the user to the AIX prompt. Of course, the PC software can't be run on any of the terminals attached to the RT.

Applications software

Although IBM issues a booklet showing more than 150 applications for the RT, most of these are languages or graphics packages and only three business applications are officially supported by IBM on the machine. These are: Samna+, a word processor that is not entirely satisfactory in a multi-user environment since it has no record locking to prevent multiple access to a single file; an integrated package called Applix, with limited word processing, spreadsheet, database, graphics and communications modules; and the Interleaf desktop publishing system, driving IBM's LED-driven page printer.

However, other business applications are currently being ported to the RT.

In use

There's no doubt that in its single-user mode, the RT is a fast and responsive Unix machine. However, there are drawbacks to the system thanks to its background as a single-user workstation. Any graphics-based program like Interleaf, and any PC software apart from the rare text-only ones, will only run on the system console and not on any of the terminals. Similarly, the 80286 co-processor board can only be accessed using the system console and the keyboard attached to the motherboard.

The screen display on the system console is black on white, and with the text display operating it looks like nothing so much as the Macintosh during communication with some text-based remote computer. In this environment Usability, thanks to its limitations for terminal operation, is almost unusable and cumbersome; using the mouse to select a menu item and then going up to the top of the screen to select an action is much slower than typing a number to select a menu item and then hitting Return.

The DOS shell works as advertised and certainly eases the pain of Unix by creating a familiar PC environment, while the co-processor really does appear to run PC applications on the system console while the ROMP is running Unix programs on the other terminals. But if MS-DOS is what you want, then the RT is an expensive way to get it. And if Unix is

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what you want, then there are cheaper ways to do that too unless you want one bit-mapped terminal for a specific purpose.

Having said all that, as a single-user machine running a tailored application, the RT is impressive. This is particularly true of Interleaf, a desktop publishing package that uses the bit-mapped console to provide a full Smalltalk-like windows and icons environment, with pop-up menus and crystal-clear fonts and graphics. But that is a single-user application only, and could be done just as well on a machine like Xerox's Documenter, or even a Macintosh with an add-on full-page display, cheaper than the RT can do it.

Documentation

The usual standard of copious IBM documentation prevails and includes two AIX manuals.

Price

A 6150 with 1 Mbyte of RAM, 1.2 Mbyte floppy drive, a 40 Mbyte hard disk, a 12in mono screen, a keyboard, a mouse and the AIX operating system costs $30,401.

A 6150 with 4 Mbytes of RAM, three 70 Mbyte hard disks, a tape streamer, a 12in mono screen, a mouse, a keyboard and four ASCII terminals costs $44,512.

Conclusion

IBM has worked hard to adapt its RISC technology to a market-place shaped by the PC architecture, and has gone a long way towards fitting a fundamentally-incompatible Unix box into its PC line.

But it's hard to see what you get with the RT that you can't get by combining any other Unix box to run multi-user applications, with a cheap AT clone to run single-user PC applications.

The RT system is a powerful, clever machine that gets round its design problems just as Compaq's DeskPro 386 does. Whether that's adaquate for the market-place, with IBM's own equally-powerful 80386 machine on the stocks, is another matter.

There's one firm conclusion to be drawn from the RT, though. After all this work, it's unlikely that Unix will be dropped entirely from the IBM PC range, whatever moves the company may make towards proprietary operating systems.

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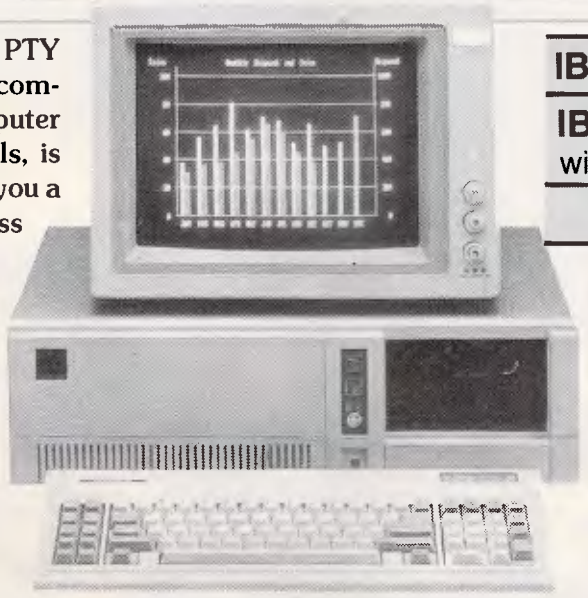

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Marc Arundale

The speed trap

Standardisation rears its ugly head, as Martin Banks ponders a low-cost, multi-speed proposal for smooth communications between low and high-speed devices.

I'm not entirely sure that I like surprises. They can be fun, it's true, but they can so often be nasty little things that sneak up behind you when you're not looking and jab their fingers viciously into your ribs when you least expect it. Letters can be like that.

Sometimes one of them can prove treacherous and do something nasty like set me thinking.

One of these treacherous surprises came the other week and set the synapses crawling around in an unnerving fashion. It was from a company called Neutral, and was a draft proposal for a low-cost local area network.

What stopped its journey to the bin was a bit that I had failed to read the first time through. This was the statement 'multi-speed', a statement that had the unfortunate effect of making me think.

Neutral, out of an apparent sense of pure altruism, wants to see its propsals as widely accepted as possible.

It takes not too much observation to see that the current status of the Local Area Network (LAN) business is something of a dog's breakfast. There are nearly as many different types of LAN as there are manufacturers producing them, and even where systems are supposedly the same, such as with Ethernet, they are often, in practice, quite different from each other.

The problem with any differences, as pointed out by Neutral, is the fact that the LANs are all very fussy about what you hang on them. For example, get a nice, tidy network of PC/XT's all working happily together on something or other and then stick a shiny, new PC/AT in as a workstation. The effect — not always, but quite often — will be the creation of some interesting problems caused by the different operating speeds of the machines.

Yet, as Neutral points out indirectly in its draft proposal, the use of these different machines is made possible by simply plugging them, willy nilly, into the same, standard, electrical sockets. Wouldn't it be nice, says Neutral, if we could all do the same with networks and the information accessible therefrom?

It was this simple statement that got the grey matter moving that morning. It would indeed be nice, thought I, if it were possible to take any system of any operating speed and plug it into a standard type of socket and get communicating. It would certainly be a potential boon to the smaller network users, who perhaps don't have the financial clout to specify all the expensive bits and pieces needed to make a single-standard network operate. For them, the ability to link together the most cost-effective devices, regardless of their speed, could be very useful.

'It would indeed be nice if it were possible to take any system of any operating speed and plug it into a standard type of socket and get communicating.'

I have no way f knowing whether the Neutral proposal is the best solution for this task. It is, however, worth an airing, for I do feel that this is an area of that thorny subject, known as standardisation, where the advantages of commonality far outweigh any restrictions on technological development.

The Neutral proposal is based on the RS485 standard for multi-drop communications. The idea is for a bus-based system using RS485 based around six-way connectors. These would link two or three twisted cable pairs, with one of the pairs running a balanced clock. This is important, because it is this that will allow slow-speed devices to communicate with high-speed ones.

According to Neutral, the system would indeed be low-cost as the key component would be a single-chip, serial, communications controller. This means an interface card for a PC would cost as little as $100 (built-in, the system could cost as little as $20). The wall sockets cost around $8, and connector cables could be made for around $6 each. The hand tool needed for this costs $10.

This means that devices could be added to a network for $120 maximum. Yet this would in practice be less, for though the maximum number of nodes per segment allowed is 32, it is quite permissible to connect in more wall sockets than that, allowing users to put in any one of their 32 devices of the most convenient point between the job in hand and a wall socket.

And this would work using an interesting little trick called Dynamic Node ID. The interface, once plugged into the network, would simply start sending out questions . . . is anything Number One? This questioning is continued in numerical sequence until there is no affirmative answer. The unit then adopts that node number as its own. Physically, it doesn't matter where it sits.

The important part of this system is the multi-speed aspect. Neutral's suggestion is a minimum speed of 250kbits per second with a maximum frame size of 64k. The maximum speed allowed under RS485 is 10Mbits per second, but most high-speed devices can be made to run at slower speeds.

High-speed systems will be able to talk to slower ones, therefore, by enquiring of the recipient what speed it runs at and working accordingly. The reverse — slow systems communicating with fast ones — will be automatically controlled by the clock lines of the network.

I can't help feeling it's to the credit of Neutral that it has offered its proposal to anyone who wants to contribute to the idea. The company isn't saying that it has the best or only suggestion, only that something of this sort is needed, and needed soon. I can't help but agree.

END

Defeating the object

Object-orientated programming is where objects communicate by sending and receiving messages. Carl Phillips gives a detailed explanation of the method, with particular reference to PARC's Smalltalk.

Writing a large computer program is hard work; writing a large computer program that works is even harder. As programs get larger they get more and more complex, and part of the reason for this is that different parts of a program come to depend on the other parts. It's a little like building a house out of playing cards: things start out OK, but pretty soon adding new cards or making changes becomes a difficult exercise.

Most programmers are familiar with the ideas of 'structured programming' embodied in languages such as Pascal or C. Structured programming techniques are an attempt to control the complexity inherent in large programs by building barriers between different parts of a program. These barriers are designed to hide the details of how part of a program works, from the other parts. Unfortunately, barriers built using structured programming have a problem — they tend to leak, revealing more than they should about the inner workings. As a result, structured programming techniques are only a partial success.

Object-orientated programming is a set of ideas and techniques for building large computer programs that *work*. By using object-orientated programming techniques, water-tight barriers are built automatically between all parts of a program.

The benefits are substantial: programs that would be hopelessly complex using conventional techniques can be straightforwardly programmed; software development time is reduced; changes are much easier to make; and the resulting software is much more flexible. Since object-orientated programming absolutely minimises the number of assumptions different parts of a program make about each other, re-using part of a program written for one application in another application is easy.

The ideas behind object-orientated programming first appeared during the 1960s. The programming language Simula was designed as an extension to Algol 60 by Kristen Nygaard and Ole-Johan Dahl at the Norwegian Computing Centre, to allow easy modelling and simulation of real-world phenomena. The ideas were developed and extended by Alan Kay at the famous Xerox Palo Alto Research Centre (PARC) during the 1970s. The PARC researchers developed the seminal Smalltalk programming environment which is still the standard by which all other object-orientated languages are judged.

This article uses Smalltalk terminology to introduce the ideas behind object-orientated programming. Differences do exist in the terms used by other object-orientated languages, but the fundamental ideas of object, message, method, class and inheritance remain the same.

Objects & messages

The basic building blocks of object-orientated software systems are called,

Object-orientated programming terminology

Object: the basic building blocks of object-orientated programming. An object consists of a set of variables and procedures (called methods) that cannot be accessed directly from outside the object. Objects can be thought of as small, specialist computers with some memory — the variables — plus a set of operations — the methods — that can access the memory.

For example, objects which represent integer quantities would have a variable storing their current value plus methods for basic arithmetic — add, subtract, multiply and divide (among others). Objects representing rectangles could have two variables, storing-point objects, plus methods for drawing the rectangle, calculating its area, or moving it.

The number of variables, plus the set of methods an object can respond to, depends on the class of the object. To get an object to do something, you have to send the object a message.

Message: a request that an object perform some operation by calling its methods. The object is free to choose how to respond to the message. Sending the message 'draw' to an object of class Rectangle could, for example, display it on the screen.

Method: a procedure that is private to an object. Methods provide the means by which an object carries out its actions in response to a message.

Class: a structuring mechanism for objects. All objects are members (called instances) of some class. The class of an object determines what it represents. Objects of Class Integer represent integers, objects of class Rectangle represent rectangles. The class specifies the number of variables and the set of methods an object will have. Class Rectangle might specify that objects which represent rectangles (that is, objects of class Rectangle) have two variables holding points named topLeft and bottomRight, and methods named height, width, area, draw and move.

Inheritance: a structuring mechanism for classes. Classes are organised in a tree structure with class Object at the top. Subclasses inherit the variables and methods of the parent superclass. Class Rectangle might inherit methods and variables from class Shape which, in turn, inherits methods from class Object.

not surprisingly, objects. Objects are chunks of memory which can contain data and/or references to other objects. In this respect objects are similar to a collection of variables in Basic, or the structures or records used in C and Pascal to represent a related group of variables. There are, however, some crucial differences.

The most important difference requires a change of viewpoint on the part of the programmer. In Basic, C or Pascal, procedures (subroutines in Basic) and operators perform computation upon passive data stored in variables. In object-orientated programming, objects are active entities. Objects consist of the data stored in their variables, plus the set of procedures or subroutines (called *methods*) which can act upon that data. If this idea seems strange, don't worry — you're not alone. It seems strange to most programmers. The reasons why it is a good idea are what make object-orientated programming special. The change is subtle but the consequences are profound.

The data and methods stored in an object are *private to that object* — they cannot be accessed directly from outside the object. This is the water-tight barrier provided by object-orientated programming and which is technically known as *encapsulation*.

To make something happen in an object-orientated language, you have to send a *message* to an object requesting it to carry out one of its internal methods (procedures). Sending a message to an object causes one of the internal methods to be called, some computation to take place and, usually, a result to be returned.

There is no way to access the internal variables (called 'instance variables') of an object directly: the only way to make something happen is by sending a message to an object. Objects are free to respond as they choose to the message.

Different kinds of object will respond differently to the same message. For example, if you send the message '+3' to an object that represents the integer 3, the result will be 6. Send '+3' to a string object 'Apple' and the result will be a string 'Apple3'. The key difference is that it's the object which is in control, not the '+' procedure. It's the object which decides what the appropriate response to a message will be.

Program flow using message-sending is like directing actors on a stage (some of the object-orientated extensions to Lisp are called 'actor languages' for just this reason) On the stage actors are told when to perform a task, but the interpretation and implementation of that task is largely up to them.

To be able to make use of an object, you need only know how it behaves and the

set of messages it responds to — you don't need to know how this behaviour is implemented inside the object: 'What should happen' is separated from the 'How it happens'. This separation of concerns is crucial for the design of modular and re-usable software.

In Smalltalk, everything is represented as an object. This includes all the basic types you would find in any conventional programming language — integers, floating-point numbers, characters, strings, arrays, and so on. Abstract data types which would be defined using structures or records, such as linked lists, hash tables and binary trees, are also represented as objects. Even the high-level components of the system such as menus, windows, compilers, debuggers and applications programs are represented as objects.

Classes & inheritance

In theory, every object in an object-orientated system could specify the number of instance variables it has and store the set of methods to which it responds. In practice, it's useful to share the structure and methods between similar objects, so saving memory and re-using code.

Objects that share the same layout of data and methods are grouped together into *classes*, and each object contains a reference to the class it belongs to. An object's class specifies the internal structure of the data stored in an object, plus the set of methods available for responding to messages. An object is said to be an *instance* of a class; classes are grouped together and organised into a hierarchy or tree structure. Classes have a parent or *superclass* and can also have subclasses; subclasses *inherit* their behaviour — their instance variables and set of methods — from their superclass. Inheritance is a powerful technique for re-using code and embedding knowledge in a program.

At the top of the tree structure the only class without a superclass, usually called class Object, defines the basic structure of all objects and the set of methods that, by default, all objects, whatever they represent, can respond to.

When an object receives a message, it looks at the set of methods stored in its class. If it doesn't know how to respond to the message using these methods, it looks in its superclass. If no method is found there it looks at its superclass's superclass, and so on, right up the tree, ultimately to class Object. If no appropriate response is found there, an error is generated.

Subclasses can add to the instance variables and set of methods an object responds to; they let you refine or vary the behaviour of the superclass. For example, a subclass of class Shape, named Rectangle, can refine the behaviour

Counting the words in a text file in Smalltalk/V

Object-orientated programming really comes into its own in the development of large programs, but a short example will serve to illustrate some of the techniques. The problem is to read a text file and produce a sorted list of the words in that text file, plus a count of the number of occurrences of each word. WordCount depends heavily on re-using classes already built into Smalltalk/V.

The words are initially read into a dictionary object (a Smalltalk dictionary is an object that would be represented as a hash table in C or Pascal). Dictionaries consist of a set of associations: an association is just that — a key plus the value associated with it. The key and values can be any arbitrary objects, but in this case the key will be a word and the value will be the count of the number of occurrences.

Class SortedCollection is used in the method report and holds arbitrary objects sorted according to some criteria. (You can, if required, specify what criteria, but for WordCount the default alphabetic ordering of strings is adequate).

```
Object subclass: #WordCount
  instanceVariableNames:
    'words'
  classVariableNames: ''
  poolDictionaries: ''

addWord: aWord
    "add word to dictionary (just increment count if already present)"
    |count|
    count:= words at: aWord ifAbsent: [count:=0].
    words at: aWord put: count+1

from: inputStream to: outputStream
    "Read from inputStream to outputStream, counting and sorting words"
    words := Dictionary new.
    self readDocument: inputStream.
    self report: outputStream

readDocument: aStream
        "Count the words in the named stream"
    | inputWord |
   [(inputWord := aStream nextWord) == nil]
        whileFalse: [self addWord: inputWord asLowerCase].
   aStream close

report: aStream
        "sort and then print word frequency list"
    |sortedWords|
    sortedWords := SortedCollection new.
    words associationsDo:
       [:anAssoc| sortedWords add: anAssoc].
    aStream cr.
    sortedWords do:
       [:anAssoc| aStream nextPutAll: anAssoc key.
                  aStream space.
                  aStream nextPutAll: anAssoc value printString.
                  aStream cr].
    aStream close
```

At the top of the listing is the class specification for class WordCount. This says that WordCount is a subclass of Object, and differs from class Object in that instances of WordCount have an additional instance variable named Words.

Class WordCount does not have any class variables (variables that are shared by all instances of a class), nor does it access any pool Dictionaries (global variables that instances of several classes may have access to). WordCount objects have four additional methods, apart from those in Object, called addWord:, from: to:, readDocument: and report:.

To create and execute WordCount from within Smalltalk you would enter the expressions:

```
|in out|
in:= Disk file: 'mydoc.txt'.
out:=Disk file: 'counts.txt'.
WordCount new from: in to: out
```

Select them with a mouse and choose the 'do it' menu option.

Smalltalk message expressions are separated by the full stop (.) character. Comments are embedded in double quotes. Temporary variables are declared between two | symbols.

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Creating and executing WordCount from within Smalltalk: order of execution

1) Declare two temporary variables to hold objects named 'in' and 'out'.
2) Send the Disk class the message 'file:' with the argument 'mydoc.text'. This will return a Smalltalk stream — an object that will let you access a file on disk named 'mydoc.text'. Assign the stream object to 'in'. Send the Disk class the message 'file:' with the argument 'counts.txt'. This will return a stream object that lets you access a file named 'counts.txt'. Assign the stream object to 'out'.
3) Send class WordCount the message 'new'; this will create a new WordCount object. Immediately send the new WordCount object the message 'from: in to: out'. The 'from: inputStream to: outputStream' method above will be executed with 'in' and 'out' passed as arguments.
4) Send Class Dictionary the message 'new', creating a new, empty dictionary object, and assign it to the instance variable 'words'.
5) Send the message readDocument: with the argument inputStream to self. 'Self' is a pseudo-variable that allows an executing method to send a message to another method in the same object. The readDocument: method is executed.
6) A temporary variable named inputWord is declared. Send the message nextWord to the stream object. The next word in the file will be returned and assigned to inputWord.
7) Send inputWord the message asLowerCase; this will return an object which is inputWord with upper-case characters translated to lower-case. If the returned word was not the object 'nil' (which signals end of file), send the message addWord: to self with the translated inputWord. The addWord: method is executed.
8) Declare a temporary variable named 'count'. Ask the words dictionary object to return the count associated with the key aWord. If aWord is not present in words, set count to 0.
9) Put aWord and count+1 into the dictionary and return to executing the method readDocument:.
10) Go round a loop in addWord: (steps 6 to 9) until the end-of-file indicator 'nil' is returned.
11) Send the message close to the inputStream as it's no longer needed, and return to the from:to: method.
12) Send the message report: with the argument outStream to self.
13) Declare a temporary variable named sortedWords. Assign a new SortedCollection to sortedWords by sending class SortedCollection the message new.
14) Go round a loop, adding each word and count in the dictionary words to the sorted collection sortedWords.
15) Send a carriage return to the output stream. For each word and count in sortedWords print the word, a space, the count as an ASCII string, and a carriage return to the outputStream.
16) Finally, close the outputStream and return to the method from: to:. There are no more expressions to do in from:to: so return to the caller.

(instance variables and methods) of class Shape making Rectangle objects more suitable for storing rectangles (only two points need to be stored rather than a list of points for an arbitrary shape, thereby saving memory). If class Shape has a method named inShape that tests whether a point is inside an arbitrary shape or not, it can be redefined in Rectangle to perform a much simpler, and therefore a much faster, test. Class Circle, another subclass of Shape, could store only its centre point and its radius. Again, the inShape method could be redefined to provide a faster test.

Example: Object-orientated design of a page make-up program

Desktop publishing and page make-up programs are currently one of the most fashionable applications for personal computers. A portion of a simple page make-up program written using an object-orientated language might be designed in the following way:

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with a wide variety of different objects, and text — in the form of paragraphs of body text, plus various floating text items such as headings, footers and footnotes. It would also be nice to be able to use various kinds of illustration — for example, pure bit-map pictures, graphs and pie charts, and screenshots from other programs.

Pages can be regarded as containers for these objects. Objects are stored on the page according to a set of constraints; typically they must not overlap so that text must flow around illustrations, for example. A page would need to be a subclass of a collection class — perhaps Linked-List. The messages a page would respond to would allow adding new objects to the page with, or without, overlap. A draw message to a page would instruct each object on the list to draw itself in its remembered position. Other messages would allow you to ask the object its height and width, and whether it could be split across a page boundary (text usually can — illustrations can't).

Class DisplayObject could be an *abstract superclass* for both text and illustrations. Abstract superclasses are not intended to have instances: instead, they merely act as a shared repository of knowledge for their subclasses. In this case DisplayObject would implement messages allowing the position of an object on the page to be stored, and messages that respond to enquiries as to whether or not an object can be split across page boundaries. Subclasses of DisplayObject could be Class TextObject and Class Illustration.

Class TextObject might have subclasses Paragraph (for body text), Header, Footer and Footnote. A subclass of Paragraph, could be a special form of paragraph for flowing text around illustrations. Paragraphs would refer to a variety of different objects: string objects that hold characters, style objects that remember the fonts and any print enhancements such as bold, underlining or italics.

Class Illustration would be an abstract superclass for the classes that represent illustrations — perhaps Bitmap, Graph (with a subclass Piechart) and Screenshot.

Note how flexible this is: you don't need to know the type of any of these objects, just that they respond to particular messages which page objects send them. If you wanted to add new types of illustration or text objects, you could do so without having to use working code: simply develop new subclasses of illustration and TextObject that reflect the new types of object.

Designing the set of messages to which objects respond, for a particular class, is

Object-orientated languages available for personal computers

Smalltalk-80: Smalltalk-80 Version 2, the latest version of the original Xerox implementation of the Smalltalk language and programming environment, is available for the IBM PC/AT from Softsmarts Inc. Apple sells an unsupported version of Smalltalk-80 Version 1 for the Apple Macintosh, for registered software developers only and costs around $100.

Smalltalk/V: This is a low-cost, high performance Smalltalk developed by Digitalk Inc to run on the IBM PC family. It was reviewed in the November 1986 issue of *APC.*

Actor: Actor is an ambitious attempt to combine Microsoft Windows and a Smalltalk-like interactive programming environment, with a new object-orientated programming language. The Actor language has a Pascal or C-like syntax and special features for improving the performance of object-orientated programs. Actor was designed by CB Duff who also developed Neon, a simple object-orientated Forth for the Macintosh. Actor (as far as *APC* is aware) is not currently available in Australia.

EXTENSIONS TO C

Objective C: Objective C is an extension to C, which adds a small amount of additional Smalltalk-80-like syntax to C to support object-orientated programming and message sending. It is a pre-processor that translates the object-orientated extensions into conventional C code, which is then fed to a standard C compiler. Objective C comes complete with a class library in source form which is a useful aid to learning the basics. It is available for the IBM PC with Microsoft C Version 3.0. There is currently no known supplier in Australia.

C++: C++ is an extension to the C language designed by Bjarne Stroustrup of AT&T Bell Laboratories — the home of the C language itself. It incorporates a number of extensions to C, including support for classes and object-orientated programming. Like Objective C it is implemented as a pre-processor. Two implementations are available for the IBM PC family.

EXTENSIONS TO PASCAL

Object Pascal: Object Pascal is an extension to Pascal, and was designed by Apple in conjunction with Niklaus Wirth for the Apple Macintosh. Object Pacal is a simple object-orientated language and lacks some of the more involved ideas present in Smalltalk. An Object Pascal compiler is available as part of the Macintosh Programmer's Workshop.

Apple Computer's MacApp is one of the best examples to date of the power of object-orientated programming. MacApp is a generic Macintosh application, written in Object Pascal, that serves as a framework for programmers developing their own applications to run on the Macintosh. MacApp implements the standard features common to all Macintosh applications (one or more resizable windows with scroll bars and grow boxes, the pull-down menu bar, application launching, printing, and so on).

The programmer specifies how the application being developed differs from the generic MacApp applications (by using subclassing and redefining methods). According to reports from software developers, MacApp makes developing Macintosh software much faster.

EXTENSIONS TO LISP

Lisp is a malleable language, and it's possible to program object-orientated extensions yourself in any reasonable Lisp implementation. Two versions of Lisp available for micros that include explicit language support for the object-orientated programming are:

XLISP: This is a public-domain Lisp implementation by David Betz that is specially designed to support experiments in object-orientated programming. It is available free from a number of bulletin boards and user groups, and runs on the IBM PC, MS-DOS, machines and the Macintosh.

Scheme: Scheme is a Lisp dialect which has been developed for teaching purposes at MIT. PC Scheme is sold by Texas Instruments for its own PC and other IBM-compatibles.

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similar to deciding which procedures or functions are needed in a structured programming language such as Pascal or C, but the responsibilities of handling data type are shifted from the programmer to the machine. The programmer is designing a 'language of interaction' for the objects and, as with any language, if it's powerful and expressive then the results will be much better.

Smalltalk is a uniformly object-orientated language — *everything* is represented as an object. With the upsurge of interest in Smalltalk and object-orientated programming in general, a large number of hybrid languages — which take conventional languages such as C or Pascal and add extensions suitable for object-orientated programming — have also been designed, and more are on the way.

In hybrid languages the low-level components remain the conventional data types, procedures and operators built into the language. Objects are used to represent higher-level components. In hybrid object-orientated languages, the total encapsulation of an object is often relaxed: the internal instance variables of an object can be accessed by external procedures or functions. However, as with global variables of an object and procedures in structured programming, this is a major potential source of bugs and problems.

These hybrid languages have the advantages of familiarity — programmers are free to choose whether or not to learn about and make use of the object-orientated features. However, they lack the rigorous consistency and conceptual clarity that makes Smalltalk such a powerful programming language. In addition, Smalltalk is a high-quality, interactive programming environment, and the hybrid languages do not attempt to replicate this environment.

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Conclusion

The best way to learn about any new programming language or technique is to try it on some worthwhile problems. A wide variety of different object-orientated programming languages are available for personal computer systems. They divide into roughly two camps: uniform object-orientated languages (Smalltalk-80, Smalltalk/V and Actor) and hybrid languages that incorporate some support for object-orientated programming.

Most people find that the easiest way to learn about object-orientated programming is to borrow a technique from learning a foreign language — total immersion. For this reason, many people initially learn about object-orientated techniques by programming in Smalltalk — everything is an object and there is no way to slip back into known habits. In addition, Smalltalk is a powerful programming environment in its own right and can serve as a useful environment for prototyping or developing applications software.

Object-orientated programming techniques represent a real change in the way people view and write computer software. Although the central idea — active objects communicating using messages — seems strange at first, it rapidly becomes second nature. This concept may well be a powerful abstraction, but it does simplify many kinds of complex programming problems. END

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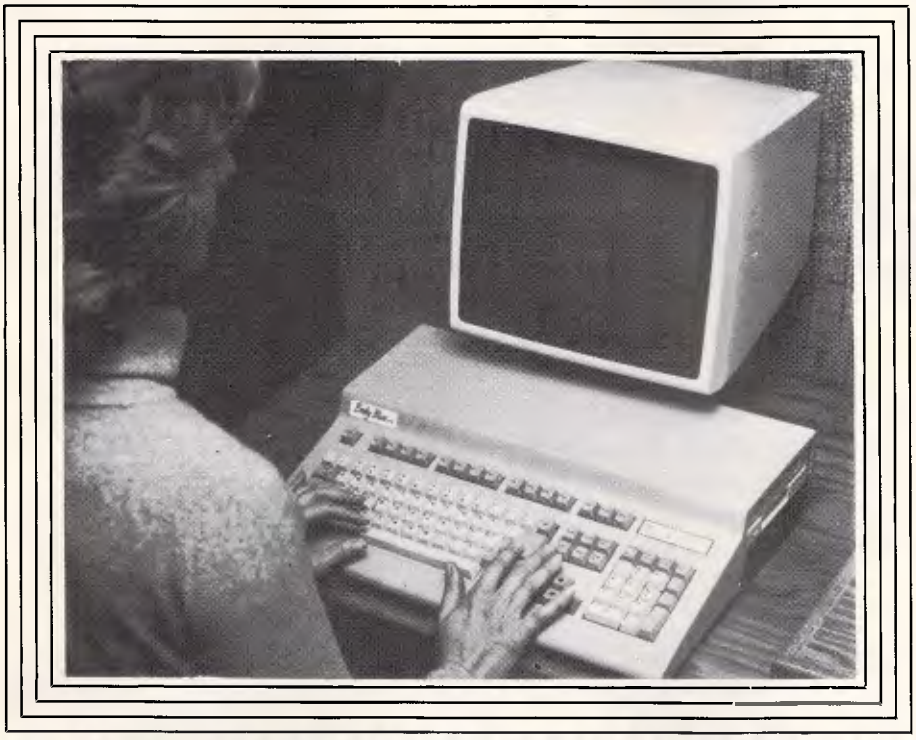

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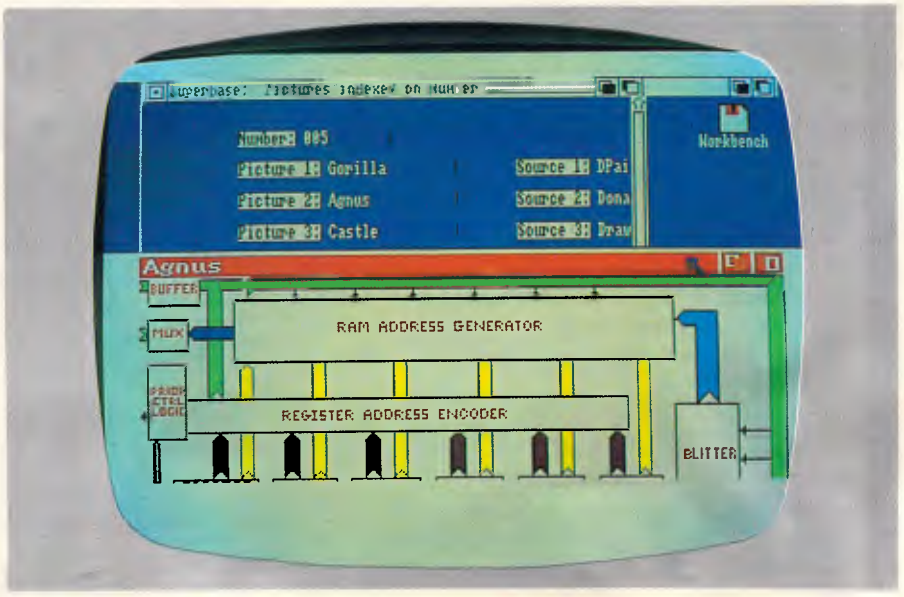
SCREENTEST

Amiga Superbase

Currently only available for the Amiga but with a GEM version in the pipeline, this 'very visual' data management system from Precision Software provides straightforward but powerful facilities for mixing pictures and text. Kathy Lang has tested the package and draws her own conclusions.

A person who studies software in depth could be forgiven for wondering, occasionally, whether software designers ever talk to real-life users. My own theory is that, since most computer people don't like the rest of the human race, they design the software first, and then go out and talk to a few users to rub off the worst glitches. Such a theory would go some way to explaining that otherwise strange phenomenon, the almost total divorce of character data from graphics in most computer systems. You try incorporating a drawing into a document on your word processor, or a picture into your database, and, with certain honourable exceptions, you'll see what I mean.

One of the few honourable exceptions is under the spotlight in this review — Superbase, a data management system for the Amiga. Superbase has a number of mundane factors in its favour, such as excellent indexing and selection facilities, and a powerful screen display. It also has a novel and very attractive approach to the problems of making reasonably powerful features easy to use. But what makes Superbase really unusual is that it allows you to coordinate the storage of records and pictures. Any file containing a picture drawn with an Amiga painting or drawing program can be referred to directly within a Superbase record, and recalled for display alone or alongside a record which refers to it. So now, instead of just storing boring old text details about those widgets in your stock cupboard, you can display a picture of a widget alongside. And there are many applications in which that could be very useful.



Superbase is currently available for the Amiga, and earlier Commodore machines and Apple II, but a GEM version for the Amstrad PC and other IBM PC lookalikes is in the pipeline. The current version is known as Personal Superbase; a 'Professional' version, aimed at developers and including some major extra facilities, should be available in July 1987.

Superbase is a British product from a company called Precision Software. The company, which has an excellent sales record also markets a word processor called Superscript which is very popular. Superbase is already proving very popular on the Amiga: the company claimed sales of 3500 copies in the first two weeks. But how does it measure up in practice?

Constraints

Superbase is remarkably free of constraints; no limit is placed on the number of fields, nor on the size of a record. A record file must be confined to a single disk, but the picture files to which it refers may be spread across several disks. Text fields are limited to 255 characters, but you can have up to 999 key fields! In a number of instances, such as specifying sort fields during a 'Query', or setting up selection criteria in a filter, the only limitation is provided by the ability to define all your requirements within a single command line of 512 characters.

The variety of data types is not great, however — no time-field type, for instance. And data validation is not startling — you can check data entered using a formula for comparison with fields within the same record, but there is, for example, no ability to check while adding data on the screen that a field value matches another in a different file.

Superbase is not copy-protected, so you can make duplicates of the program disk. But in order to run Superbase, you must have a dongle — this plugs into a joystick port on the side of the machine, next to the mouse, and provides copy protection.

File creation & indexing

The minimum specification to set up a Superbase file is to create a set of field definitions, and specify an index field. Each field may be character, numeric or date, or a reference to an external file. Character fields may be up to 255 characters long, enough for most purposes apart from applications where it's necessary to store lengthy text fields. Numeric fields may be calculated from others, and any field may be validated against a test set up when the file is created.

External files are used to store data that cannot be handled directly within Superbase itself, usually files containing pictures created with one of the painting programs for the Amiga. (The screenshots contain some examples of pictures displayed within Superbase). This unusual feature would be a great advantage in keeping track of information which is a mixture of text and graphics — for example, relating files of sketches of sets to the acts of a play to which they relate, or coordinating reference material such as an estate agent's pictures and verbal descriptions of houses.

When a record format has been created, the next step is to create an index. Superbase allows up to 999 indexes — though, in practice, keeping many indexes up-to-date could be expected to slow down updating dramatically. Indexes are used both for direct access to records, and for displaying records in a particular order. You can have only one index in operation at a time, but can change the current index at will; all indexes are kept up-to-date automatically. Index pointers are maintained while the index is open, even when the index is not current, so that, if you open a second index and later return to the first, that first index will still be pointing to the same record.

At any time, the record format can be amended purely by altering the definition; you can change lengths, display attributes and even types, though clearly some loss of data will be inevitable if this is done without care. A price has to be paid for this flexibility; on the basis of some experimentation with field displays, it appears that Superbase stores fields in a way that does not allow you to recoup lost space when field lengths are reduced, until you use the utility to reorganise a file. This approach could also have speed penalties — but more on this in the concluding paragraph.

As you would expect with a WIMPS-based system, the process of file creation in Superbase is highly interactive and makes extensive use of the mouse, pull-down menus and requesters — equivalent to dialogue boxes in GEM. Sometimes the antipathy to the keyboard is taken too far: for example, when setting the length of a field, you cannot enter numbers from the keyboard but must click the digits display — and while you can change units, tens and hundreds separately, you cannot hold the mouse button down to keep increments going, but must press the button once for each unit of change. To enter a field length of 255, for instance, needs 13 key depressions instead of just three!

Data input & editing

Records can be entered and edited interactively, and also amended in batches to provide automatic updating. When entering data, full-screen editing is provided, using the mouse and cursor keys; some functions, such as saving a record, are provided through the pull-down menus, but for the most frequently used you can use the Amiga key in combination with a character instead. A useful addition is the ability to duplicate a record, but you can't repeat just the value of a single field from one record to the next, nor can you provide for a field to have a default value. Entry to a field can, however, be made obligatory. Data can be edited when displayed in any of the three 'Views' of the data described in the next section.

Screen display

Superbase provides three standard ways to display records: 'Record', 'Form' and 'Table' Views. Record View is essentially the default format provided by Superbase, with one record per screen (or screens, for long records), and each line containing one field name followed by its value. Form View provides a similar display initially, but you can modify the layout by dragging the fields and captions around using the mouse. In either case, a record may span more than one screen, and you can use the scroll bars to see currently-hidden information. The Table View is intended for the display of lists of

The 'video-recorder' graphic controls work in both Table view (shown here) and Form view

Filters limit the search of subsequent searches. Here, the search is restricted to US addresses

A query can be applied to any files, and the result displayed as single records or as a table

Features and constraints

Max file size	Disk size
Max record size (chars)	Unlimited
Max no fields	Unlimited
Max field size	255
Max digits	13
Max prime key length	255
Special disk format?	No
File size fixed?	No
Link to ASCII files?	Various formats
Data types	Character, Number, Date, Picture
Fixed record structure?	Yes
Fixed record length stored?	No
Amend record structure?	Yes
Link data files?	Y
No. data files open	Unlimited
No. sort fields	Unlimited
No keys	999
Max key length (chars, fields)	255, 1
Subsidiary indexes kept up-to-date?	Yes
Unique keys	Optional
Data validation	Adequate
Screen formatting	Paint-a-screen Default given
Report formatting	Col/row co-ords Default given
Store calculated data	In data entry
Totals & statistics	Extensive
Store selection criteria	Permitted
Combining criteria	And, Or, Not
>1 criterion/field?	Yes
Wild code selection?	Any part string
Browsing methods	Any field
Interaction methods	Menus, commands
Reference manual (max 5*)	***
Tutorial guide (max 5*)	***
Hot-line?	No

records, and shows one record per line with field names across the top of the screen. In each View, you may select a subset of fields for display during the current session.

Numeric fields may take a variety of formats, but I could not find one which suppressed the display of the decimal point. Date fields may also be displayed in several ways — no struggling with MM/DD/YY for Australian users of Superbase!

Printed reports

Superbase provides a 'Query' option to set up reports that can be printed or stored in a file. A filter can be attached to the Query, and you can either specify a subset of fields or use the field selection already in force for screen display. A default format, similar to Table View, is used, unless you specify column positions for the fields. Numeric fields can be sub-totalled and totalled, and records sorted by order on several fields. And you can define calculated fields, and produce summary reports based on totals and statistics only. Fields may come from more than one file, by using a link field — not necessarily of the same name in each file — to join the records as needed. There is also a special label-printing facility, able to print labels up to four-up across the page.

The personal version of Superbase contains no special facilities for handling free-format text. In the Professional version, simple word processing will be available, including the ability to produce personalised letters by merging text with information from database records.

Selection & sorting

Superbase provides an excellent set of facilities for choosing individual records or sets of records. To select an individual record, using the current index, you choose the 'Key Look-up' button, shown as a question-mark, and enter the value required. Such a selection finds the key value closest to that entered, and warns you if it is not an exact match. Once a record has been located — through Key Look-up, or by going to the start or end of the file — you can then run through the records, in order by that key, using controls that mimic the buttons on your tape-recorder.

With fast-forward, for example, the screen shows each record in turn, leaving it on the screen long enough to enable you to press the Pause button when the record you want appears. Records can then be amended or viewed in the usual way. The index used can be changed at any time.

For selection of groups of records, or to use more than one criterion, you can set up a filter. This allows you to construct tests using relational operators — a LIKE operator for character variables, the use of AND and OR to combine tests, and parentheses to modify the order of the application of tests. Like Key Look-up, you can display records using the filter in any of Superbase's three Views. But you can also create a complete Query based on a filter and report format, using the layout features described under the section 'Printed reports'.

When displaying records on the screen, you can show them in order by any index — that is, by any single field defined as a key; ordering set-up in this way is maintained when records are amended. In reports, more than one field can be used for ordering: for example, to sort personal records by surname within department within region.

Calculation

Input calculation is permitted through the derived attribute, in which a field may be calculated from one or more other fields in the same record. In reports, Superbase allows you to ouput calculated fields, again derived from other fields in the same record, as well as producing subtotals and totals aggregated across the whole set of records. Quite a wide range of functions is available, including several for correct handling of arithmetic on dates.

Multiple files

Superbase allows limited handling of multiple files. You can update one file from another, provided the two files can be linked through shared fields (not necessarily with the same name). And you can create reports, using the Query facility, that include fields from more than one file, again specifying links between the files concerned. But you cannot display parts of more than one file and update them interactively.

Consequently, while simple applications involving shared information could be implemented, more complex situations could not be handled straightforwardly, especially where it was necessary to check data interactively. For that kind of application, you would need the Professional version of Superbase which will have the ability to include fields from more than one file in a form, and thus carry out interactive updating of several files at once.

The other aspect of Superbase's file-linking concerns the use of pictures and other external files. Essentially this involves storing the name of the file concerned as a text value in a field within the record to which it relates. A record can refer to more than one external file, and such a file may contain more than one image. And it is possible, by manipulating the window size and shape, to show both the record display and the picture on the screen together. Such a facility could be invaluable in mixed text and graphics applications.

008 335757 TOLL FREE MAILORDER HOTLINE FOR ORDERS!!

Where else can you buy top quality disks at these prices?!

XIDEX DISKS AT INCREDIBLE PRICES!

All prices per 10 disk boxes!

Our Cat Number	Product's Code	Description	1-9 Boxes	10+ Boxes
		XIDEX 3½" DISKS		
C12600	3012-3000	S/S	$55.95	$53.95
C12602	3022-3000	D/S	$69.95	$65.95
		XIDEX 5¼" DISKS		
C12400	5012-1000	S/S D/D 40 track	$29.95	$28.95
C12410	5022-1000	D/S D/D 40 track	$38.95	$36.95
		XIDEX 5¼" HIGH DENSITY DISKS		
C12412		D/S High Density	$79.95	$69.95

VERBATIM DISKS AT INCREDIBLE PRICES!

Number	Product's Code	Description	1-9 Boxes	10+ Boxes
		VERBATIM 3½" DISKS		
C12610	MF350	S/S D/D 80 tracks/135 TPI	$54.95	$52.95
C12612	MF360	D/S D/D 80 tracks/135 TPI	$59.95	$55.95
		VERBATIM 5¼" DATALIFE DISKS		
	MD525-01	**S/S D/D soft sector 40 track**	**$27.95**	**$26.95**
C12504	**MD550-01**	**D/S D/D**	**$34.95**	**$32.95**
	MD550-10	D/S D/D 10 sectors 40 tracks	$61.20	$56.95
C12507	MD577-01	S/S D/D soft sectors 80 tracks	$61.20	$56.95
C12510	MD557-01	D/S D/D soft sectors 80 tracks	$75.60	$68.95
		VERBATIM 5¼" VALULIFE DISKS		
C12421		S/S D/D	$22.95	$21.95
C12421		D/S D/D	$29.95	$26.95
		VERBATIM HIGH DENSITY 5¼" DISKS		
C12520	**MD/HD**	**D/S H/D soft sector**	**$79.95**	**$69.95**
		VERBATIM 8" DISKS		
C12811	DD34-4001	D/S D/D	$69.60	$67.50
C12814	DD34-4026	D/S D/D	$69.60	$67.50
		HEAD CLEANER DISKS		
C12551		5¼"	$11.75	$ 9.95
C12851		8"	$14.95	$12.95

Now you can buy absolute top quality 5¼" **disks that are also the cheapest in Australia!! They even come with a 5 year guarantee, which indicates the quality of the Microdot disks. So why pay 2-3 times the price for the same quality as Microdot?**

CHECK THESE PRICES!

DESCRIPTION	1-9 BOXES	10+ BOXES
5¼" S/S D/D	$14.95	$13.95
5¼" D/S D/D	$18.95	$17.95

(SEND $2 FOR SAMPLE DISK!)

EVEN LESS FOR "NO FRILLS" DISKS!

Bulked packed, Microdot D/S D/D without boxes, or labels, or brand name, just their white card jacket!

1-99 DISKS	100+DISKS	1,000+DISKS
$15.95 (PER 10 DISKS)	$14.95 (PER 10 DISKS)	$13.95 (PER 10 DISKS)

(SEND $2 FOR SAMPLE DISK!)

(TAX EXEMPT PRICES LESS 20¢ PER DISK)

3½" "NO FRILLS" DISKS!

Bulked packed, D/S D/D disks with white boxes, but no labels or brand name. (These are a top name brand, but we can't tell you which.)

1-99 DISKS	100+DISKS	1,000+DISKS
$47.50 (PER 10 DISKS)	$45.50 (PER 10 DISKS)	$42.50 (PER 10 DISKS)

(SEND $5 FOR SAMPLE DISK!)

(TAX EXEMPT PRICES LESS 40¢ PER DISK)

RETAIL INQUIRIES: Rod Irving Electronics,
MELBOURNE, 48 A'Beckett St. Phone (03) 663 6151
NORTHCOTE 425 High St. Phone (03) 489 8866
MAIL ORDER: (03) 543 7877 or P.O. Box 620, CLAYTON 3168

WHOLESALE INQUIRIES: Ritronics Wholesale, 56 Renver Rd. CLAYTON 3168. Phone (03) 543 2166.

008 335757 TOLL FREE MAILORDER HOTLINE FOR CREDIT CARD ORDERS!!

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JUMBO 5¼" DISK STORAGE

If you've got lots disks, you'll appreciate the extra capacity of this disk storage unit when it comes to locating "that" disk!

Features...
- 100 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- 9 Dividers/spacers

C16020 ..... **only $24.95**
C16027 (Hinged Lid) **$26.95**

5¼" DISK STORAGE

Efficient and practical. Protect your disks from being damaged or lost!

Features...
- 70 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- Dividers/spacers

Cat. C16025 **only $24.95**

5¼" DISK STORAGE

Efficient and practical. Protect your disks from being damaged or lost!

Features...
- 50 disk capacity
- Smoked plastic cover
- Lockable (2 keys supplied)
- Dividers/spacers

Cat. C16030 ..... **only $19.95**

3½" DISK STORAGE UNIT

- Holds up to 40 x 3½" diskettes
- Lockable (2 keys supplied)
- High impact plastic lid and base
- Anti static

Cat. C16040 **only $19.95**

3½" DISK STORAGE UNIT

- Holds up to 40 x 3½" diskettes
- Lockable (2 keys supplied)
- High impact plastic lid and base

Cat. C16035 ..... **only $19.95**

2 & 4 WAY RS232 DATA TRANSFER SWITCHES

If you have two or four compatible devices that need to share a third or fifth, then these inexpensive data transfer switches will save you the time and hassle of constantly changing cables and leads around.
- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector

2 WAY Cat.X19120 ~~$125~~ **$100**
4 WAY Cat.X19125 ~~$145~~ **$115**

2 & 4 WAY CENTRONICS DATA TRANSFER SWITCHES

Save time and hassles of constantly changing cables and leads around with these inexpensive data transfer switches. These data switches support the 36 pin centronic interface used by Centronics, Printronics, Data Products, Epson, Micronics, Star, and many other printer manufacturers.
- No power required
- Speed and code transparent
- Two/Four position rotary switch on front panel
- Three/Five interface connections on rear panel
- Switch comes standard with female connector
- Bale locks are standard

2 WAY Cat.X19130 ~~$125~~ **$100**
4 WAY Cat.X19135 ~~$145~~ **$115**

SAVE $20

RS232 DATA SWITCH WITH TESTER

- No power required
- Ideal for 1 computer to 2 peripherals or 2 computers to one peripheral.
- 25 pin RS232 "D" connectors.
- Six dual coloured LED indicators showing certain flow status.

T.D. Transmit Data
R.D. Receive Data
R.T.S. Request To Send
C.T.S. Clear To Send
D.S.R. Data Set Ready
D.T.R. Data Terminal Ready
- Size: 200(W) x 68(H) x 150(D)mm

Cat.X19110 ..... **R.R.P. $169**
Our Price $149

25% OFF THESE PRICES!!

DB CONNECTORS

Cat. No.	Description	Price
P10880	DE9P Male	$1.95
P10881	DE9S Female	$2.25
P10882	DE9C Cover	$1.20
P10884	DE9P R.A. Plug	$3.65
P10885	DE9S R.A. Skt	$4.25
P10890	DA15P Male	$2.10
P10891	DA15S Female	$2.25
P10892	DA15C Cover	$1.25
P10894	DA15P R.A. Plug	$4.25
P10895	DA15S R.A. Skt	$5.00
P10900	DB25P Male	$2.75
P10901	DB25S Female	$2.95
P10902	DB25C Cover	$1.25
P10904	DB25P R.A. Plug	$4.50
P10905	DB25S R.A. Skt	$5.95

MAINS MUFFLER

Sudden mains disturbances can seriously affect your computer equipment, and stored data. So why risk it when you can have a Mains Muffler, particularly when the cost of one failure is likely to be greater than the purchase price! So vanish those dangerous clicks and voltage spikes forever with the Mains Muffler!

SPECIFICATIONS:
Maximum total load:
1000W 4 AMP 250V 50Hz
Outlet Sockets
Attenuation: 150KHz - 47dB
500KHz - 68dB
10MHz - 66dB
Dual T Section:
VDR Transient suppression
Surge capacity 200 Amp 8 x 20uS

2 WAY Cat. X10089 ..... **$199**
4 WAY Cat. X10090 ..... **$299**

SUPER 5 EP-1090 DOT MATRIX PRINTER

- 80 C.P.S.
- Pica or Elite character set
- 9 pin head
- 100 million character life

Cat.C20030 **only $435**

SUPER 5 EP-1201 DOT MATRIX PRINTER

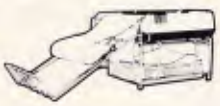
- 120 C.P.S.
- Pica or Elite character set
- Print Modes: NLQ, Dot Graphics, Proportional Font, Draft.
- Proportional Printing
- Reliable and Compact
- Proportional Printing
- Logic Seeking
- 1K Printer Buffer

Cat. C20035 ..... **only $595**

CANON A-40 PRINTER

- Serial Impact Dot Matrix
- 140 C.P.S.
- Near Letter Quality Mode
- 1.4K Buffer

Cat. C20040 ..... **$525**



PAPER TAMER

- Restores order to the top of your desk or work area
- Made of white plastic coated steel
- Stores up to 900 continuous sheets
- Allows perfect paper feed
- Allows easy examination of print out

C21050 ..... **Normally $59.95**
Special, only $49.95
(Printer and paper not included)

COMPUTER PAPER

Quality paper at a low price! 2,500 sheets of 11 x 9½", 60 gsm bond paper.

Cat. C21003 **Normally $49.95**
SPECIAL, ONLY $44.95

PRINTER RIBBONS

CP80, BX80, DP80, BX100, MB100
ALL A CRAZY LOW $9.95

SAVE $20

UV EPROM ERASER

Erase your EPROMs quickly and safely. This unit is the cost effective solution to your problems. It will erase up to 9 x 24 pin devices in complete safety, in about 40 minutes (less for less chips).
Features include:
- Chip drawer has conductive foam pad
- Mains powered
- High UV intensity at chip surface ensures EPROMs are thoroughly erased
- Engineered to prevent UV exposure
- Dimensions 217 x 80 x 68mm

WITHOUT TIMER
Cat. X14950 ..... **Normally $119**
Special, $89

WITH BUILT-IN TIMER
Cat. X14955 ..... **$139**
Special, $119

SAVE $56

RITRON 2 MONITORS

Stylish monitors available in green or amber displays and featuring swivel base that tilts forward and back 30 degrees and swivels right to left 60 degrees!

SPECIFICATIONS:
CRT DISPLAY SIZE: 12 inches non-glare 90 degree deflection.
INPUT SIGNAL: 1.0 - 2.5V p-p composite video signal.
INPUT INPEDANCE: Normal 75 ohm, high approx. 50K ohm.
INPUT TERMINALS: RCA phone jack.
RISE AND FALL TIME: Less than 25 us
VIDEO BANDWIDTH: 20MHz (-3dB)
SCANNING FREQUENCY:
Horizontal; 15.75 KHz + =0.5KHz
Vertical; 50 Hz /60 Hz
Horizontal Retrace time: Approx. 8.5 us
Vertical Retrace time: Approx. 800 us
RESOLUTION: Centre; 1,000 lines
Corner; 800 lines
Geometric distortion; 2% or less
Linearity: less than 2%
CONTROLS: Front; Power On/Off, brightness, contrast
Rear; Vertical hold, Horizontal hold, Vertical line, Vertical size.

Green Cat. X14506 ..... **Normally $235**
Amber Cat. X14508 ..... **Normally $239**
SPECIAL, ONLY $179

SAMSUNG TTL MONITOR

A quality 12" TTL monitor, with a high contrast, non-glare screen at a very reasonable price!

SPECIFICATIONS:
CRT: 12" diagonal 90° deflection, non-glare screen.
Active Display Area: 216(H) x 160(V)mm
Display Cherecters: 2,000 (80 characters x 25 lines)
Scanning Frequency:
Horizontal: 18.432 + - 0.1KHz
Vertical: 50 HZ + - 0.5%

Description	Cat.No.	1-9	10+
Green	X14517	$189	$179
Amber	X14518	$189	$179

SAVE! SAVE!

ANTI GLARE SCREEN

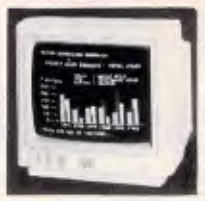
Half the price of other brands!!
Relieve eye strain and headaches and increase productivity with these Anti Glare Screens. Suitable for 12" monochrome and colour monitors.

Cat. X99995 ..... **$24.95**

150W IBM COMPATIBLE SWITCH MODE POWER SUPPLY

DC output: +5/13A, -5V/0.5A +12V/4.5A -12V/0.5A
AC input: 240V AC + - 15% 1.5A 47Hz - 63Hz

Cat. X11096 ..... **Normally $239**
Now only $149



INTRA 14" RGB COLOUR MONITOR

Resolution: 640 x 200 dots
Display Format: 80 x 25 characters
Display Colours: 16
Dot pitch: .39mm
Sync Horiz. Scan Freq: 15.75 KHz
Sync Vert. Scan Freq: 50Hz
Band Width: 18MHz

Cat. X14520 ..... **$695**

INTRA 14" RGB HIGH RESOLUTION COLOUR MONITOR

Compatible with IBM® and compatibles, and EGA Cards.
Why pay more?
Resolution: 640 x 350 dots
Dot pitch: .31mm
Display Format: 80 x 25 characters

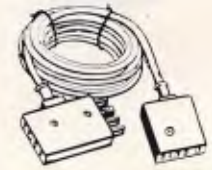
Cat. X14514 ..... **Normally $1,295**
Our price $995

TOSHIBA 13" RGB COLOUR MONITOR

High quality IBM® compatible monitors, great with VCR's too!

SPECIFICATIONS:
CRT: 13", 90° deflection colour
Input Signal:
Video Signal: Separate video signal
Video: Positive
Sync.: Positive
Input Level: TTL Level
Scanning Frequency:
Horizontal: 15.7KHz
Vertical: 60Hz
Display Size: 245(H) x 182(V)mm
Resolution:
Horizontal: 640 dots
Vertical: 200 lines
Size: 343(H) x 362(W) x 421(D)mm
Weight: 11.6kg

Cat. X14530 **$695**



TELECOMMUNICATIONS AUSTRALIAN STYLE ADAPTOR CABLE

- Australian socket to plug/socket
- Length 10 metres

Cat. Y16015 ..... **$14.95**

U.S. TELEPHONE EXTENSION CABLE

- U.S. plug to 2 U.S. sockets
- Length 10 metres

Cat. Y16028 ..... **$9.95**

TELEPHONE ADAPTOR

- Australian plug to U.S. socket
- Length 10cm

Cat. Y16026 ..... **$5.95**

TELEPHONE CURL CORD

- U.S. plug to U.S. plug
- Replacement hand set cord
- Length 4.5 metres

Cat. Y16023 ..... **$6.95**

SAVE $9

CENTRONICS GENDER CHANGERS

- Female to Female
- Saves modifying or replacing non-mating Centronics cables.
- All 36 pins wired straight through

Cat. X15660 **Male to Male**
Cat. X15661 **Male to Female**
Cat. X15662 **Female to Female**
Normally $33.95.
Our Price $24.95

RS232 GENDER CHANGERS

- Saves modifying or replacing non-mating RS232 cables.
- All 25 pins wired straight through

Cat. X15650 **Male to Male**
Cat. X15651 **Male to Female**
Cat. X15652 **Female to Female**
Normally $19.95 each
Our Price $14.95

SAVE $8

RS232C NULL MODEM ADAPTOR

- Male to female connections
- Pins 2 and 3 reversed
- All 25 pins connected

Cat. X15657 **Male to Male**
Cat. X15658 **Male to Female**
Cat. X15659 **Female to Female**
Normally $22.95
Our Price $14.95

SAVE $6

RS232 MINI PATCH BOX

- Interface RS232 devices
- 25 pin inputs
- 25 leads with tinned end supplied
- Complete with instructions

Cat. X15653 **Male to Male**
Cat. X15654 **Female to Female**
Cat. X15655 **Female to Female**
Normally $25.95
Our Price $19.95

RS232 WIRING ADAPTOR BOX

- Male to female
- 25 Detachable plug on leads
- 2 mini jumpers
- Ideal for experimenting or temporary connections

Cat. X15665 ..... **Normally $39.95**
SPECIAL $29.95

SAVE $7

RS232 MINI TESTER

- Male to female connections
- All pin wired straight through
- Dual colour LED indicates activity and direction on 7 lines
- No batteries or power required

T.D. Transmit Data
D.S.R. Data Set Ready
R.D. Receive Data
C.D. Carrier Detect
R.T.S. Request to Send
D.T.R. Data Terminal Ready
C.T.S. Clear to Send

Cat. X15656 ..... **Normally $39.95**
SPECIAL, ONLY $32.95

MAIL ORDER HOTLINE
008 335757
(TOLL FREE)
LOCAL: 543 7877

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008 335757 TOLL FREE MAILORDER HOTLINE FOR CREDIT CARD ORDERS!!

008 335757 TOLL FREE MAILORDER HOTLINE FOR CREDIT CARD ORDERS!!

COMPUTER LEADS

CL33
- IBM PC, XT and look-a-likes with 25 pin 'D' plug on computer end to Centronics 36 pin plug
- Length 2.13 metres

Cat. P19029 **$19.95**

CL2
- 9 pin 'D' plug to 9 pin 'D' plug
- All pins wired straight through (removable terminals)
- Length 1.5 metres

Cat. P19033 **$19.95**

CL3
- 9 pin 'D' plug to 9 pin 'D' plug
- All pins wired straight through (removable terminals)
- Length 3 metres

Cat. P19035 **$25.95**

CL5
- 9 pin 'D' plug to 9 pin 'D' socket
- All pins wired straight through (removable terminals)
- Length 3 metres

Cat. P19036 **$27.95**

CL7
- 15 pin 'D' plug to 15 pin 'D' plug
- All pins wired straight through (removable terminals)
- Length 3 metres

Cat. P19016 **$32.95**

CL8
- 15 pin 'D' plug to 15 pin 'D' socket
- All pins wired straight through (removable terminals)
- Length 3 metres

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Overall verdict

Information: Personal Superbase is basically a flat-file package, but it does have the ability to link more than one conventional data file for reporting, and also when amending records in a batch. It can also link textual records with picture files, allowing you to create a database of linked records and pictures. It would be especially suitable for applications in which you want to display pictures alongside descriptive text, and the use of variable-length records should make it economical for use in applications where the amount of information varies widely between records.

Processing: Records can be selected in a wide variety of ways, providing considerable flexibility in display. Sorted order may use indexes, which are maintained, or be specific to a particular report, in which case sorting must be repeated when records are changed. Calculations are permitted on input and in reports.

Housekeeping: Records may be amended on the screen, or in a batch, and retrieved through any field or combination of test criteria. The structure of a file of records may be amended at any time (even after data has been entered) in a very flexible way, making it easy to get the structure just right. Files may be deleted within Superbase, ASCII files imported and exported, and access to files controlled through passwords.

Control: Personal Superbase is controlled through the usual Amiga repertoire of mouse, pull-down menus and requester boxes, making it very easy for beginners to use. Reports can be automated by setting up a Query to include selection criteria, sorting and layout instructions. Apart from query, however, there is no ability to store sequences of instructions, nor can you construct tailored environments — for example, using your own menus — for naive users. Superbase would, therefore, be much less suitable as a system developer's tool.

Support: Support is provided by the Customer Service Division at Commodore Business Machines.

Tailoring

Superbase has no programming language; you can set up stored report formats using Query, but there is no facility for recording keystrokes or for the kind of tailoring that would be needed by system developers. (This will be included in the Professional version, which will have its own programming language).

Housekeeping & security

A data file may have up to three passwords: to control access for reading only; for any action except deleting the file; and for full access.

Links with outside

You can read and write ASCII files in Superbase, with control over the terminators used for fields and records. But there are no facilities for importing or exporting other standard formats, such as the DIF format often used by spreadsheets.

User image

Superbase is one of the most visual packages on the market in its methods of interacting with the user: full use is made of the Amiga's features, of mouse, menus, radio buttons and requesters, windows and scroll bars — the screenshots will give you some idea of the overall effect. Sometimes, however, all this innovation can prevent an experienced user from getting things done quickly; apart from the occasional absurdity, Superbase avoids these pitfalls.

Documentation

A single manual does duty for reference and tutorial on Superbase. It is divided into three parts, covering increasingly complex aspects of using Superbase. Within each part, short tutorial sessions are included, each labelled with the time that should be needed to complete it. For becoming familiar with the package in a systematic way, this works quite well; but it is sometimes difficult to find out where to check on some specific item.

The manual includes an index, but it is rather short and, as is usual, very solution-orientated. There is a short reference summary of each menu function at the end.

Conclusion

Superbase on the Amiga provides straightforward facilities for handling records and referencing pictures. Its selection facilities are excellent, display is imaginatively handled and reporting is good. And the methods of storing records should make it economical for handling information of variable length.

For a variety of reasons I was unable to run my standard Benchmarks on the Amiga, and therefore could not verify a slight suspicion about the speed of operation with a large number of records. These doubts do not relate to interactive operations which, with the well thought out and flexible indexing, should stay fast, but to batch tasks where speed is, of course, less important. Superbase should in the near future be available under GEM for the IBM PC, so I shall be able to comment on that implementation and carry out some Benchmarks on at a later date.

At the same time, I also plan to look at the Professional version of Superbase. The promised enhancements to provide a development environment through a pseudo-programming language, direct file relationships via forms updating of multiple files, and simple word processing, should enable system developers to exploit the ease of use of Superbase on tailored systems for less experienced users. END

Superbase for the Amiga costs $299.00 and is available from all authorised Commodore dealers.

The result of applying a query on an example file — a table summary showing numeric fields

External graphic files can be associated with any record and viewed like the Amiga 'rollerblind'

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MORE

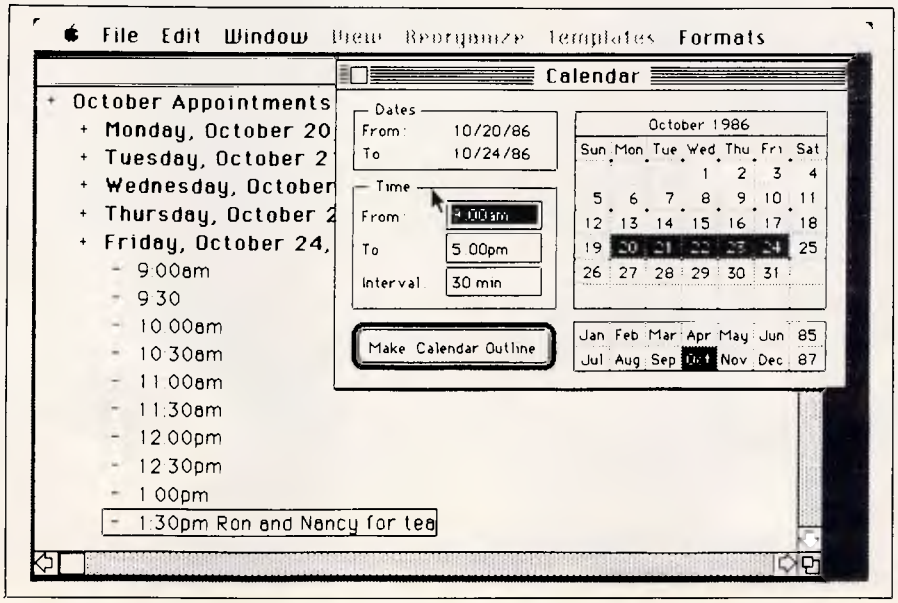
There are really only a few products that significantly affect the way we work. Living VideoText's ThinkTank was one such product, and it has defined its own niche as an 'ideas processor'. MORE, for the Apple Macintosh, takes this concept one step further. Mick O'Neill checks it out.

As an innovative young company grows successful and large, the amount of time and energy it spends listening to and responding to critics often seems to grow proportionally small. Success in itself sometimes breeds conservatism as the company copes with expansion by hiring professional 'Don't rock the boat' style managers. In the computer software industry, this short-sighted strategy has caused the demise of several promising firms.

The alternative approach is exemplified by Living Videotext Inc which seems to view its product line as something almost *organic*. The company looks at criticism as a form of feedback and where possible modifies its software accordingly. With the release of MORE for the Apple Macintosh, Living Videotext has comprehensively responded to every major shortcoming of the 'ThinkTank' series and has taken the product into previously unchartered directions.

ThinkTank, described as an 'ideas processor', cut its own innovative niche in the software world in the manner of MacPaint with graphics, PageMaker with desktop publishing or Business FileVision with pictorial-orientated data processing. ThinkTank took the tedious and underused process of outlining, and turned it into a simple, convenient and powerful tool for anyone who could benefit from organisation. MORE is a superset of ThinkTank.

For a proper analysis, the program has to be viewed as an 'ideas processor', a desktop publishing aid and a productivity tool. Although these three categories appear to be somewhat ambiguous and overlapping, they do add some perspective to MORE's many features.



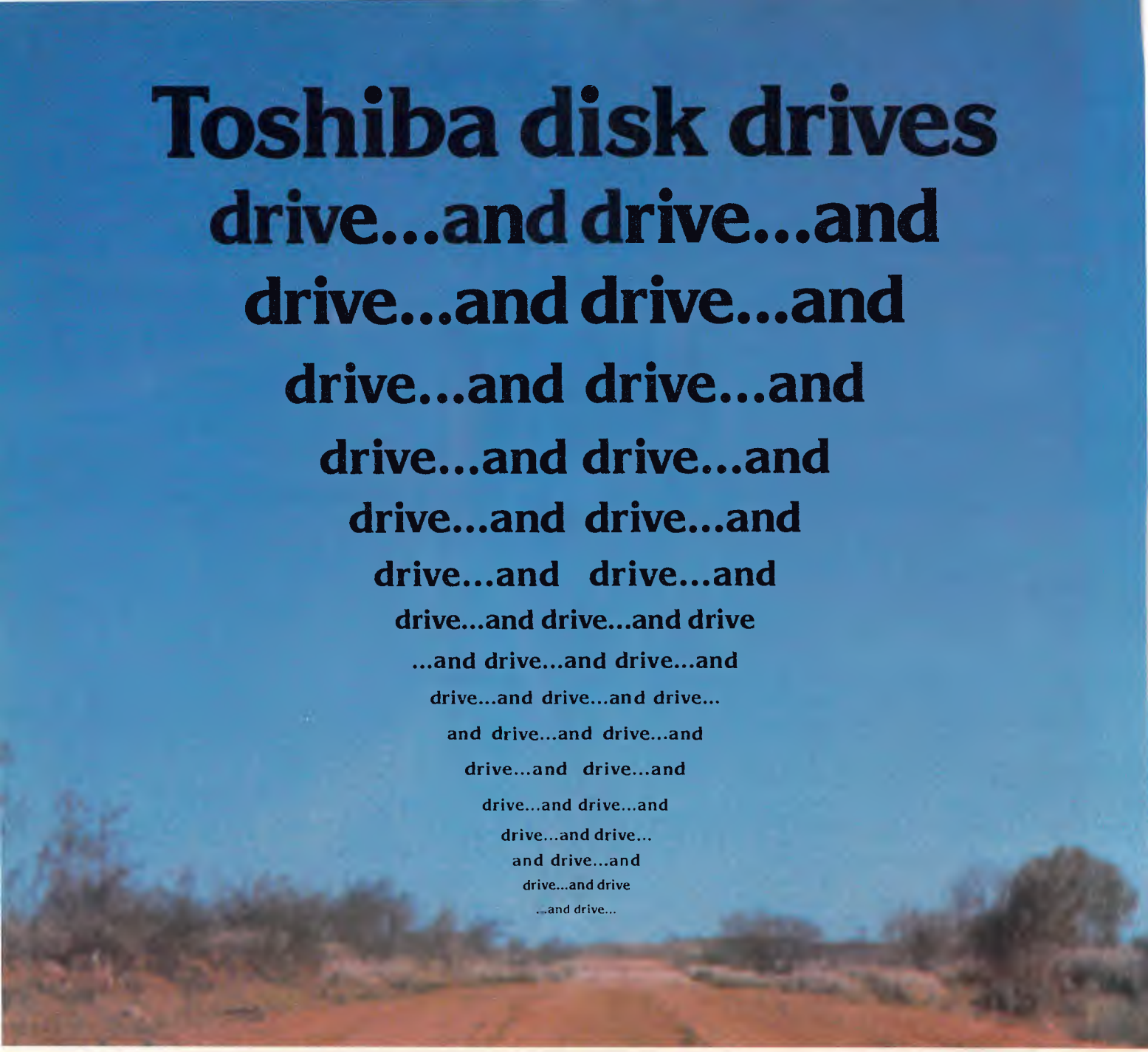
MORE can help you utilise your time efficiently. For example, any part of the 'Calendar' can be highlighted to generate an appointment outline

The ideas processor

An 'ideas processor' is a program that allows the user to create an outline with headlines and sub-headings several layers deep, attach documents or graphs to any layer, and reorder the structure at will. ThinkTank, the first ideas processor on a microcomputer, is a powerful tool used by managers throughout the information industry.

Virtually everything you can do with ThinkTank, you can do with MORE. The company even includes an option to alter the default settings in MORE to exactly emulate ThinkTank commands and cursor movements. Documents created in ThinkTank can be imported effortlessly by MORE, and holding down a key combination will allow a ThinkTank document to be opened by MORE directly from the 'Finder'.

A major improvement introduced by MORE relates to repetitious outlining. For example, every software review I write includes a 'Details' section with the name of the product, the company name, the street address, city, the cost of the product, and so on. Because ThinkTank is unable to handle multiple documents, I have to open an old review, copy the subsection outline, close it, open a new document, paste in the structure, and then delete any extraneous information.



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With MORE, there are several ways to handle this problem.

Because MORE can handle up to six open documents simultaneously (though only one is *selected* at any time), it's easy to open a few 'resource' outlines that contain parts to be incorporated into your new document. The program includes an easy-to-view 'tiling' system whereby open documents are arranged in convenient patterns and, thus, choosing an outline and cutting and pasting is almost instantaneous.

MORE, however, contains a powerful feature that makes simple cutting and pasting even seem tedious. It's possible to install repeatedly used outlines in the 'Templates' menu. These can then be called up and inserted in the current outline. After spending several hours fine-tuning a monthly report structure, the capability of accessing it from a pull-down menu is simply delightful.

Other new outlining features include the ability to 'hoist' part of an outline to focus on one section; 'cloning', to cross-reference ideas, marking and gathering headlines for special treatment; emphasising headlines with font or format instructions; colour printing with the ImageWriter II; employment of a search and replace function with extensive wild cards; and a full range of print options for producing professional-quality reports.

Desktop publishing

MORE has the ability to translate any outline and/or sub-outlines into sophisticated tree charts of the line/block variety, or presentation-style 'bullet charts' for transparencies and onscreen slide shows. These options include comprehensive and almost intuitive formatting, and break new ground in the desktop publishing area. If you are not completely pleased with the results from MORE, the program includes the option to export your charts to MacDraw for further modification.

One of the major criticisms of ThinkTank is the difficulty in moving formatted data from a ThinkTank outline into a word processor. It is a simple matter to cut and paste between programs, but the resulting text includes extraneous characters devoid of all formatting.

MORE eliminates this problem completely. You can now transfer the data in MacWrite or Word format and have the

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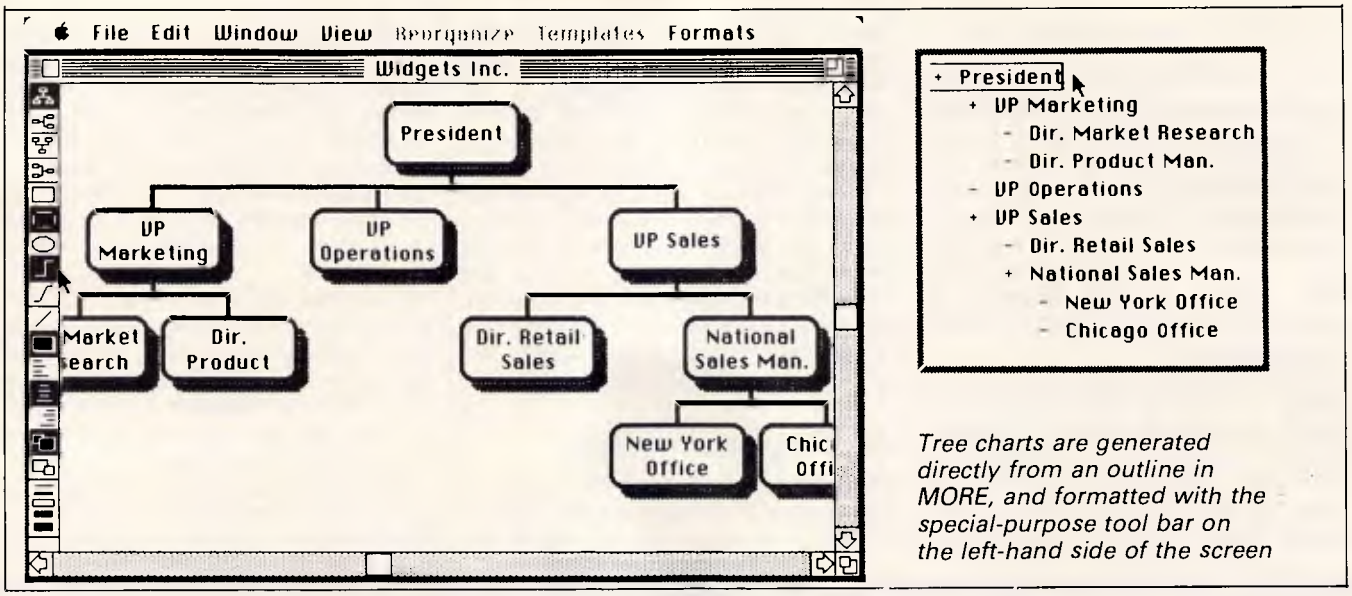

Tree charts are generated directly from an outline in MORE, and formatted with the special-purpose tool bar on the left-hand side of the screen

option to include bullets, numbers, Roman numerals, and so on. For serious writers, this feature has greatly added to the utility of the outlining process.

Productivity features

Selecting 'Calendar' from the Edit menu presents the user with an onscreen calendar displaying the current month and year. The months and years can be toggled forward or backward, and any day or group of days can be highlighted to create appointment outlines on a daily basis. The user indicates the regular appointment intervals (half-hour, hour, and so on) and headlines are created for each.

Time and date-stamping an outline could be important for timing phone calls, creating project charts with deadlines, or generally keeping track of outline alterations. This is one of those functions that might appear superfluous at first sight, but in practice proves quite useful.

The automatic phone dialling is for person to person rather than computer to computer and, so, I suspect, is of limited value except in those instances when a full address file is being queried and a number of calls are being made. However, not having made the communications plunge with the Mac as of yet, I'm probably not a good judge of this.

Documentation and support

Like most good Macintosh software, MORE can be used instinctively. Still, Living Videotext has included a first rate 200-page manual full of useful examples and pertinent screen-dumps, which is organised in a manner that itself suggests the power of ideas processing. The package includes a systems disk and a program disk with all of the necessary printer drivers (Imagewriter and Laser), the latest version of the Finder and system, the program and several sample outlines.

And, you can breathe a sigh of relief, MORE is unprotected and, therefore, can be easily installed on, and backed up from, a hard disk. After considerable use, I discovered no bugs, and I've decided that the best support any company can give me is to release a bug-free, unprotected program.

Price

MORE costs $540. It is produced by Living VideoText Inc, 2432 Charleston Road, Mountain View, California 94043. Tel: (415) 964 6300.

Conclusion

The inevitable question is, of course: 'Is this piece of software worth $540.

I'm always amazed to read reviewers' attitudes concerning 'value'. I frankly admit that I can't answer this question for you. I've described what the program does; if it seems to meet your needs but you have doubts about the price, I suggest that you go to a dealer and take a first hand look at it. No matter what your requirements, I suspect that you'll find MORE a remarkable package. Personally, I wouldn't settle for anything less!

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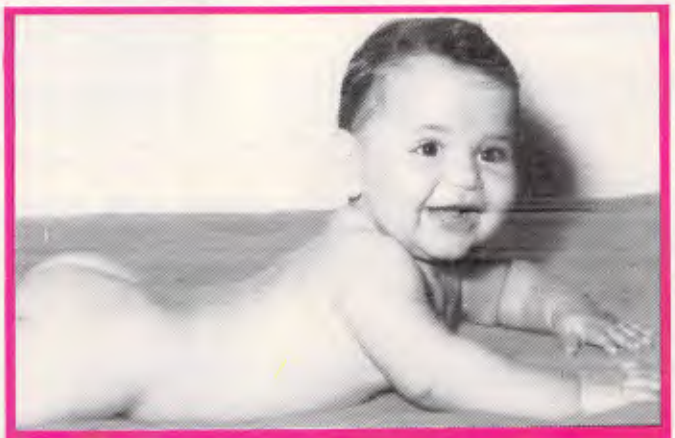

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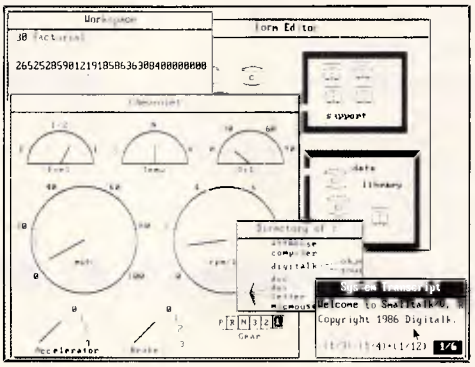

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SOFTWARE

Ready, steady, go!

Despite being a late starter, resident software is now an integral part of most users' libraries. Dick Pountain assesses the functions and the future of this multi-application environment.

Resident — often called pop-up — software has become a fact of life for most users of IBM PCs and compatibles. Every time I boot my computer, four resident programs are loaded. Two of these are merely small extensions to DOS: DOSEDIT provides full command-line editing and re-use of previous command lines; while a Mouse Menu program integrates the Microsoft mouse with my other software. The other two are pop-up applications, namely Borland's SideKick and Caxton's Smartkey.

In use

What are resident programs and how do they work? A resident program is one which is loaded into memory but is not overwritten when a new program is loaded. Instead it sits underneath whatever other software is running, and can be summoned by a special command. Of course, in a sense, DOS itself is a resident program since it's always there whatever application program is running.

From the user's point of view, resident programs produce the subjective effect of multi-tasking (that is, being able to do more than one thing at once). For example, when SideKick is loaded, it can be summoned at any time by pressing the Ctrl and Alt keys simultaneously. Whatever program you are using at the time, whether it be a word processor or spreadsheet or compiler, SideKick's window appears in the middle of the screen and you may use any of the utilities it provides (a notepad, calendar/diary, calculator, ASCII chart and phone dialler). Pressing Ctrl Alt again makes it disappear and you are back doing what you were doing before.

However, this is not true multi-tasking because your application is suspended while SideKick is on the screen and only one program is actually being executed by the CPU at any time. If you pop-up SideKick in the middle of an operation such as a sort, search or compile, the operation will be no further advanced when you pop SideKick down again; it did not proceed while SideKick had control of the computer. In a true multi-tasking application, the operation would have continued to execute 'in the background' while you were using SideKick, and might be completed by the time you finished with SideKick.

True multi-tasking is achieved by sharing the processor's time between various programs (usually by giving each one alternate 'timeslices' of a few milliseconds), and it normally needs to be supported by the kernel of the operating system. MS/PC-DOS is not such an operating system. With the single exception of the background PRINT utility, PC-DOS only supports one task executing at a time. The only well-known personal computer operating systems which multi-task are Commodore's Amiga-DOS, Digital Research's Concurrent DOS and DOS Plus, and, of course, Unix.

Most applications spend most of their time waiting for user input from the keyboard. Therefore, resident software can give most of the beneficial effects of multi-tasking, without the complication (and often the unreliability) of the real thing. The areas where real multi-tasking are desirable are those where the computer talks to a slow peripheral, or performs a slow operation, without user intervention: for example, printing, communications, database sorting and program compilation.

A late starter

Resident software has only appeared in the last few years mainly because the older 8-bit personal computers were not well-suited to its use; but the IBM PC changed all that.

The real spark to the development of resident software, though, was that (in PC-DOS versions from 2.0 upwards) Microsoft provided a DOS function call called 'Terminate and Stay Resident' (function number 31 hex). When a program calls this function, it is terminated (that is, it stops executing) but the memory it occupies is not reclaimed by DOS. The next program to be loaded and executed loads at a higher address and leaves the first program's code intact. This provides half of the means for writing resident software at a stroke. Resident programs are usually called TSRs' by professional programmers (after the Terminate and Stay Resident call which makes them possible).

Interrupts

However, making a program stay resident is only half the game — it must also be

Fig 1 How resident programs sit in memory

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possible to reactivate the terminated program at will. This is achieved via another feature of PC-DOS, namely the software interrupt.

PC-DOS is basically an interrupt-driven operating system. This means that operating system activities take over from one another by interrupting the previous activity (whose state is saved on a stack so that it can be resumed), rather than by simple subroutine calls as in older systems like CP/M. For example, when you press a key at the keyboard, the keyboard interrupt stops whatever DOS is doing until the keystroke has been stored in the input buffer.

DOS function calls are usually made by issuing interrupt number 21 hex with the function number held in a register, rather than by a jump to the routine's entry address. Interrupts allow application programs to use the operating system's facilities without knowing the absolute addresses of the routines they are calling; a table of interrupt 'vectors' at the bottom of memory tells DOS which routine to execute whenever a given interrupt is received.

Since DOS interrupts are vectored, it's relatively easy for an application programmer to 'capture' a particular interrupt by putting the address of his own routine into the appropriate slot in the vector table. This provides the means for reactivating terminated resident programs. Most often the programmer will capture the keyboard interrupt and examine the keystrokes typed by the user. For example, SideKick captures the keyboard interrupt and keeps a lookout for the Ctrl Alt sequence; if this is not found, then it hands over the normal keyboard interrupt service routine. If, however, Ctrl Alt is detected, then control is transferred to the dormant SideKick program which pops up and does its thing.

Sometimes it might be desirable to capture a different interrupt: for example, the IBM PC has a periodic timer interrupt which controls the timing of system functions. To write a pseudo multitasking TSR, you can capture this interrupt and do a piece of your own program before handing control back to the DOS interrupt handler. A program to display a clock permanently in the corner of the screen could work this way. (See 'MS-DOS Programming', November '86, *APC* — Ed).

Blueprint

The blueprint for writing a TSR for PC-DOS is this. The program comes as an ordinary .COM or .EXE file which is executed from the command line in the normal way. It contains two parts, a loader and the TSR code itself. When executed it loads the TSR program into memory, and patches the appropriate interrupt vector table entry to point to it. Then it calls the DOS TSR function, and stops and returns you to the DOS prompt. Normally you would put the program name into your AUTO EXEC.BAT file so that this all occurs automatically when you boot the computer.

If this is a well-designed TSR it will also want to throw away the loader code which is of no further use, since the TSR stays resident until the system is rebooted. This is easily achieved by putting the loader code after the TSR code and beginning the program with a jump to it. The TSR address is set so that the next program to load will overwrite the redundant loader code, the only memory wasted being that single jump instruction at the beginning (which must *not* form part of the TSR CODE).

I don't intend to get into actual coding of TSRs as that would be subject enough for a separate article. In general, you will need to be an accomplished system-level assembly programmer and have a well-thumbed copy of the *IBM Technical Reference* to write one from scratch; you will also need a good debugger, nerves of steel, lots of luck and preferably a comfortably upholstered Reset button. There are, however, easier ways, as we shall see later.

How is it possible to have several TSRs in memory at the same time? The answer is that sometimes it isn't! Any heavy user of resident programs will tell you horror stories about ones which clash with each other and hang the system, corrupt files or worse. But, in general, well-designed TSRs work with each other quite happily, as well as with most application programs. For example, I can pop-up Smartkey to define some keys while inside SideKick with no problem, and I can use the mouse while both of them are active. Smartkey does occasionally interfere with the mouse (sounds vaguely indecent!) in a subtle way which is too obscure to explain here. The reason TSRs can co-exist lies in the nature of interrupts. By their very nature, interrupts must preserve the state of the activity that they interrupt. The same should apply to captured interrupts if the programmer has done his homework properly.

When a TSR captures, say, the keyboard interrupt, it POKEs its own address into the table and saves the address of the original interrupt handler (to which it must return control if its 'hot key' is not detected). If another TSR is loaded on top, then it will in turn patch its own address into the table and save the address of the first TSR's handler. In this way it's possible to have a long chain of captured keyboard interrupt handlers, each of which returns to the one before and finally to DOS, so that all the TSRs get a peek at each keystroke. All should be sweetness and light in the best of all possible. . .

Of course, it doesn't work like that in practice. For example, I can't call SideKick from inside Smartkey, even though the reverse works. The order in which they're loaded matters. In fact, SideKick 'feels' a Ctrl Alt but it just beeps — its signal that Smartkey is doing something it doesn't like. It's quite rare these days to find TSRs which hog the keyboard interrupt and don't pass keystrokes down the chain at all.

There are plenty of other potential problems, though. Many applications which were written in pre-TSR days (or whose writers just don't care) hog the hardware keyboard interrupt for themselves, rather than doing I/O through DOS or the BIOS. Word processors like Samna III and XyWrite are guilty of this, and they cause agony for TSRs.

Also, there are more issues at stake than I have outlined so far. The latest generation of TSRs are fully fledged applications in their own right. They may

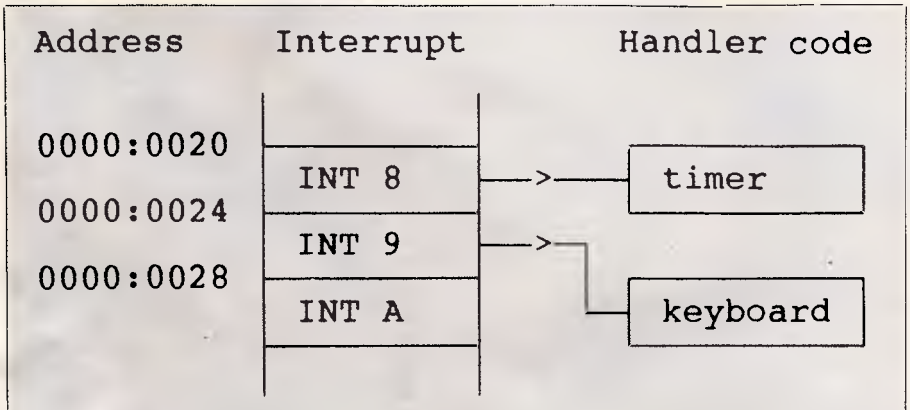

Fig 2 A portion of the DOS interrupt vector table. The slots contain addresses of DOS interrupt handler routines

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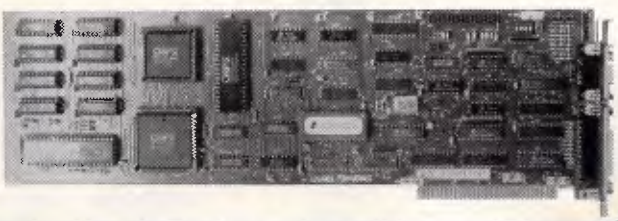

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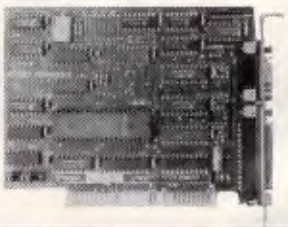

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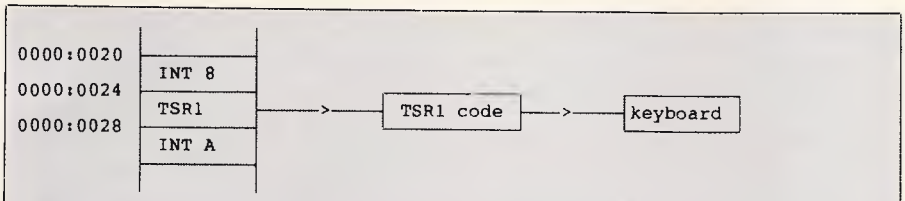

Fig 3 A resident program, TSR1, has put its own address into the INT 9 slot

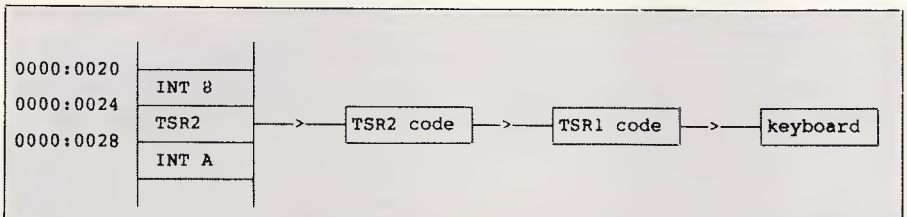

Fig 4 A second program has taken over INT 9 and has chained to TSR1

open and close disk files, use the printer, and some, like Homebase, even use the serial port. What this means is that before such a TSR can pop up it must be sure that it's safe to do so — that is, sure that DOS isn't doing something like a disk access that might be upset.

DOS wasn't really designed to work with sophisticated TSRs (even though it provides the 'loophole' that permitted them) and so it doesn't provide any single, unambiguous signal that everything is safe. Accordingly, many TSRs have to take over several interrupts to monitor the state of various DOS activities. Ready!, the popular resident profile editor, takes over the timer, video, disk, keyboard (both hardware and BIOS level) and print spooler interrupts in order to be sure it's safe for it to take control. Such programs don't just pop up in the simplistic way I've suggested when their 'hot key' is pressed: they set a flag that says 'pop up at the next safe opportunity' and carry on monitoring.

Turbo Task

I've recently been testing a piece of software which allows you to write your own TSRs in a high-level language (Turbo Pascal), in a very simple way. The software is Turbo Task from Tangent Technologies in the US. It's a library of Turbo Pascal utilities, one of which is a binary file called TTASK.BIN which does all the dirty work of loading a TSR.

When you have included TTASK.INC in your program, you may make a single call to an external procedure defined therein called Turbo_Task(). Turbo_Task() takes a single parameter which is the code for the desired 'hot key' to pop-up your TSR. For a program to be made resident, it must have a very well-defined structure. You can have as much initialisation code as you wish, to set up variables, array windows and files. This is executed when your TSR is loaded. However, after the point at which Turbo_Task() is called (only once per program), the program must take the form of an

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endless loop which does the job. It must never terminate or the whole system will crash. Here, for example, is a simple pop-up clock:

```
program pop-up clock;
{$1 ttask.inc}
{$1 regpack.lib}
{$1 timedate.lib}
const
  ctrl_@=$0300;

begin

Window (60,2,70,5);
TextBackground (white);
TextColour (black);
turbo_task (control_@);

{Everything from here on is the pop-up
 code}

 repeat
  GotoXY (2,2);
  Write (Time);
 until false
end.
```

(Time is a function that returns the time of day from the system clock, as a string in pretty formatted form, and is defined in my 'timedate.lib' file).

Turbo Task only adds 5k to the size of the Pascal code, but a Pascal program is already much larger than an assembler program would be; this clock program compiles to 17k, which is a lot for such a simple utility.

I've written some quite powerful utilities using Turbo_Task, including a pop-up version of Debug, but regrettably they are not altogether well-behaved.

Improvements

Resident software is so well-established and popular now that things can only improve. Writers of new applications must be acutely aware that their brainchild will be used with the popular TSRs and make sure that it behaves itself accordingly; any application which doesn't work with SideKick these days is 'Dead On Arrival'. Similarly, TSR writers are getting together to agree to standards of behaviour for their programs that will ensure that they don't interfere with one another. A group of US programmers are even working together in Borland International's Special Interest Group on Compuserve to define a generic 'shell' for TSRs to which programmers can add their own functions.

Meanwhile, resident software continues to grow in power, so it's possible to imagine that very soon all a person's software needs might be catered for by a set of pop-up programs. There are already resident word processors available which lack few of the features of a stand-alone program (for example, the PC Outline profiler). Resident spreadsheets and graph-drawing programs like Graph-in-Box have been around for a while. The latest version of Ready! can work with Extended Memory boards, and many other programs are following suit which will mean that you can stuff all the pop-ups into extended memory and have the whole 640k of DOS memory free for ordinary applications. Resident communications programs now exist, some of which (for example, Mirror) can receive and transmit in the background in a truly multi-tasking fashion. Pop-ups which allow DOS housekeeping functions (disk formatting, file copying) to be performed from inside an application are also emerging.

From another direction, people are churning out programs like Software Carousel and Resident which make ordinary application programs co-resident in memory and permit switching between them at a keystroke. This approach has the advantage that you can use your favourite program, rather than having to live with the features a TSR writer has provided (there is as yet no pop-up editor which I prefer to PC Write).

There are even resident programs that exist only to manage other resident programs. Referee, for example, lets you define a list of pop-ups which will work with each application, and disables all the others.

PopDrop is a utility for unloading pop-ups from memory without having to reboot. Although many TSRs have the ability to disable themselves, it isn't usually possible to reclaim their memory unless they are the topmost program in memory; hence PopDrop. Personally, I find it hard to imagine myself using enough pop-ups at once to justify either.

Conclusion

What is the future for resident software? The next generation of microprocessors (for example, the 68020 and the 80386) have on-chip support for multi-tasking, and will be used with proper multi-tasking operating systems. This would seem to remove much of the rationale for resident programs, since you will be able to execute as many applications as you want simultaneously.

I'm not so sure, though. There is something very ergonomically attractive about utilities that pop-up at the touch of a button. I suspect that the outward form of pop-up utilities will survive, with the difference that instead of suspending the main application, they will, if appropriate, allow it to continue running in the background. Equally, they themselves could continue executing in the background after popping down!

What we could be looking at is a new style of user interface in which you can switch activities at any time by a single button press — a modular applications environment consisting entirely of pop-up programs.

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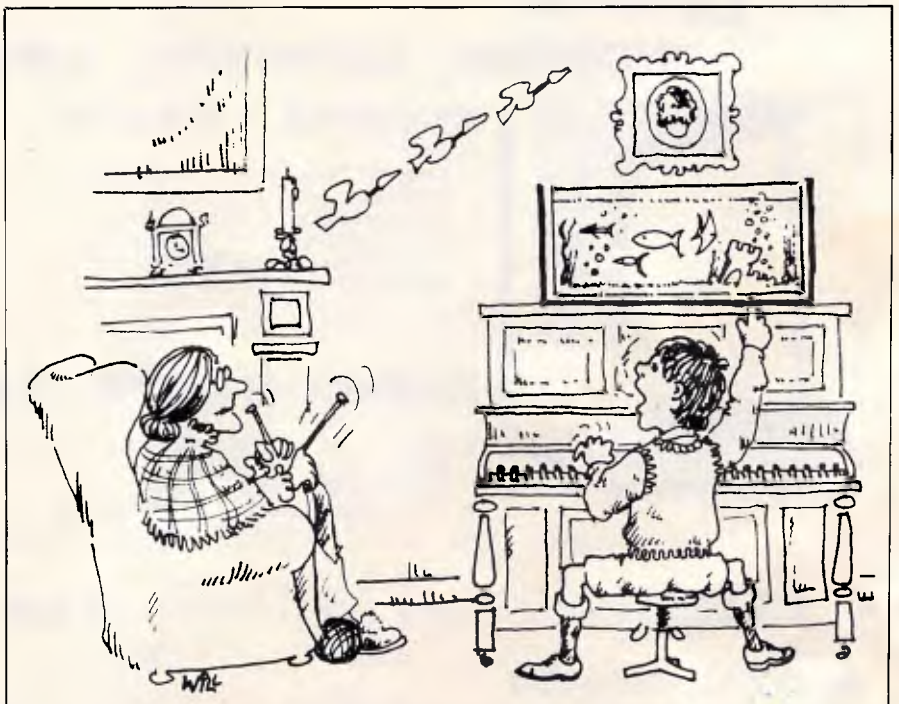

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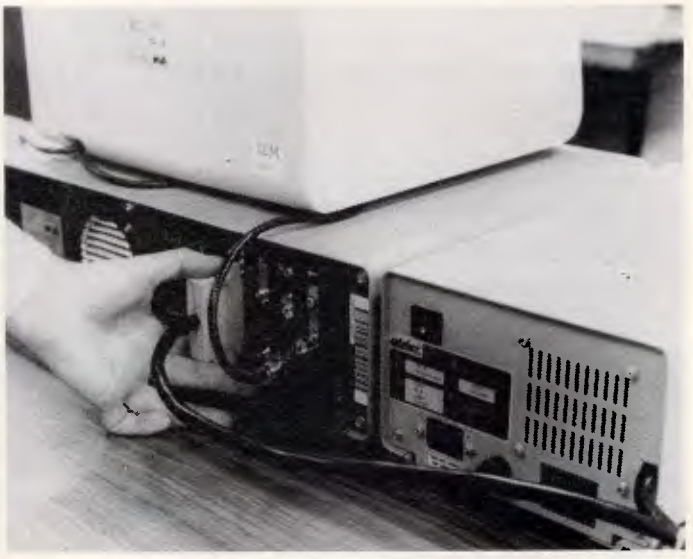

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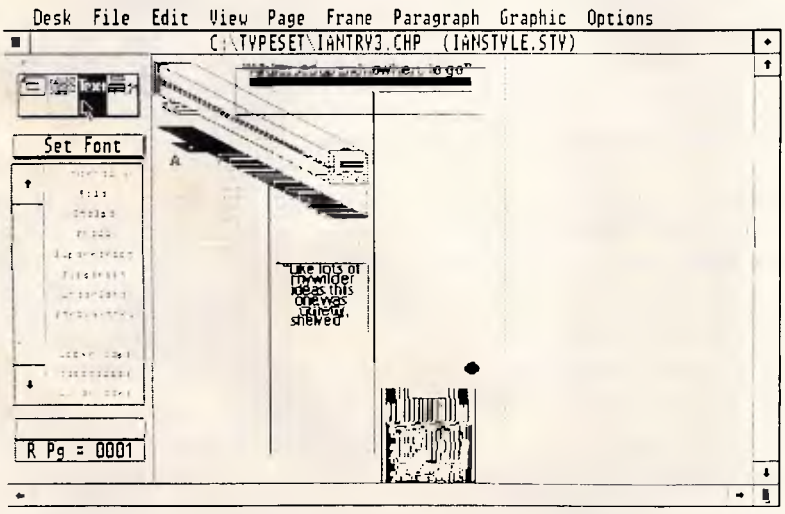
SCREENTEST

Ventura Publisher

The introduction of GEM gave a Macintosh-like environment to the IBM PC, but Ventura Publisher goes one step further — desktop publishing on this predominantly text-based machine. Mac enthusiast Ian McKinnell casts a critical eye over Ventura's page make-up facilities.

It would be best to start this review by putting my cards firmly on the table. I was one of the first people to buy an Apple Macintosh, almost three years ago. I consider myself a visually orientated person, and the Macintosh was a machine that thought and worked like I did — so I took to it immediately. Although the Macintosh had a few small problems, I was able to forgive it because it was fun and easy to use. For me, an IBM PC with its arcane, unintelligible gobbledegook, crude display and sickening colours had all the attraction of the enormous breeze-block it resembled. Life is just too short to have to memorise IBM manuals.

Macintoshes were for guys in jeans; IBMS were for men in suits. Therefore, no-one was more surprised than I was when *APC's* editor phoned and asked me to review a piece of software — IBM software. After I made sure he'd got the right number, I protested that I didn't even know how to switch on an IBM, let alone carry around in my head those ridiculous cryptic commands needed to make it perform. 'No problem', said Derek, 'it runs under GEM and it's just like your Macintosh'. My protestations were eventually overruled, but it was still with trepidation that I approached that ominous grey box.



Ventura Publisher operates through four icons: 'frames', 'paragraph tagging', 'text' and 'graphics'. Here the text icon has been selected and clicking 'Set Font' on its pull-down menu brings up a list of all options

Success story

From its early beginnings, the Macintosh has grown at an incredible rate. That growth began slowly because the Macintosh was such a different machine — it required a new way of thinking. You could not simply rewrite IBM software: Macintosh owners were a different breed who would not tolerate a user interface modelled on Gestapo interrogation techniques, and they expected to be able to use software as soon as it came out of the box. The eventual success of the Macintosh philosophy can be seen not only from the vast amount of software now available for the machine, but also from the fact that almost every other machine has tried to emulate it.

This new thinking asked questions such as: What is the Macintosh good at? And received answers like: Well... graphics, and word processing, and charts, and presentations, and things like that. Soon these areas were combined in packages for the presentation of documents — the design of information for the printed page — which still ruled despite (or perhaps because of) the microcomputer revolution. All that was needed was the introduction of Apple's amazing LaserWriter and for some clever marketing person to come up with the concept, and, hey, presto! — Desktop Publishing — an entire industry was born. And it was Apple's, all Apple's.

Desktop publishing (DTP) was not just selling software, it was selling Macintoshes — lots of them. Offices previously solely occupied by big, grey boxes suddenly had small corners where little

beige Macintoshes were appearing, with a bigger white box, the LaserWriter, at their side. People wanted DTP — and they were even prepared to forego compatibility to get it. And as people began to discover the power of mega-spreadsheets such as Excel, and realised that they didn't have to sacrifice their squash or evenings in the pub to memorise the manuals, the little beige boxes began to breed. The guys in jeans were no longer alone. Soon the men in suits realised what was going on: they had been outsmarted by the yuppies and there was only one answer — if you can't beat 'em, join 'em.

It took a while before the concept of DTP arrived on other machines, and most of the early attempts did little but discredit the whole concept. But serious DTP programs for the IBM are now on the near horizon, and include the eagerly awaited, but yet to be released, version of Pagemaker for the IBM, and, the subject of this review, Ventura Publisher ('Ventura') from Xerox.

At the start

To be of any real value DTP programs have to be easy to use, and because the IBM doesn't know what mice, icons and windows are, Ventura has been designed to run under the GEM operating environment and generally behave as much like a Macintosh program as is possible on APC. The choice of GEM over Microsoft's Windows will doubtless be a great boost to GEM should Ventura succeed, and presents an interesting paradox to those who recall Xerox's famous PARC/Smalltalk project (see 'Defeating the object', in this issue) where many of the principles that were to become the Lisa interface, (and thus the Macintosh), were developed — of which GEM is a slavish copy. Only the GEM operating system is supplied with Ventura — neither the desktop nor any other GEM programs are included, as with many other GEM applications.

Using the GEM interface has many advantages, for while the software may not be portable between the IBM and the Macintosh, the users can be. The screen bears a great similarity to the DTP programs on the Mac, and I found I could use Ventura immediately, only occasionally tripping up when GEM strayed from Apple's example — for instance, GEM's annoying system for selection menus which is necessary because Apple has patented the sensible way of doing it.

The choice of GEM also allows Ventura to be installed on a wide variety of configurations.

As a Macintosh user, I have always thought that 'installation' is what central heating engineers *do* and *avant-garde* artists *make*, so it came as an unpleasant surprise to realise that what for a Macintosh user takes perhaps 20 seconds at the most (and then only if you have a hard disk), is an incredibly convoluted process that can take over 20 minutes on the IBM. Were it not for being surrounded by those with the knowledge, this prospective page designer would certainly have fallen at the first fence.

Ventura Publisher is supplied on an 11-disk set and the installation procedure is invoked by typing 'vpprep' at the DOS prompt. Through a series of menus, the user is prompted to specify his or her particular hardware set-up: the options cover display, a pointing device (usually a mouse, though it could be a Summa tablet) and printer. More than one printer may be installed — for example, a laser printer could be used to proof the page — with the final document being produced in Postscript format for a typesetting machine.

For this review Ventura installion on an Olivetti M24, took 15-20 minutes, much of this time being taken up 'unpacking' the bit-mapped printer fonts. These fonts reside on the installation disk in Ventura's own format and are translated into the appropriate format for the printer in use. Ths process also creates the

It's difficult to give a page much impact when you are restricted to a maximum of 24-point type, but in close-up, the text is perfectly acceptable for LaserWriter output. The spacing between words and letters is good and the justification is generally well-executed — note where the automatic hyphenation has taken place. However, the tones in the drawing imported from GEM Draw have virtually disappeared, along with the finer lines. (Example text has been taken from the Cauzin Softstrip review, page 176, this issue.)

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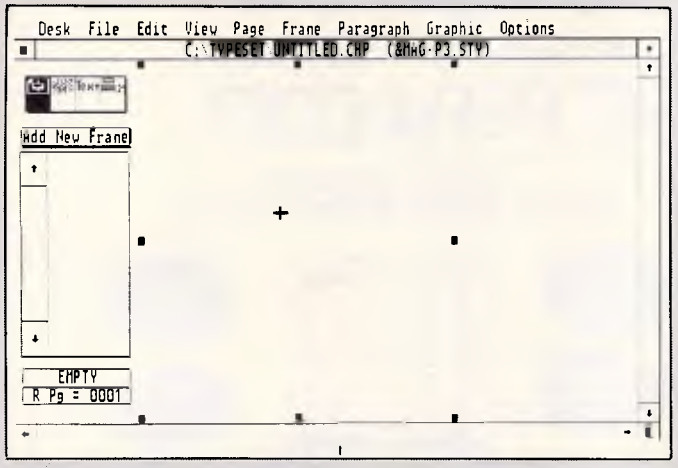
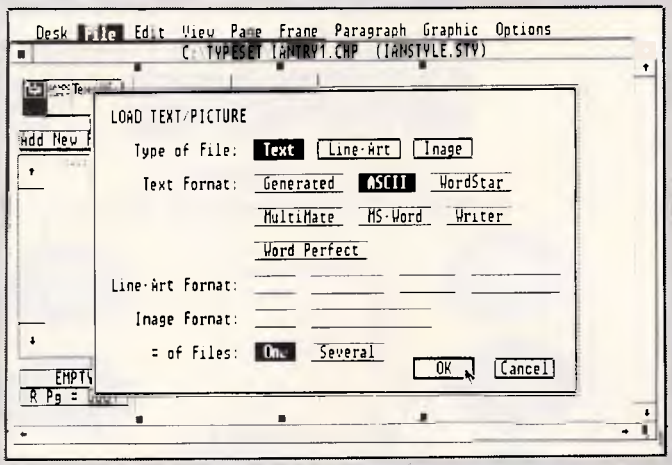


This is what greets you when the program is loaded; any resemblance between this screen and that of a Macintosh is purely intentional. The first action to take would be to load a 'style sheet' which contains a comprehensive list of information about which fonts should be used for which part of the document, what paper size you are using, what your sub-heads should look like, and so on



The next stage is to import the pictures and text that you will be using. Ventura automatically increases the number of pages to fit whatever document you include. Text and pictures can be imported from a variety of sources, and the names of the documents will be displayed in the large box to the left of the page. It's important that all of the documents you include are on your hard disk

representational screen fonts for the type of display being used.

Documents

There are two basic documents used by Ventura: a style document; and the content, which is referred to as a chapter. The number of pages in a chapter depends on your machine's memory: 40k of text for a 512k machine; 168k with 640k of memory. A number of chapters can be linked to form a publication many hundreds of pages long. Each chapter's file does not contain all the actual text, pictures, and so on, in the complete publication, but it does tell Ventura which individual documents are to be included in the publication, and it assumes that all of these are accessible. Annoyingly, if a drawing or text file is missing from the hard disk or is not in the floppy disk drive, the program doesn't prompt you to insert the relevant disk — it just ignores it and carries on regardless. Appalling.

Under this system, changes you make to text files while in Ventura are stored in the original documents. This helps save disk space (and you're going to need all the disk space you can get with this program) as information is not duplicated.

To create a new document, you would normally begin by loading in a previously created style sheet. This document contains extensive information for Ventura to use, such as in which font and size the main text (body copy) is to be set, the number and size of the columns used on a page and the size of the gutter between them, and a great deal more. In effect it's similar to keeping a blank document with all the pages already set up, with no text or pictures; but it's a far more elegant solution. Any item on a style sheet can be changed at any time; Ventura will then ask whether you wish to incorporate those changes into the style sheet for later use.

There are many sample documents (of which more below) included with Ventura, and most users would probably begin by adapting one of these for their own use. It is noticeable that throughout Ventura, both in the program and the manual, a fairly extensive knowledge of typography is taken for granted and specialist terms are presented with little or no explanation. The manual does contain a glossary, but this is a light weight affair and many of the terms used are not defined.

Although an experienced designer will be able to take most terms in his stride (though some, like 'deckhead', I had never heard of, nor could find any reference to), the average user of this package is unlikely to fit into that category. Most new users will have to begin to use the package by learning the terms and anachronistic measures that have been developed over the centuries by the printing industry, though these may appear as paradigms of logic and clarity compared to MS-DOS — and at least are in plain English.

It should also be borne in mind that the graphic and printing industries of the US and Australia sometimes use different terms for the same thing ('surprint' really means 'overprint'). To make life even more fun, they can also use the same term for different things: a 'point' in Australia and the US is $^{1}/_{72}$ of an inch — it isn't in Europe.

The review copy was an American version of the software — and it remains to been seen how much translation, if any, it will undergo for the Australian market.

In use

The way Ventura Publisher works in practice varies from machine to machine, depending on the kind of display you are using. Ventura naturally looks its best on a high resolution screen and will work with the 1280 × 800 pixel Wyse 700 unit. But the most vital variable is the kind of printer you are using, which greatly affects the performance of the program. For this review Ventura was used with a laser printer called the LaserMaster which is based on Ricoh's print engine and emulates a HP LaserJet. Unusually the LaserMaster has no fonts — these are downloaded at the beginning of the print session and changed dynamically as required. All fonts are bit-mapped, which means that a separate font is required for every size and style, and the maximum size is 36-point. Larger typefaces have to be incorporated as pictures created in programs such as PC Paintbrush, but this causes an inevitable reduction in quality. This obviously imposes great limitations — the entire Hewlett-Packard font set takes 1.6Mbytes of disk space!

Using Ventura with the Laser Master gave the use of only four fonts, and not all of them were available in all styles and sizes.

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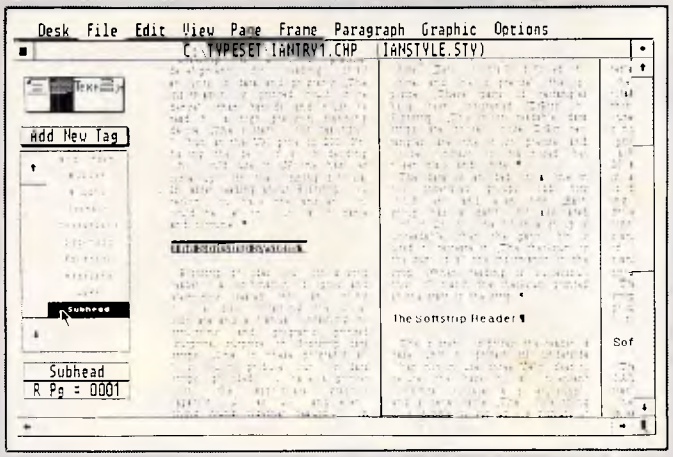
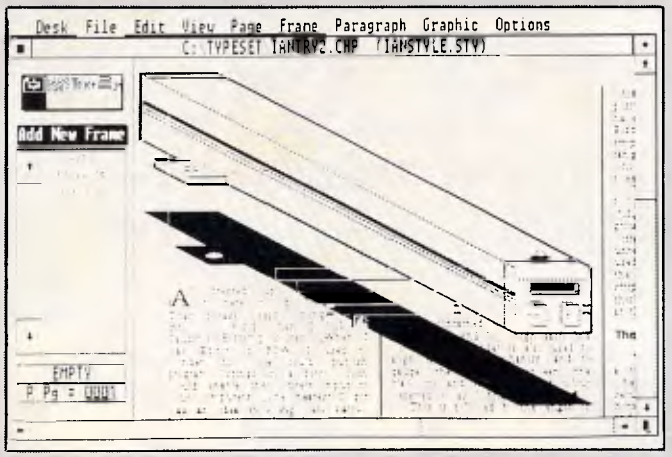
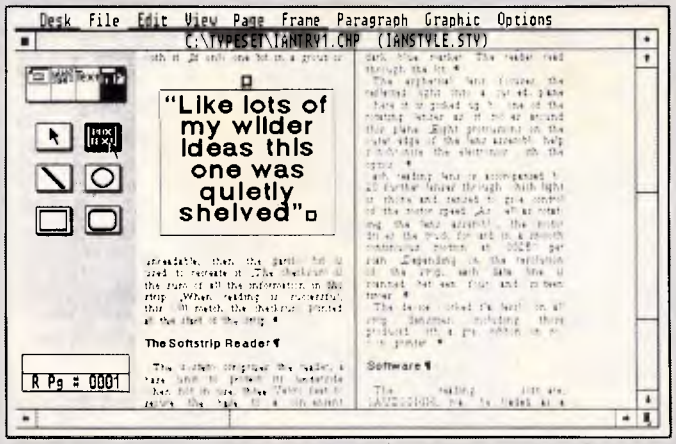


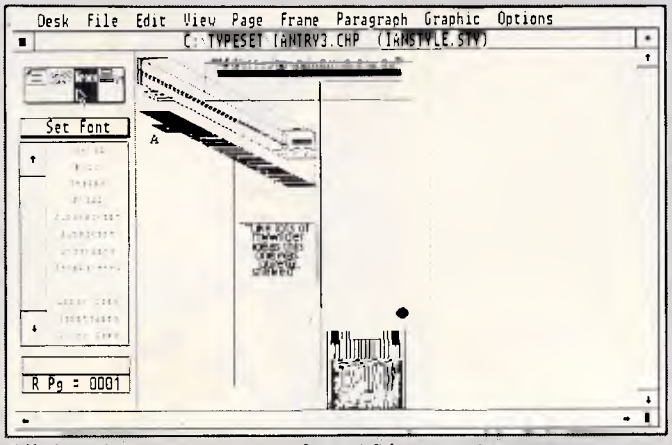
Here the text has been flowed into the chapter, and details and elements of the word-processing document are being selected and instantly converted into their relevant style by selecting the appropriate name from the box on the left-hand side — in this case a sub-head. It's possible to embed the code to do this directly in the word-processing document so that this process occurs automatically



Here a picture from Gem Draw has been pasted into the chapter, and text is being made to flow round it by drawing a series of 'frames' beneath the drawing. Any changes will ripple through an entire chapter very quickly and changes that are made to the text will also be made in the original word-processing document — pictures can only be resized, they cannot be redrawn



Ventura Publisher has a few basic drawing tools which can be used for creating grids, rules and simple shapes. Here 'box text' has been selected, around which can be seen the outline of the frame within which it sits. These graphics can be easily selected and repositioned, and the pattern with which they are filled (if any) chosen from a wide selection



All the elements are now in position on the page, as can be seen in this reduced view. Any of these elements can be 'picked up' and repositioned. Here the text is represented by lines, though this option can be disabled and the text drawn in full but it will be illegible at this scale. The text is generally drawn very quickly, but pictures can slow proceedings down considerably

Ventura becomes a far better program with a much greater range of options when teamed with a laser printer such as Apple's which, along with other Postscript devices, takes the opposite approach to the LaserMaster.

The outlines of a font are held in ROM in the machine. In the case of the LaserWriter Plus this means 11 complete typefaces — more can be downloaded. Rather than have a different set for each point size, each particular font size is scaled from that outline. There is no real limit to the size (maximum or minimum) of a letter, and it can be stretched, rotated, italicised, outlined, inverted, condensed, expanded, shadowed, and so on.

Using Postscript also allows portability between machines, compilers and printers: for example, a document prepared in Ventura could be proofed on the LaserWriter and then output to a Postscript typesetter, such as the Linotronic 100 working at 1200 dots per inch. And the availability of typesetters is very important, for although laserwriters at 300 dots per inch offer far better quality than daisywheel or dot-matrix printers, they are not typeset quality and not good enough for the highest-quality work. Venture can also be configured to work with Epson MX and FX dot-matrix printers, but these cannot be recommended for the job.

Ventura can import text and pictures from a wide variety of sources, both from word processing programs and graphics programs. Currently Ventura can open files directly from WordStar, Multimate, MS Word, Writer and Word Perfect — it can also open other files generated by itself. If your word processor is not on the list, then text can be imported into Ventura as an ASCII file. Investigating an existing Ventura text document reveals that many of the style changes, and so on, are visible as embedded code, and

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therefore can be included into documents that are for example, to be mail-merged — this also has the advantage that Ventura documents can be produced without needing a graphics screen.

As Ventura can cope with many formats, it is also capable of converting a document from one format to another. This facility for creating Ventura templates with another program is not limited to word processors. For example, templates can be created in dBaseIII for transfer to Ventura for printing, so that graphics could be added to, say, a catalogue.

Ventura can import graphics from AutoCad, PC Paintbrush, GEM Draw, GEM Paint, GEM Graph, Mentor Graphics' PC CAD and Lotus 1-2-3. The graphics used in this article were made using GEM Draw, GEM Paint and PC Paintbrush. In comparison with the wide selection of increasingly sophisticated graphics programs for the Macintosh, these three programs for the IBM and clones can really only be described as pathetic. Their resemblance to the Macintosh programs on which they are based is purely superficial. This lack of any good graphics program, apart from the extremely complex and user-hostile AutoCad, is a severe shortcoming of Ventura, and so is its lack of a seamless interface with most other programs.

Operation of Ventura Publisher is through icons and pull-down menus, most of which are generally well thought out. The four main aspects of its operation are presented by four icons in the top left-hand corner of the screen. Clicking on one of these icons leads to a different set of tools for undertaking different tasks.

The first icon represents 'frames'. Every element on the page, be it text, headlines or pictures, is contained in a frame. It's possible to have just one frame — the underlying page — or a number of frames containing many elements, possibly even overlapping. A frame can be thought of as a miniature page in itself, and can be set up in a style completely different to the rest of the chapter. Each of these frames, with the exception of the underlying page, can be moved and repositioned anywhere in the chapter. If a frame is placed over a block of text, that text can be made to flow around it — all very nice.

While in the frame mode, the box below the icon contains the names of all the documents associated with the current chapter, and including one of these is as simple as clicking on it.

The second icon represents 'paragraph tagging', where the style of a particular paragraph can be assigned. In this mode the box beneath the icons contains 'tags', which can be given names such as body text, byline, and so on, which are part of the style sheet. To create a new 'tag' the user specifies the attributes such as point size, font, spacing and alignment, which can be given a relevant name. Any paragraph, word or words that have been selected with the mouse can now be instantly changed by clicking in the list on the left (that is, assigning a tag to them). Thus, if a paragraph (which, in the case of a heading, may only be one word long) is selected (groups of paragraphs are selected by keeping the Shift key pressed) and 'sub-head' chosen (or whatever label you have applied to that particular style), it will instantly appear in larger bold type, with extra space about and below, outdented with a large first letter — or whatever style you have assigned.

This macro facility is one of Ventura's best features. It's fast, simple and elegant, and allows an existing word-processing document to be adapted to a particular style very quickly. In this respect Ventura is a real improvement over the Pagemaker on the Macintosh, and presents an object lesson in carefully considered program design. Many tags can be assigned to a style sheet, and a scroll bar appears at the side of the box when all of the tags cannot be displayed at once. Ventura can also generate an automatic table of contents by searching for paragraph tags, and it can also search for index entries to produce automatic index generation.

The third icon (if the word 'text' can be considered an icon) selects the mode for editing individual characters or words. Thus, in this mode, new text can be added or existing text altered, and the font and style of selected text can be altered very quickly by clicking on the appropriate style in the box to the left of the screen. Clicking the 'set font' box brings up a dialog box showing all the available options, and text can also be cut and pasted in this mode. The methods of selecting text lack many of the Macintosh's short cuts (such as double-clicking on a word to select the whole of that word). On the screen, small symbols represent the end of a paragraph and double word spaces, such as the beginning of a new sentence — they do not appear on the final hard copy.

The remaining icon, the graphic-drawing function, enables you to draw lines, rectangles and circles. These tools are very basic and not really comprehensive enough to undertake drawings of any consequence which need to be imported from a graphics program, but they are adequate for most page design.

User image

Most of the work undertaken using Ventura, apart from initially setting up the style sheet and making any exceptions to that style, will be undertaken using the four modes described above. This relative simplicity also allows for flexibility of use: for example, when a style sheet has been fully developed, *anyone* could use it to design pages. Many people could, and probably will, use the program like this without venturing any further. If they did, they would find a number of facilities that allow small changes to be made: for example, an individual character can be lifted a fraction of a millimetre at a time, and individual letter pairs can be moved closer together (kerning).

It is small touches such as these that add greatly to Ventura's claim to be a 'professional' page make-up program, but they also have a negative side — they make the program appear much more complex and, to a new user, much more intimidating, as dialog boxes offer a wealth of choices and decisions to be made.

On the negative side Ventura has some odd quirks — for example, it suffers the usual American chauvinism of having inches as the default measurement — and don't be fooled into thinking that if you've changed one, you've changed them all.

Documentation

The manual is a weighty tome. It was informative about the program and generally readable as manuals go, but it can only be described even by the most generous reviewer, as dull. Desktop publishing is about producing attractive, professional-looking results quickly and easily — and good design is not a subject dealt with in this manual.

Conclusion

Despite the general excellence of the program, Ventura is not a program that will sell machines to new users, because utimately it cannot fully overcome the complexities of the system on which it runs. However, for any company which already owns an IBM or compatible, Ventura Publisher is well worth investigating.

But don't be misled by desktop publishing — there's far more to producing a masterpiece than simply having the right tools. A great deal has to be learnt, and much of that learning has nothing to do with computers. Before you get too confident, remember that virtually all the materials used by Leonardo da Vinci can be bought from your local art shop!

Ventura Publisher costs $1750 and is supplied by MegaVision on (02) 957 5797.

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Ability

Ability is a fully integrated software package for the IBM PC and compatibles which offers a variety of functions at a knock-down price. But how substantial are its facilities? Robert Schifreen finds out.

According to its packaging, Ability is a fully integrated software package for the IBM PC and compatibles. It comprises a word processor, a spreadsheet, a database, a communications facility, a graph-drawing system and presentation graphics. Such facilities are certainly not unique among PC software, even when bundled together as an integrated package, though you'd normally have to pay at least around $1000 for them. So how can Tech Pacific afford to sell Ability for around $318, and include free telephone support?

The Ability box contains four disks, only three of which actually contain the Ability programs. The fourth is a self-contained interactive tutorial which, although well put together, is not really necessary.

Included in the box is a fold-out piece of card which I assume to be full of useless information and immediately threw away. It was only after spending half an hour scouring the manual for installation instructions that I turned, in desperation, to the card. On it was a section headed "Installation instructions", which informed me how to install Ability for use on a hard or floppy disk system.

Installing the software on a hard disk is just a matter of creating a directory called/ABILITY and copying the contents of the three program disks to it. Installation on a floppy disk system is slightly harder, as you can't fit a complete Ability system on a single disk. Starting up requires a disk change half-way through, while another change is required to enter the presentation graphics module.

Ability requires an IBM PC or compatible, with at least 384k of memory. In order to display graphics, a colour graphics adaptor and colour monitor are needed. If you have a monchrome system, you can use the text-based applications only. The system supports a Hercules card, and if one is installed, it is used by default and the system powers up in 43-line mode.

Getting started

When the software has been installed, you type ABILITY at the MS-DOS prompt. Ability uses only the unshifted function keys, and allows you to assign a string of up to 30 characters to each of the ten function keys used with Shift, Ctrl and Alt. These characters are stored in a file, and are loaded when you start, after the configuration details.

When these details have been loaded, you are presented with a library screen. This is the top-level screen from which all applications are loaded, and from where you can run external MS-DOS commands. There are seven columns, labelled: Database, Spreadsheet, Graph, Write, Communicate, Other Programs and Other Files. The presentation graphics module is a separate program and, therefore, appears in the Other Programs column.

Unless you indicate otherwise, or do not have a graphics monitor, the screen starts up in graphics mode. This allows you to have graphics and text displayed at the same time. The first word in each column is «NEW», under which is a list of all the files that exist in the specified categories. For example, any word-processing documents are listed in the Write column.

The names of files do not contain the files' extensions, as the extension is used by Ability to decide which application created it. Consequently, you can't specify an extension on a file when you save it. Any files containing extensions that are not recognised as having been created by Ability, appear in the Other Files column (these files can still be accessed from within Ability). As the file extension is used to group files, there's no need to have separate directories for different types of files.

At the bottom of the screen is the status line, which displays the name of the currently selected drive and also the amount of free memory. All applications are RAM-based, so if memory goes down to 0%, you can't make the current file any larger.

If the Caps Lock or Num Lock functions of the keyboard are active, the words CAPS or NUM appear on the status line. Below the status line is a list of the function keys that are curently available. Pressing F2 brings up a list of commands, any of which can be activated by typing its first letter, or highlighting it with the cursor and pressing Return. Highlighting a command and pressing F1 produces a help screen referring to that particular command.

Every command in every part of Ability has a screen of related help information. Most commands are executed by pressing F2 which displays a list of commands,

and a command can then be selected by typing the first letter of its name. These menus are sometimes two or three levels deep, but you don't have to learn any commands — everything that Ability can do is listed onscreen in one menu or another.

To use an existing file, you just move the cursor so that the file's name is highlighted and press Return. According to which column the file's name is in, the correct application will be started and the specified file loaded.

Whenever you load or save a file, a copy is kept in memory. If you select the same file again, it can be loaded more quickly from memory than if it were stored in disk. Files which exist in memory are marked on the library screen with an asterisk after their name. When the indicator on the status line shows that you are running out of memory, you have to return to the library screen and ask for any unwanted files to be removed from memory (the copies on disk are not affected). Normally, putting away a resident file takes just a couple of seconds. However, if you only have 1% of memory left, it seems to take forever — I gave up after 10 minutes and rebooted the machine.

If memory permits, you can load two applications simultaneously. Flipping between them, as it's called, is accomplished by pressing F9. If only one application is loaded, pressing F9 takes you to the library screen from where you can load another. The two active applications can be of the same type (spreadsheet, word processor, database, and so on) or they can be different. Such a facility makes for an easy method of moving data between files, as you can pick up a block of data from a file, flip to another application and put it down. Keys F5 and F6 are helpfully labelled Pick Up and Put Down. If you flip to a second application, and from that second application, try to exit to DOS, the first application that has been suspended automatically will be saved before Ability is exited.

The display in Ability is all one colour — normally green. When you flip to a new application, the screen changes to cyan to remind you that you have changed applications. These colours can be changed through an option on the library screen, and your chosen colours will then be permanently recorded in the configuration file.

Word processor

Ability's word processor is called Write. It has all the functions of a basic word processor, but lacks some of the features found in more expensive packages. What Ability does, though, it does well. It's also incredibly easy to use.

You start the word processor in one of two ways. If you select a file from the Write column on the library screen, the word-processing program appears and the selected file is loaded. Alternatively, you can select «NEW» from the library screen if you want to create a new file. You will then be prompted for an eight-character filename before you can enter text.

When the word-processing module has been powered up, the familiar status line appears at the bottom of the screen. This tells you the name of the file being edited, and has indicators to show the current page, line and column number. There's also a note of the amount of free memory, which starts at around 96% and varies according to the number of files held on the library screen. With a page length of 60 lines, I managed to enter a 78-page document before getting down to 1% of remaining memory on a 640k PC.

The format of the page onscreen is rather strange. Each page is surrounded by a border made up from block graphics characters. At the end of a page is a horizontal row of block characters, then a couple of blank lines appear before a new frame starts.

Below the status line is a list of the available function keys. As always F1 is used for help, and F2 produces a list of commands — for example, Centre, Typestyle, Print, Spreadsheet and Graph. The Spreadsheet and Graph options are used to insert another file into the document. When you have selected the option, you are prompted for a filename. The specified spreadsheet or graph is then loaded and, if you're in graphics mode, is displayed onscreen.

The other options are fairly self-explanatory. You can select a menu option by positioning the cursor over it and pressing Return, or by typing its first letter. Selecting the Typestyle option produces another menu from where you choose bold, italic or underlined text. Because everything is done in graphics mode, the image you see onscreen is made to look as much as possible like the final, printed output.

As with all functions, the Typestyle commands operate on a block of text if

Creating a new file or using an existing one is simply a matter of selecting an option from the library screen. The column heading tells Ability which application program you want to load

If memory permits, Ability will handle a spreadsheet of 9999 rows by 702 columns. Sideways printing is built in. Functions and formulas can be included in word-processing documents

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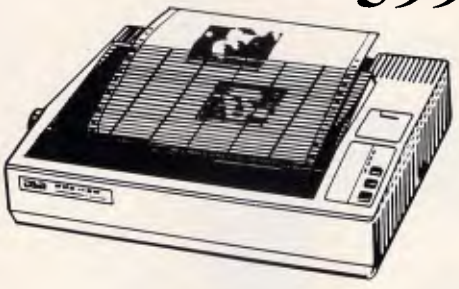

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MINI AT

Zeno MINI-AT

SPECIFICATIONS

Size:
Same footprint as PC/XT.

Colour graphics board:
RGB colour output. Composite colour output. Composite monochrome output.

Multifunction board containing:
Parallel printer port. Games port. Serial port.

Disk drive controller:
Hard disk controller. Floppy disk controller. 1 x 1.2 megabyte floppy disk drive (NEC).

Motherboard containing:
Real time clock with battery back up. 640k memory.

Keyboard:
Enhanced with large "special" keys and excellent tactile characteristics.

Processor:
80286. 6/8 megahertz.

Award BIOS.

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one is currently marked. If not, the command operates on any text you type after selecting it.

A number of key combinations are used to move around the file. The cursor keys by themselves move the cursor in steps of one character; pressed with the Ctrl key, they move in steps of a word. The Home and End keys move to the start and end of the current line, while PgUp and PgDn move up and Dn by a Pg at a time. Ctrl-home and Ctrl-end move straight to the top and bottom of the document, respectively.

As everything is based in RAM, movement is very fast. Block operations are performed using the F7 key, to highlight a block. This key, known as the Shade key, is used to highlight a portion of the screen and is used in every part of Ability, not just the word processor.

To delete a block of text, you shade it with F7 and then press Delete. To move a block you shade it and pick it up with F5, then move the cursor to where you want the text to be, and put it down with F6. You can also put text down in any other Ability application as long as it's in the correct format.

Being able to flip between applications made it easy to write this review. I kept the text that I was writing in the word processor, but could look at any other part of Ability by flipping to it.

Inserting a graph in a word-processing document is easy. A graph option on the menu lets you insert a graph at the current cursor position; the graph is then displayed onscreen as part of the document. When you save the document, though, the graph is *not* saved. Instead, the document contains a special pointer which indicates the name of the graph to be included. With this method, if you update the graph, the changes will be reflected in the document. It also saves disk space, as you can have the same graph in 30 different documents, although only the one copy of the graph will be kept on disk.

The F3 key is called Goto, and it leads to two commands. The first is called Search, and lets you go to a specified word in the document. As in MS-DOS and CP/M, the wildcard characters * and ? can be used to represent one or more unknown characters when searching for a string. The other option on the Goto menu lets you go to any page which you specify by its number. This is useful if you are editing a long document. The word processor's pages are normally set to a length of 54 lines, with margins of 10 and 75. These can be changed through a menu option. Headers, footers and page numbers are all supported.

Although the onscreen text is in graphics mode, Ability was intelligent enough to drive my Epson printer in text mode. If you have a graph included in the document, the printer switches into graphics mode to produce the graph, then back to text mode for the plain text.

There is also an option on the Print menu that will print a file to disk.

Write will cope with existing WordStar files, and will even convert them to Ability format so that the fonts display correctly onscreen.

When you have input a document, you press F10; this is the 'Done' key, which tells Ability to save the current task and return to the library screen. It's worth noting that Ability doesn't make back-up files of edited documents. If you want a back-up, you can use the Copy option from the library screen to create one before you edit a file.

Generally, I found the word processor easy to use, though the screen updating often falls behind if you are typing fast. The lack of a spelling checker is a problem, but one has been promised for version 2.

Spreadsheet

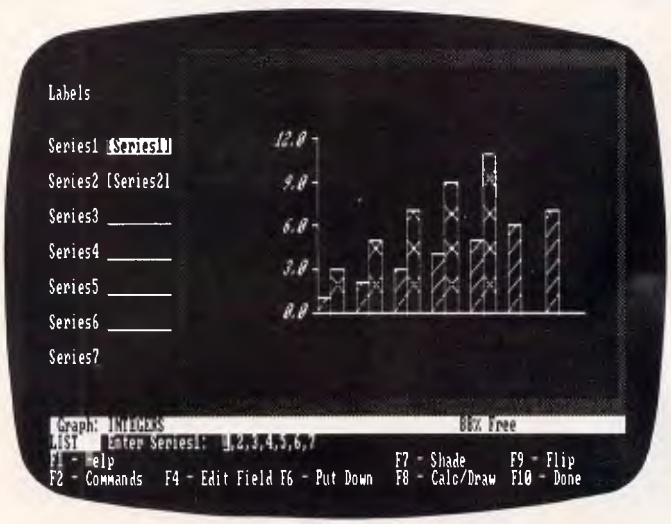
As long as you have enough spare memory, Ability can handle a spreadsheet of 9999 rows by 702 columns. Like all Ability applications, you start the spreadsheet from the library screen: the spreadsheet grid appears and the cursor is at cell A1. The status line gives you the name of the current file and the amount of memory remaining.

Below the status line is the prompt area, where you enter or edit the contents of a cell. Below this is the list of function keys, some of which perform functions of their own, while others lead to further menus.

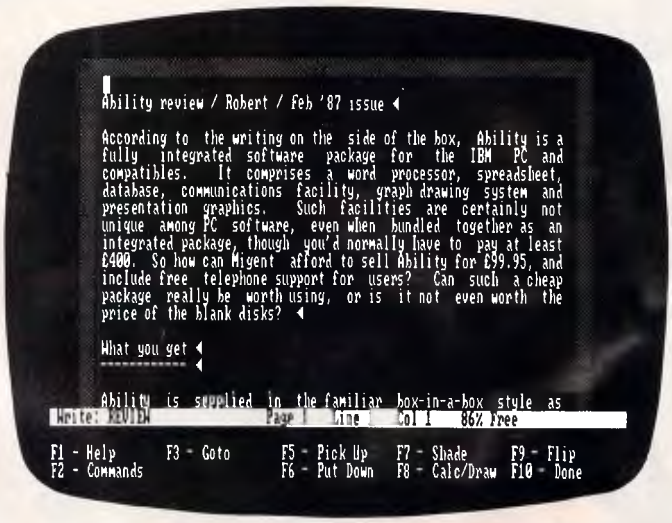
Again pressing F1 brings up a help screen related to the selected menu option.

Moving around the spreadsheet involves the same key combinations as the word processor. Pressing F2 leads to a menu of commands. Commands which apply to cells normally operate on the current cell — that is, the one which the cursor is on. However, if you use F7 to shade a block of cells (as in the word processor), any command will operate on the block. You can pick up a block of cells and put them down in another application.

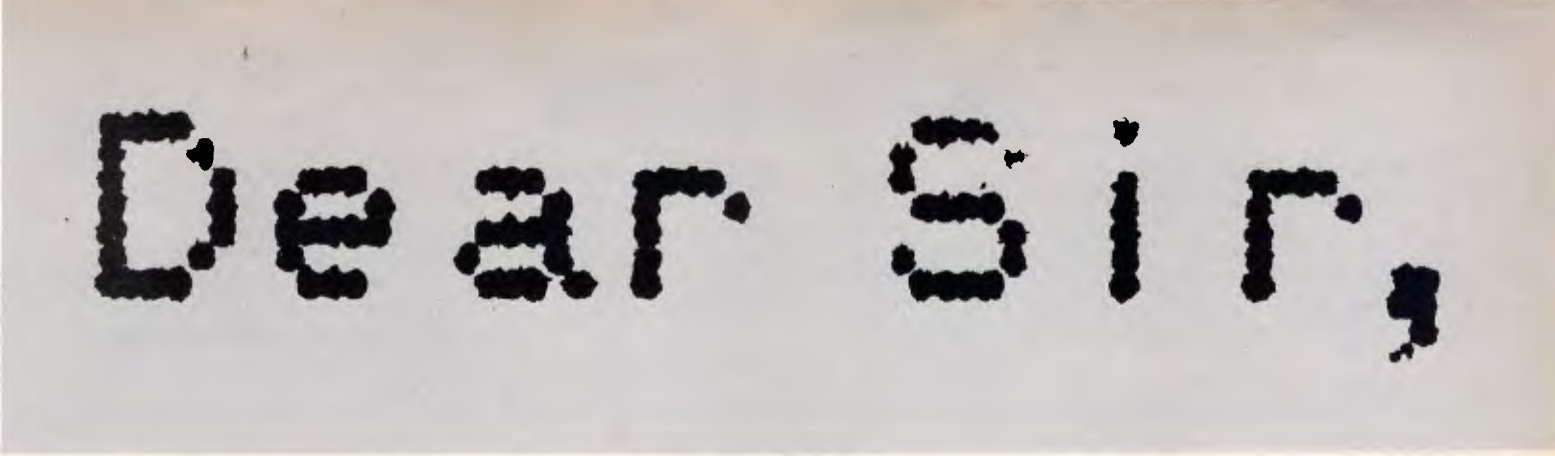
The Data-fill command fills a marked block of empty cells with a sequence of values. When the block has been marked,



The graphics module will graph up to seven sets of values. Sets can be superimposed onscreen and need not all be drawn in the same mode. Updating a graph automatically updates exported copies



Ability's word processor is RAM-based with a maximum document size of around 80 pages. Underlined, italic and bold text are shown on the screen as they will appear on the hard copy.



Actual unretouched photo – 9 pin printer

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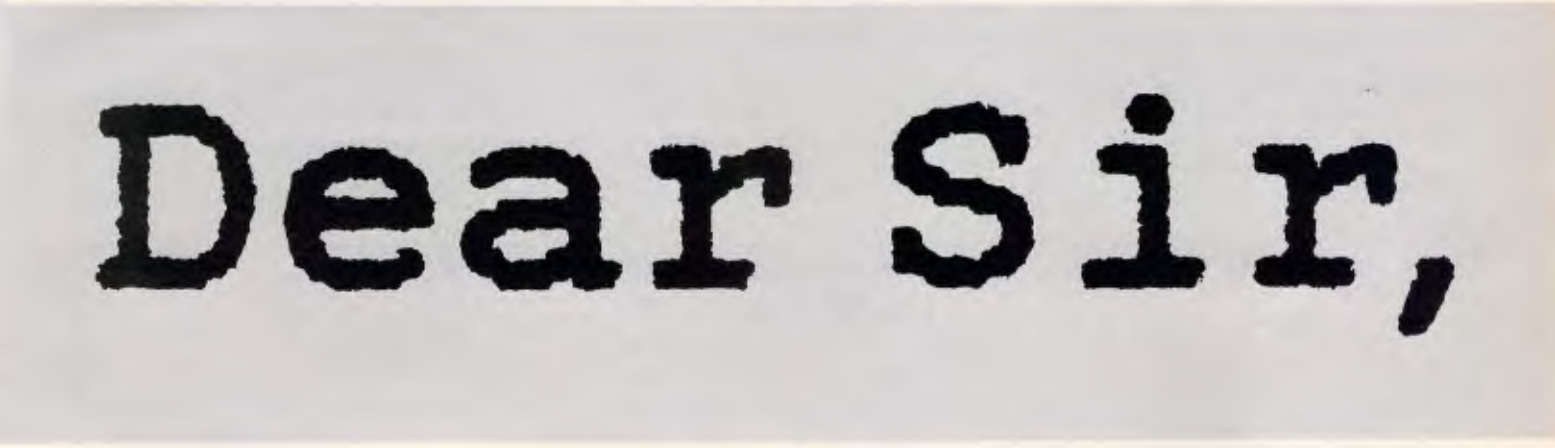

Actual unretouched photo – Toshiba 24-pin printer

Everybody knows the importance of making a good first impression.

The first impression most people have of your company is the correspondence they receive from you.

But have you looked recently at just how impressive those letters are? If you've had your printer for a while, chances are that it's not up to scratch.

If you want to make the best possible impression, it makes sense to talk to the people who know most about printers (after all, Toshiba were the inventors of 24-pin technology).

You'll have the choice of a range of printers with a selection of font styles and sizes, paper feeds and loading, and a range of prices. In fact, about all they have in common is their technological superiority, compatibility with major PC brands, and their legendary Toshiba reliability.

There are four printers in the Toshiba 3-in-One range (fast drafts, letter quality and graphics) printers:

P351 – the industry standard setter. Compatibility with just about all IBM software, high speed printing at 300 characters per second. Letter quality printing at 100 characters per second with ten fonts selectable from the front panel. An extra 45 fonts are accessible through font cartridges and downloadable font disks. Superb graphics, automatic paper loading.

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P341e – An economical wide carriage printer with high speed printing and automatic paper loading, from A4 to A3. Letter quality printing at 72 cps, plus graphics and high speed drafts at 216 cps.

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you specify the starting value and the increment, and Ability does the rest. There is a Sort command, which will sort any row or column into ascending or descending order. Sort works with numeric fields or alphabetic labels. The Transpose command rotates a marked block of cells by 90 degrees.

Formulas must start with a plus sign or any other symbol which makes them uniquely identifiable as a formula. If you enter the contents of a cell as A1+A2, the text 'A1+A2' will be put in a cell. To put the sum of A1 and A2 in a cell, you have to specify the formula as +A1+A2.

If a cell contains a formula which can't be evaluated, the symbol «N/A» appears where the result should be. If, in the above example, I had not put a value in cell A1, the result of A1+A2 would display as «N/A».

As well as standard maths symbols, there are 46 functions that can be used in formulas and — believe it or not — other Ability applications. There are functions to calculate interest rates, averages, trig functions, and so on. Write includes a command to create an area on the line known as a field, into which you can enter a function just like a cell on a spreadsheet. Fields are allocated a unique number when you define them, and you can use these numbers to refer to other fields. There's also a full recalculation facility which will update any affected fields if a value changes — nothing new when it comes to spreadsheets, but a wonderful facility for a word processor to provide.

Printing the spreadsheet is simply a matter of selecting a menu option. There's a built-in sideways option which will print a spreadsheet sideways if the selected printer has a graphics mode.

Database

The Ability database works like a card index. To create a database you first create a master form; then, to add records to the database, you fill in the form on the screen. To start a new database, you select «NEW» from the Database column on the library screen and you are then presented with a blank screen on which to create the master form. The form is created in exactly the same way as creating a document with the word processor, so it's easy to get everything looking right. The only extra command is one to define where the fields go (these are the areas that will be filled in when you start to put information into the database). To enter a field, you select an option from the menu and use the cursor keys to mark out the length of the required field.

When the form is complete you press F10 to save it, which puts you into Add Forms mode. Your master form appears onscreen, with the first field highlighted. Entering information is done by typing into the space marked out by the field; the cursor keys move the cursor around so that each field can be filled in. When the form is complete, pressing F10 stores the data on disk and presents you with another blank form to start adding the second record. This process will continue until you press F10 again, which puts the system into Browse mode.

In Browse mode, you can look through your newly-created database. The standard cursor key combinations are used to move around the database in increments of a character, a field or a complete form. The sequence number of the record you are looking at is displayed on the status line.

As in all Ability modules, commands are executed by menu selection. F3 is the Search command: if you know the number of the record you want to examine, you can go straight there by typing its number; if you don't; the

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search process involves filling in one or more fields on a form. The system then searches for records that match the partial form you have filled in. You can use the * and ? pattern-matching characters in searches, as well as the =, < and > characters to specify ranges of values to look for. Also, AND, OR and NOT can be specified in searches by the use of special characters.

When the information has been put into a database and saved, you can retrieve it with the Report command. There are three types of reports. If you select a Forms report, the information will be printed in the same format as it appears onscreen. The Summary option enables you to have columns of output, with each column being one field from the database. To produce a summary report, you fill in a blank copy of the master form, but, instead of putting data in the fields, you put a number there. The summary report will then be printed, with the columns appearing in the order specified by the numbers you put in the fields. The third type is mailmerge.

The database system contains a number of commands for manipulating the data in forms; one of the most useful being the ability to sort the forms in a database, with the sort taking place against any specified field.

Deleting a form involves pressing the Delete key when you are looking at the form you want to delete. Ability keeps a copy of all deleted records, so it's possible to retrieve them if you change your mind. When memory is running low, you can permanently delete those 'deleted' records which are still being stored.

Ability will quite happily let you edit the master form of a database, and will even let you add or delete fields. The old database will then be copied into the new one. If the new database contains fields that were not in the old one, the new fields will be left blank. If you delete a field, the information will not be copied into the new database.

The Pick Up and Put Down options allow you to pick up records from a spreadsheet and, as long as the fields are wide enough, put them down in a database form.

Graph

The graph utility allows you to draw graphs onscreen and print them to a printer or plotter. The values for the graphs can come from the keyboard or an Ability spreadsheet. When the graph has been drawn, it can be included in a word-processing document.

The graph module is started from the library screen like all other applications; the status line and function key list then appear. When the graph program has been loaded, you can type in a list of numbers separated by commas. A bar chart is then drawn, with scales automatically generated. If you don't like the program's choice of scale, you can change it.

Ability can draw a graph with up to seven series of numbers. Each series is a separate set of numbers, whose graph can be superimposed on another set. For example, if you were graphing half-yearly sales and profit figures, you would have one series for each month's sales and another for the profits. When the graph is drawn, all the numbers from the first series are plotted, followed by those from the second series. For example, all January's data will be drawn first, then February's, and so on.

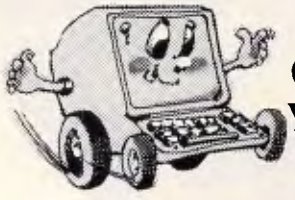
There are four graph styles available. A bar chart is the default, which plots numbers in different series next to each other. The stacked bar chart shows numbers in different series on top of each other, so, in the above example, there would be six columns with each month's sales and profits on top of each other. The bars are shaded to show where one value ends and another begins.

You can also opt for a line graph or a pie chart. Pie charts can show only one series. Selected segments from a pie chart can be 'exploded', pulling them away from the remaining segments. It's easy to graph values from a spreadsheet. You tell Ability which cells in a spreadsheet are to be graphed, and the values are extracted and the graph is drawn. This is done by specifying what are known as linked fields. Printing a graph is done from a menu, like any other Ability file — and you can print the graph sideways if you wish.

Communications

The communications facility is a terminal emulation program for connecting to services like Minerva. Viewdata graphics as used by Viatel are not supported. For each service that you will be calling with Ability, you have to specify a screen of information. This is entered on a form just like entering information into a database. You can specify the emulation required (dumb terminal, VT-100 or VT-52), and baud rates and other parameters. Ability will work perfectly with a Hayes-compatible modem or any other dumb modem. If you have a Hayes type, you can specify the phone number of the service and have it dialled automatically for you.

There is a facility to upload ASCII files to a remote computer, and another that allows incoming data to be captured to a file. The captured data is automatically put in a file with extension .CAP. Unfortunately, this means that it doesn't end up in the Write column on the library screen, as it isn't classed as a Write document (such documents have an .XTX extension). To load the captured data into Write, you have to rename it so



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that it appears in the correct column. Alternatively, you can include it into a document with an Include command and then save the file from within Write, which will assign the correct extension.

In addition to the terminal emulation, there's also a mode that allows files to be sent automatically between two computers that are both running Ability. You can specify a password that will be sent to the other micro before file transfer, and you can also specify the password you expect to receive from the other micro before proceeding with the transfer.

For remote services which have a lengthy log-in procedure, you can put the required commands into a file called a log-in file which contains commands that instruct Ability to send your log-in commands to the service at the correct time.

Despite operating the screen in graphics mode, Ability had no problems keeping up with incoming data at 1200 baud and displaying it. Each character was displayed as it arrived, compared with, say, Gem Comm, which waits for an entire line and then displays it all at once.

Presentation

Ability features a presentation graphics module. This does not appear in its own column on the library screen, but exists as an option on the Other Programs column. The program can be run from the library screen, as can any other MS-DOS program; or it can be run from the MS-DOS prompt, independent of Ability.

Within every Ability application, you can take a snapshot of the screen display by pressing the large, grey '+' key. The presentation program let you play back these snapshots to form an automatic display. When you take the first snapshot, you are asked for the name of the snapshot library file; when this has been given, all subsequent snapshots for the session go to the named file. Taking a snapshot is done by pressing the single '+' key, and the snap is added to the current library. The presentation program allows you to re-order the snapshots in the library at a later date.

When you have saved some snapshots in a library, you load up the presentation program and tell it which library you are using. Within the presentation program are options to add, re-order and delete snapshots from the library, as well as play back the current selection onscreen. A contents list of the current library is shown, and you can specify the time that each slide will appear onscreen before being replaced by the next in the sequence. You can also put captions on slides, or create blank slides that just contain captions.

Most novel among the snapshot features is the music. The program has a built-in repertoire containing snippets from a selection of popular tunes, as well as the odd fanfare. Each snapshot can be allocated a tune, which will be played through the PC's interval speaker when the snap is displayed. Although it isn't the most useful of Ability's applications, the presentation graphics could be put to good use in sales demos.

Documentation

The Ability package includes a 200-page manual bound like a paperback book. Trying to learn about software by reading manuals is never a good idea; but Ability is so easy to install and use that you can easily get by without opening the manual.

Conclusion

Would I recommend Ability? The answer is a definite yes. Although I would have to admit that it lacks some of the more advanced features found in expensive software packages, it does cope well within its limitations. For the money it's an excellent introduction to integrated software, and should be able to deal satisfactorily with the requirements of a small business.

My main criticism is the lack of a spelling checker for the word processor, but Ability 2 will include one.

If you have any problems with Ability, Tech Pacific, the supplier, is also handling the support side.

Ability costs approximately $318. For more details contact Tech Pacific on (03) 690 9055.

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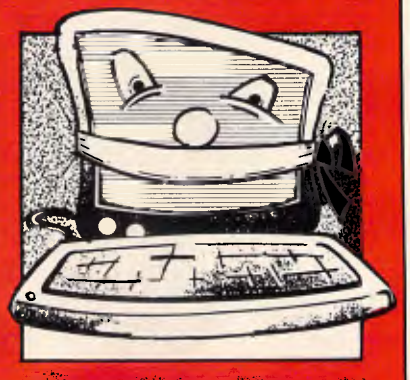

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Paul Hardy, Bushcat.

Driving without due care and attention

My car can comfortably travel at 100kph on local roads, even in wet and slippery conditions. The next time I crash because I am driving without 'DC&A', I think I shall sue GM or Ford, or whoever: it's obviously the comany's fault for selling me the car.

At least that's the logic of a blatant piece of journalistic sensationalism, the like of which I did not expect to see in *APC*. In the November 1986 issue, David Ahl wrote about a user suing Lotus because of a fault that he, the user, had introduced into the model. Ahl seemed to be giving tacit support for the case with such phrases as 'faulty software', glitch in the software', and 'if software doesn't perform in accordance with its specifications'.

The instance Ahl uses to illustrate what, in essence, might be a good talking point, is flawed through and through.

True, you may consider I have an axe to grind. As a Lotus Authorised Consultant, I am only too aware that larger spreadsheets need careful driving. And just as I would not expect youngsters to pick up a steering wheel and venture forth without expert tuition, so the average Lotus user needs guidance.

Using the @SUM function in a sensible manner is a key point on my IT courses, as it is on many others.

Geoff Mosley.

Could the answer also be to use analytical tools like Javelin to sort out the intricacies?

Not in the same league

With reference to the Compaq DeskPro 386 Benchtest by Peter Jackson in the November 1986 of *APC*, I find his 'comparison' — or rather, his reference to the Compaq machine as being a contender to the IBM System/38 — as rather mind-warping.

As I'm a System/38 programmer, and also quite capable of programming and using micros (I use them as network PCs to the 38), I think I can make a reasonably unbiased view based on his Benchtest.

The System/38 is not a 'small minicomputer'. It began life as a medium-to-super minicomputer and has now, with the new model 700, grown into a fully-fledged mainframe system. The 38 has always had strong competition from below in the form of the System/36 and its SSP operating system; and from above with the IBM 4300s running the VM operating system. However, it has survived, and the 38 is arguably one of the most powerful business data processing machines available.

The 38 operating system (CPF — Control Program Facility) uses 64-bit address resolution — already a significant increase in memory capacity over the DeskPro 386. Internally, though, the machine uses a 48-bit address bus to cut down on hardware costs. The MI (machine interface) transforms the different-sized addresses, and this is not apparent to the user. IBM could increase the address space to 64 bits at the machine level at any time without affecting user applications. Disk storage is 14 gigabytes, using the highest-capacity disk drives currently in production (25 megabits per square inch).

However, this is only a practical limit, as the 64-bit CPF resolution can, theoretically, address a great deal more. You can have as many as 256 local users and remote users can extend to a theoretical 20,000 but you would run out of processor and networked resources long before that limit was reached. CPF is vastly more powerful than any micro or 'super-micro' operating system (and Unix if you are a supporter of the 38 stable).

Logical data views over physical data files are just one of the 38's powerful integrated pseudo-relational database functions.

('Integrated' in this case means that the machine handles most of the database functions as opposed to the operating system. Security is another integrated function).

I have no doubt that the DeskPro 386 is a powerful machine, but only as long as

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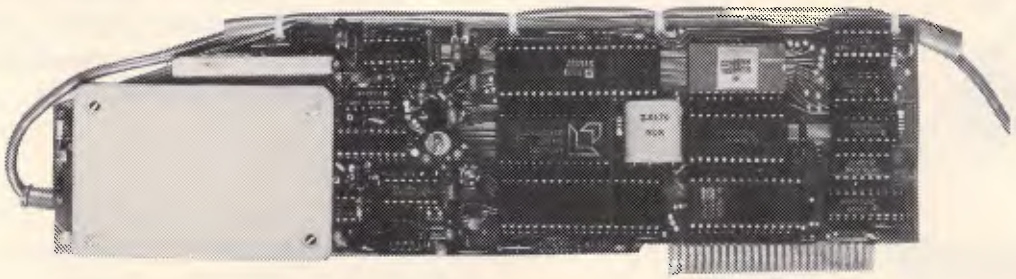

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Sending/receiving files is very simple:—
— Press "ESC" to display menu.
— Select "(S) END A FILE" option
— Answer the prompt "FILENAME?:"

The modem will search the disk for the file, make all the decisions (e.g. binary, basic, textfile, DOS 3.3 or ProDos) and transmit it in the correct format. <CR> transmits the file in memory. Similarly to receive a file select "(R) ECEIVE A FILE" option.

* AUTO ANSWER — AUTO DIAL. Senses true dial tone, ring tone, busy tone and acts intelligently, returning status messages. Characters can be included in the phone number to set baudrate, pause, "await dialtone" and multiple redial on busy. On answer, it selects the incoming baudrate by precision frequency measurement. This is much more reliable than the normal autosearch using carrier detect which is often confused by voice and phone tones. A reliable autosearch is a must for bulletin board operation.

* 300 Baud full duplex or 1200/75 and 75/1200 with fast automatic line turnaround. An upgrade kit to add V22 (1200/1200 baud) and V22 Bis (2400/2400 baud) will be available later.

*Main menu option "(V)IDEOTEXT" shows the VIATEL menu. It becomes a full graphics VIATEL terminal, automatically dialling and transmitting the user ID stored in the battery backed ram. When online, a keypress will immediately save pictures to memory. These can be reviewed later and selectively saved to disk or printed (requires a graphics printer card). Pictures can be loaded from disk and printed out. The modem can act as a videotext host and can be programmed to act on frame information. e.g. — use the clock to ring "MONEYWATCH" hurly and dial you at the office if your shares move outside a given range.

* TELESOFTWARE DOWNLOAD facility to purchase programs over VIATEL from suppliers such as MICROTEX 666 and TANGO.

* A full wordprocessor in EPROM for pre-composition of text before transmission. It can also be used to edit or print received files as well as for general wordprocessing.

* Onboard battery backed calendar clock can time and initiate calls or keep an activity log. ProDos uses it to time and date disk files and it is accessible from Basic.

* 2Kx8 battery powered CMOS RAM stores default parameters, phone numbers, ID, password, logon strings, search codes and setup parameters (e.g. baud rate, parity, printer ON) for each number, allowing single keystroke call establishment to specific areas of complex databases. Main menu option "(T)ELELIST" displays the list of 23 names and one is selected.

* Incorporates XON/XOFF and CHRISTENSEN error correcting protocol. Textfiles are not so fussy but error correction is a must when transferring program files. A debug function can display normally invisible control characters sent by the host.

* Can output directly to printer even when online at 1200 Baud — a fast printer is not required as the printer is spooled out of the receive buffer. A "FILTER" function is available to remove screen control characters from textfiles (these can drive a printer crazy). Special scroll routines print to 80 column screen and printer at 1200 Baud without any lost characters.

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it is viewed in the right context — as a super micro.
Warren Allen.

Intelligent implications

David Levy's arguments in 'Literary Choice' (*APC*, January) have implications which he may not have considered.

One useful rule in estimating the intelligence required to perform any action is that one should never assume that an action is the result of a higher function of intelligence if it could equally well be the result of a lower function. In the case of Ms Chisman's program, the function performed is the random selection of preset words and phrases in fifteen categories — this is a very low function of intelligence. One could build a machine containing fifteen faceted wheels, with words or phrases in the appropriate category printed on each facet, and have the machine spin the wheels. This would perform the same function, but I would not on those grounds argue that a glorified fruit machine was intelligent.

The fact that the end product of one process is not readily distinguishable from the end product of another process does not mean that one can directly equate the two processes in terms of skill or intelligence. One could write a program which enabled people to write programs, simply by presenting them at each stage with a series of alternative instructions which they could type in, any of which would be correct. The results would be indistinguishable from computer programs created by a programmer, but one would not argue that anyone playing this game was *ipso facto* a computer programmer.

These programs, considered as intelligence tests, effectively consist of a multiple-choice test in which every answer is correct. The end result, a mark of 100 per cent, is indistinguishable from a mark of 100 per cent awarded in an examination in which it is possible to get the answers wrong. The functions of intelligence required to attain those results differ.

If Mr Levy really regards 'intelligence' as an assessment of product rather than process, then, as he asked Mr Goodwin, what value does he put on intelligence?
Stephen Airey.

As long as they don't invent low-intelligence machines to edit magazines, we'll be happy. (Whaddya mean, you thought they had already?)

IBM's intentions

I refer to Mr Baccanello's recent article 'Spinning the Token Ring'. This otherwise clear and informative article was somewhat misleading about the software support.

IBM has not made the Token Ring dependent upon Netbios. Netbios is merely there for migration of PC Net software, such as that used between a PC 3270 Workstation and a PC 3270 Gateway.

It is clear that IBM regards the Adapter Support Interface (ASI) as the way forward, not Netbios. APPC-APPC communication (PU.T2.1) uses ASI. APPC-3725 (PU.T2.0) over TR will use ASI.

PC 3270 V3 will be able to communicate with the 3725 over TR using ASI. In short, none of the IBM software products which are specifically for Token Ring use Netbios.

As observed in the article, Netbios is not suitable for internetworking and has no hook-up to SNA. ASI, in contrast, has clearly been developed with both of these requirements in mind.

It follows that customers who are new to LAN should be more interested in the performance of APPC PU T2.1 for inter-PC communication than that of PC Network.
Derek Bolton

SDI war rages

After reading the December edition of *APC*, I believe that a reply is in order to R Roper's comments concerning my letter published in October *APC*. Unlike Mr Roper, I distinguish between valid comment and blatant propaganda. Guy Kewney's remarks were propaganda because he failed to provide any sort of evidence, rational argument or any quotations from more knowledgeable people such as R Roper's quotation of Theodore H Nelson. Had Guy Kewney done so then he would not have been subject to criticism. It is most unfortunate, however, that the quotation of Theodore H Nelson failed to provide evidence that 'all those computer programs have to work perfectly the first time'. Upon thinking about the matter, I have come to the conclusion that they can be tested as often as necessary. My logic is as follows:

In order for the SDI project to successfully defend (say) the USA it would be essential for it to be able to detect and destroy all missiles launched from Soviet territory, all territory held by Soviet allies, and all Soviet or Soviet-allied planes and ships in neutral territory (say North Korean ships and planes in the Pacific Ocean).

Assuming that the detection and destruction of missiles

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launched from Soviet or Soviet-allied territory is comparitively easy (radar units mounted on satellites, say, would detect them), then the problem could lie with detecting and destroying missiles launched from neutral territory. In order to do this, it would be necessary to detect the missile (using radar, say) and then examine its trajectory (or, perhaps, its radar signature if Soviet missiles have different signatures to Western ones) to determine whether or not the missile represented a threat to the USA (it could be a missile launched from an American B52 or B1 bomber aimed at Moscow). Or, all Western missile launchers could be electronically linked to a central computer, thus whenever a missile was fired from a US or allied launcher, the central computer would know about it so the SDI would have to shoot down all missiles whose launch had not been recorded.

Thus, in order to test the SDI, all that would be necessary is for the USA to launch unarmed missiles at itself. The SDI can practise on dummy missiles launched from neutral territory or from countries whose borders are close to those of the Soviets or their allies, such as West Germany, Turkey etc. The tests can be made as complex as necessary to simulate a real-life situation. Countries like West Germany and Turkey could be given a 'Temporary Enemy Status' for about half an hour or so during the duration of the tests.

Needless to say, it would be important for the SDI to distinguish between non-nuclear missiles (such as satellite orbiters) and nuclear missiles. Also, I have made no attempt to try to prove that the technology needed for the SDI is currently feasible, I have merely tried to establish that it is not essential for the SDI to have to work first time. Obviously the system is going to be enormously costly, time consuming and complex. It will take decades to develop and probably decades to test, and it will use trillions of dollars which could probably be spent in more worthwhile areas. The benefits flowing from the research and development may be of little significance to humanity, unless, of course, it works.

Furthermore, I never implied in any, shape or form that any of *APC's* journalists were 'Greenie-Commoes'. I did say: 'I can only assume that your magazine is becoming a repository of anti-nuclear (and anti SDI) propaganda. I do not object to your being against these issues, but it is not satisfactory to propagate ideas. . .'

One does not have to be a 'Greenie-Commoe' to be against both nuclear missiles and the SDI. Similarly, even 'Greenie-Commoes' should respect the fact that intelligent, rational comments should be expected from journalists, regardless of whether or not the 'Greenie-Commoes' agree with the point of view being expressed. R Roper agrees with Kewney's comments, but he fails to notice that Kewney provides no evidence, nor does he quote any 'experts'. If he did, then R Roper would not have needed to.

Also, with reference to the Editor's comment to my letter in the October issue, he may be interested to know that 'The Jacaranda Atlas' (Jacaranda Press, reprinted 1975), adopts, whenever possible, the suggestions of the Permanent Committee of Geographical Names (London) and the Board of Geographical Names (USA). Needless to say, 'The Jacaranda Atlas' was the source upon which I based my comment. However, if David Taylor looked up the word in the dictionary before the article was published then he did do research, and is to be commended for it.

Perhaps *APC* could welcome further correspondence on the issue of the SDI from its readers. That is, rational, logical comment, not the emotional hype Kewney likes to throw at us.

David Bourke

DOS errata

I waited, with interest, for the December 1986 issue of *APC* to see whether the most obvious error in the assembler program presented by Ian Davies in the article of 'MS-DOS programming' would be corrected. I was amazed to find that, in a high quality magazine, such as *APC*, no correction was mentioned.

So here's the problem: the resident clock program (on page 151, November, *APC*) at address 0184 is testing bit 3 of the monitors status register which corresponds to the vertical retrace being active and NOT the horizontal retrace as implied in the program. The program 'appears' to work amazingly enough but careful analysis will reveal its flaws. One, since only the active state of the vertical retrace is being tested, it may catch the end of the retrace interval and hence update video memory after the retrace. And two, since vertical retrace occurs once every 16ms, a lengthy delay may occur before exiting the resident clock routine. This wastes a great deal of processor time!

A quick glance at the Bios listing in the Technical Reference manual will show that the following is the best way to update video memory:

```
            mov     es,ax           ; forget b/w test!
            cld
Colour:
            mov     dx,3dah
```


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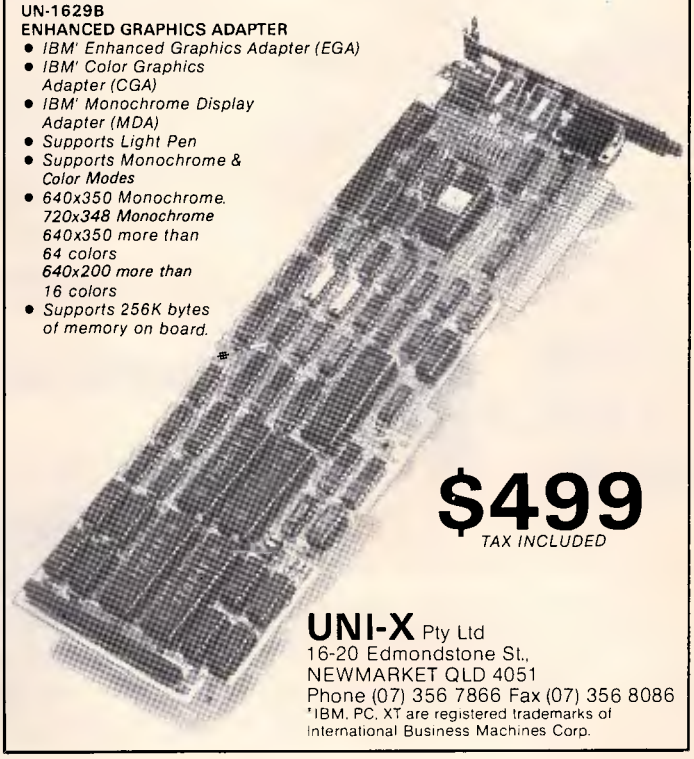

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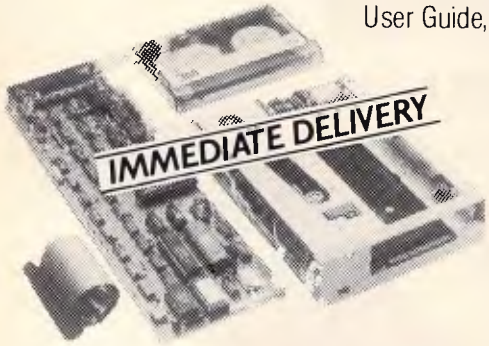

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```
Wait1:    in      al,dx           ; get status
          test    al,1            ; is it low
          jnz     Wait1           ; wait until it is
          cli                     ; no more interrupts

Wait2:    in      al,dx           ; get status
          test    al,1            ; is it high
          jz      Wait2           ; wait until it is
          movsw                   ; move char/attr
          sti                     ; interrupts back on
          loop    Wait1           ; until finished
Endhere:
          pops <di,si,ds,es,dx,cx,bx,ax>
```

You should note that there is really no need to test for the colour screen, however one could incorporate it with:

```
                mov     es,ax
                cld
                cmp     ax,0b000h
                jne     Colour
                rep     movsw
                jmp     short Endhere
  Colour:
                mov     dx,3dah
```

One final point, which I feel is misleading, is that the saving of the flag register is unncessary on the 8086/88 as this is automatically performed by the processor when an interrupt occurs. Hence the instructions Pushf and Popf may be removed from the program.

For those readers who are just venturing into assembler programming may I simply emphasise that care is necessary and that the Technical Reference manual can greatly assist them in starting out. Good luck, and let's hope that many more interesting assembler programs will appear in the *APC* magazine.

Peter King
ProCon Software
Melbourne

It's always nice to find that someone has read an article, and even nicer to find that the subject matter is sufficiently 'on-target' that there are people who know all about it.

There are many ways in which to deal with flicker suppression on CGA compatible adaptors, with Mr King's technique being just one of them. Indeed, the subject itself is probably worthy of an entire article.

Readers who are concerned about the 'flaw' Mr King has discovered, may like to incorporate his suggested modification.

Mr King is, of course, absolutely correct in that the processor automatically saves the flags upon an interrupt. Readers who wish to reclaim the two bytes wasted by this, and reap the $0.00056 saving, should contact Mr King at ProCon Software.

Ian Davies

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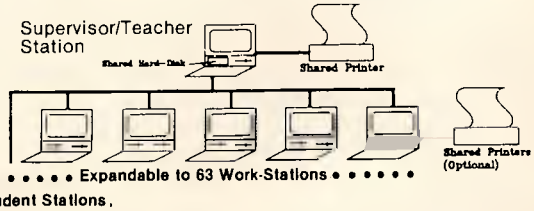

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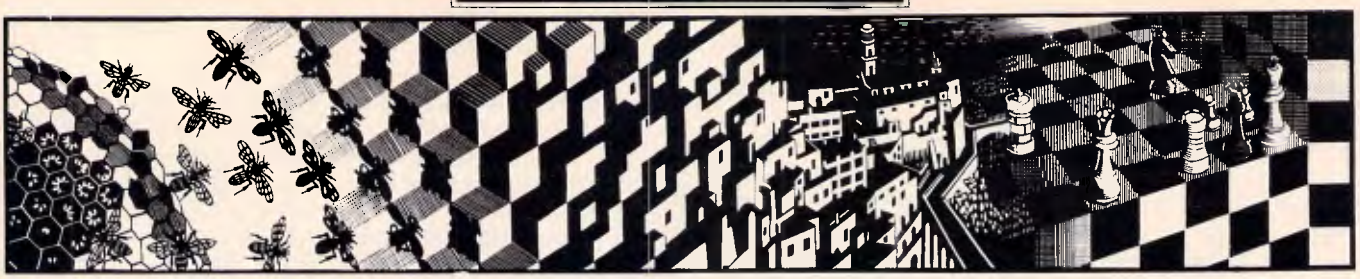


This month's selection of games finds Stephen Applebaum transported back in time to ancient Apshai and medieval England.

Thinking of England

TITLE: Defender Of The Crown
COMPUTER: Commodore Amiga
SUPPLIER: Imagineering
PRICE: $89.95

When King Richard was brutally murdered in 1149, his killer must have foreseen the evil seeds he sowed. With one fatal cut of his sword, he not only spilled the lifeblood of a man, but sealed the fate of thousands of others.

At the time, King Richard was the only thing keeping England from being ravaged by civil war. The Normans and the Saxons had, for years, been looking for an excuse to meet on the battlefield. With Richard out of the way, there was nothing to keep them apart any longer.

As the news of Richard's dreadful death spread throughout the shires, people began to speculate over who had killed him. Most puzzling of all was the disappearance of his crown. Obviously, whoever had dealt Richard the fatal blow had also made off with the royal headgear. But why?

While people spoke of vengeance, six great lords — three Norman and three Saxon — prepared themselves for battle, building armies out of liege-men and their subordinates.

One of the lords, a Saxon, rode out to Sherwood Forest from his castle in the north; and there, finding the rebel hero Robin Hood, asked him to pledge his loyalty in the fight for the throne. Robin gave him his word gladly, swearing that he and his men would fight by the lord's side when called upon to do so.

Now, put yourself in this lord's position. In front of him is the glittering prize — the throne of England. But between him and his goal stand three Norman lords: men endowed with the fighting spirit and tactical acumen of William the Conqueror. If you were this lord, what dark thoughts would run through your mind as you rode back to your castle and, possibly death?

Such is the position you find yourself in at the beginning of Defender of the Crown, Mindscape's visually stunning epic of medieval warfare in which you, the player, take the role of the Saxon lord whose singular plight I have just described.

The lord whose persona you adopt is chosen from four characters, each of whom is versed in the skills of leadership, swordplay and jousting, albeit to different proficiency levels. Of the four, a man called Geoffrey Longsword is the best choice when playing for the first time, because he is the most accomplished swordsman of the group. (Why this is such a desirable trait will become clear later).

The outbreak of civil war finds you in your castle, brooding over a map with your advisors. There are two maps in Defender of the Crown, but the most important one is shaded to indicate the proportion of land — or rather the number of shires — owned by each lord. It also provides invaluable information such as the pecuniary worth of each shire, the number of vassals living there, and how strong a specific region's army is; information which, were it not at hand, could mean your sending an army into a situation where it had no chance of survival.

In the early stages of war, the shires bordering your own are free from the jurisdiction of an overlord and can be easily taken. When this land has been secured, the only way to strengthen your claim to the throne is to assemble a campaign army and move further afield. A campaign army consists of foot-soldiers, who require only low wages and are relatively dispensable; knights, who although they are much more expensive, make an excellent vanguard; and one or two catapults.

Financing a campaign army is very costly and can empty your coffers quickly, but don't forget that this is the age of feudalism. The greater the number of shires overseen by you, the wealthier you'll be when the monthly taxes come in.

When you *do* send your campaign army into an occupied region, the computer presents you with a chart showing the number of men in both armies, and offers you the choice of attacking ferociously, standing your ground or fleeing. However, such skirmishes seriously deplete an army and hence your financial resources.

Apart from land, though, another way of acquiring money is to raid the coffers of another lord. Raids are where a good swordsman really shines. They are always carried out at night and invariably meet with resistance from castle guards, which

is why a lord who lets his sword sleep in his hand will not last long enough to reap the rewards of these nocturnal forays.

Swordfighting, as far as the player is concerned, is a simple matter of moving the mouse towards your character's attacker, while at the same time pressing and depressing the button. Together, these actions cause your man to walk and thrust with his sword simultaneously. Sound effects add to the realism of this scene, as they do to many of the combat situations.

And it isn't always money that beckons. The cry of a Saxon maiden held hostage by a Norman lord holds promise of a far more precious prize than mere riches (Barbara Cartland, eat your heart out). Should you manage to evade the castle guards and enter the maiden's chamber, you will be rewarded with one of the game's most impressive, and ever so slightly risque, sequences.

Rescuing a Saxon lady gains you a wife, which in turn raises your morale to greater heights, spurring you on to even more daring deeds.

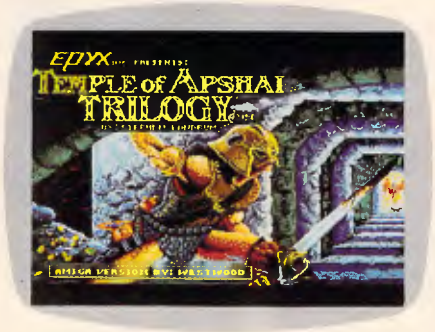
As the war winds its fatal course, your coffers grow fatter and the poor ever poorer. Wealth gained on the battlefield can be used to build forts to defend your newly acquired estates, or even to finance a joust.

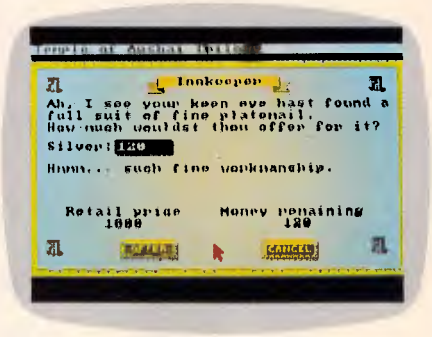
The tournament is the high spot of Defender of the Crown. It opens with trumpeters heralding the arrival of the competitors, before switching to a display that simulates a jouster astride his horse. Your aim is to overcome the movement of the horse, so that you can hold your lance still long enough to strike your opponent's shield with its tip.

Desporting yourself on the fields at Ashby-de-la-Zouche might, if you're lucky, win you land, but won't earn you the throne. To do that, you have to lay siege to each of the three Norman castles in the south of England.

To capture a castle, you first have to breach its walls by means of a catapult. The siege screen is a beautiful depiction of an army encamped outside the walls of a great castle. In the forefront of the picture is the catapult, as seen from the rear. Using the mouse, the arm of the contraption can be pulled back and then released, hurling a boulder at the castle ramparts. If your aim is good, the boulder will knock a hole in the wall. This continues until your supply of boulders has been depleted, when you should have created a big enough hole for your men to climb through. When all the Norman castles have been taken in this way, you can exercise your right to the throne.

Defender of the Crown is one of those rare games that counter-balances a rare, aesthetic quality with good gameplay — very few games succeed on both levels.





The punishment of luxury

TITLE: Temple of Apshai Trilogy
COMPUTER: Commodore Amiga
SUPPLIER: ECP
PRICE: $59.95

Far away, in a sequestered corner of the world, there is an ancient door embedded in the rockface of a steep, towering mountain. No-one knows what secrets it conceals behind its awesome aspect, for those who have stepped into the darkness beyond have never returned to tell what they have found there. Some say it's the gateway to Hell; others say it's the entrance to the Temple of Apshai.

Legend has it that in an age long forgotten, before the great flood even, there lived a race of people called Gebites. They were nature's own children, and daily gave thanks to the God of the Earth. The Gebites lived in peace for many centuries, until, dissatisfied with the fruits of their existence, a small group renounced the Gebite God for Apshai, the Insect God. These rebels were banished to the world without.

Even in the depths of their despair, the Apshaians never forsook their Insect God, whom they believed would lead them to a new and better life. And, sure enough, following days of prayer and meditation, the Apshaian priests were guided to a subterranean world where weird fauna and flora flourished in the darkness.

There the Apshaians lived, prospered and grew strong. Eventually even the Gebites came to respect them, receiving incense and gems from them yearly. Greedily reaping the rewards of the Apshaian's success, the Gebites forgot that they had once exiled these people for practising rites tantamount to witchcraft. Little did they know, then, that the gifts they received with open arms were artifices calculated to bring about their doom.

Insect plagues scourged the Gebites, who prayed to the God of the Earth to deliver them from the devilish conditions which had befallen them. After days of suffering, the God replied with an earthquake which, knowing no boundaries, destroyed the Gebite village and the Apshaian homestead.

Years later, a Gebite priest foolhardily ordered the excavation of the Temple of Apshai as a means of recovering the vast quantities of gold and gems buried there. Teams of engineers were sent down into the shadowy caverns, once home to a great people. Many of these engineers failed to emerge, lost in the prevailing darkness.

Realising the terrible mistake they had made, the Gebites set about sealing up the opening in the mountain, leaving it as a monument to the Apshaians and a reminder of the omnipotence of their own Earth God.

Now, only intrepid adventurers hungry for wealth dare step through the door into the darkness. Those who enter this great portal do so at their own risk, and in the knowledge that they may never again see the light. Such is the danger. Will you accept the challenge?

Acceptance of the enterprise summons forth the Innkeeper who, being more than mortal, holds the key to creation. Through him, adventurers 'build' charac-

ters who they think embody all the physical attributes necessary to succeed in the quest for riches.

With the Innkeeper's help, a player can alter a character's strength, constitution, dexterity, intelligence, intuition and ego. A character so prepared must then be equipped with items purchased from the Innkeeper's store. Fledgling adventurers are poor fellows and are only able to buy the barest minimum, such as light armour, a dagger and a shield.

Being a pauper might make you immune to a beggar's pleas, but it won't save you from the jaws of death. Adventurers must choose the few items they buy wisely, because entering the Temple of Apshai unprepared will result in the adventure being ended very swiftly.

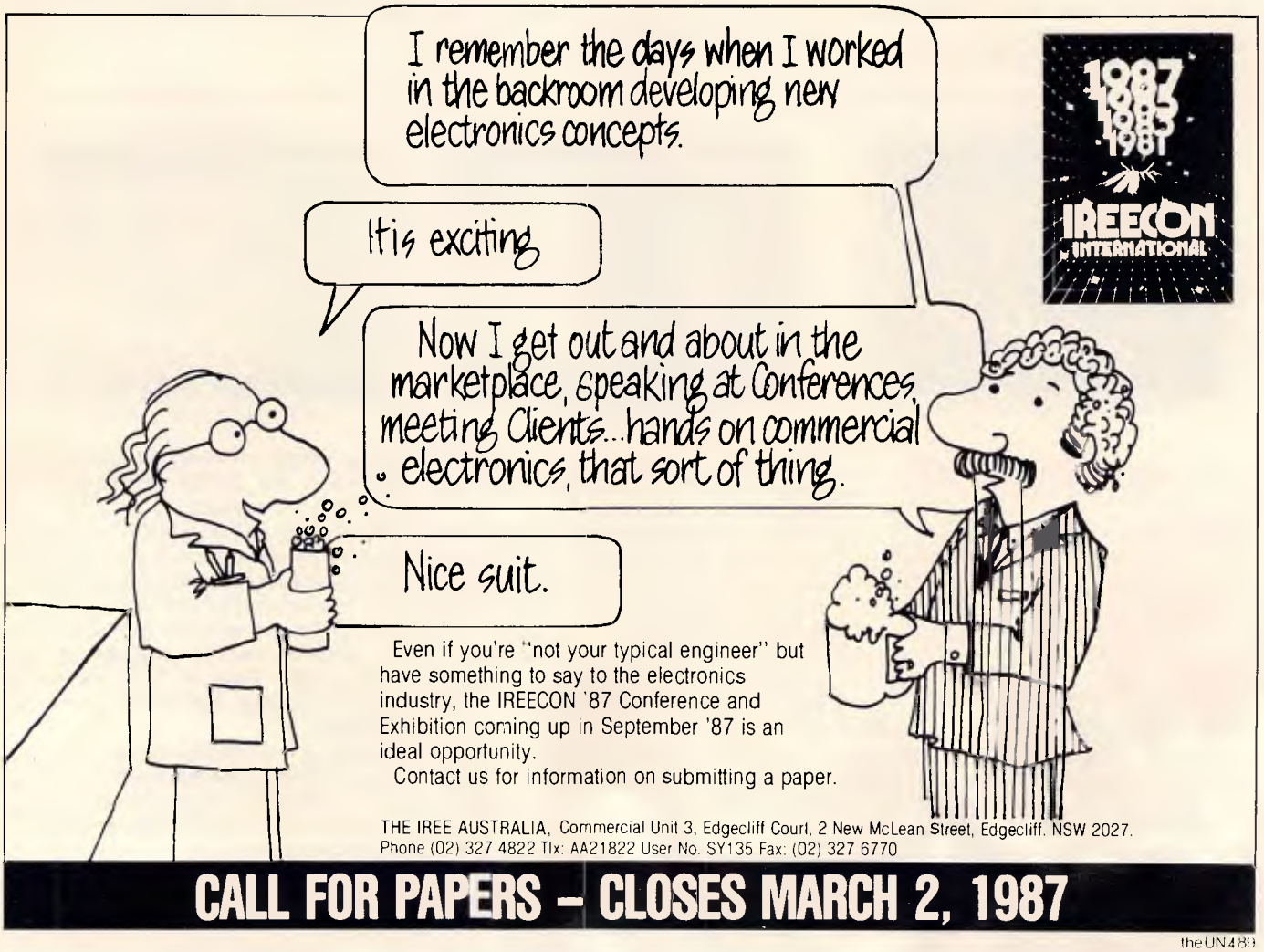
Finally, it's time to say goodbye to the world of light and enter the fetid depths of the cavernous underworld. Here, the adventurer follows his/her character around a vast, winding maze, like a guardian angel.

Within the confines of this strange world live legions of voracious creatures, ready to attack at the merest glimpse of an intruder. Strewn about the muddy ground are dried bones — the last remains of monsters' victims and a sad reminder of those who have gone before.

Evil lurks in every niche of the Temple, but not everyone there is out for an adventurer's blood. Some merely want gold, and although they won't kill straight away for it, most will certainly threaten to.

Take Olias the Dwarf, for example. This irascible little character will rob an adventurer of everything. Lowenthal the Wizard, on the other hand, will only steal magical items. And then there's Bendic, the wandering priest. He's the kindest character of them all, promising resurrection if he ever finds his way out of the labyrinth, in return for a small donation to his sect (of course).

The Temple of Apshai is difficult, but is merely a taster for the horrors to come in parts two and three. Those adventurers who get out of the Temple alive, must then investigate the Upper Reaches of Apshai. Then, just when you think you can hang up your sword, the secret of the Curse of Ra must be discovered, so lifting the veil of evil that hangs over Apshai. Only then can you return to your home. END



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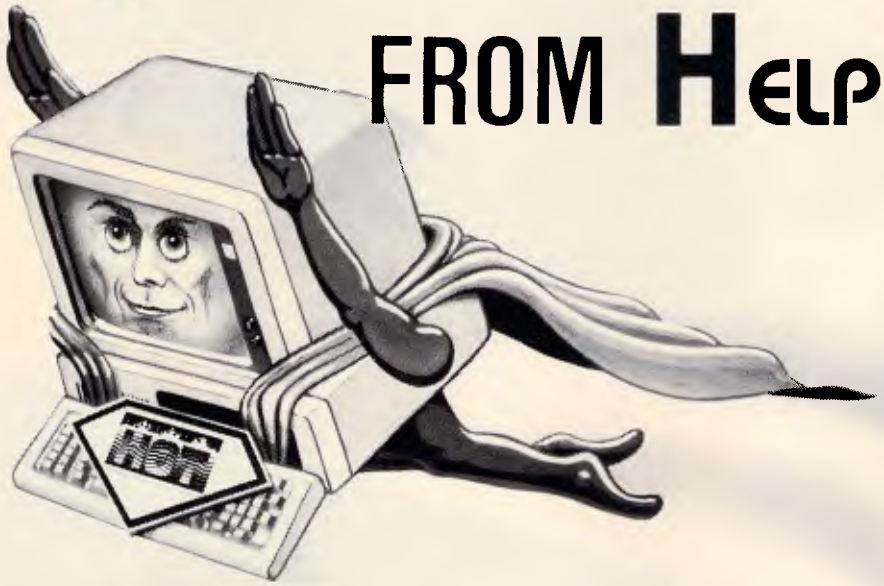

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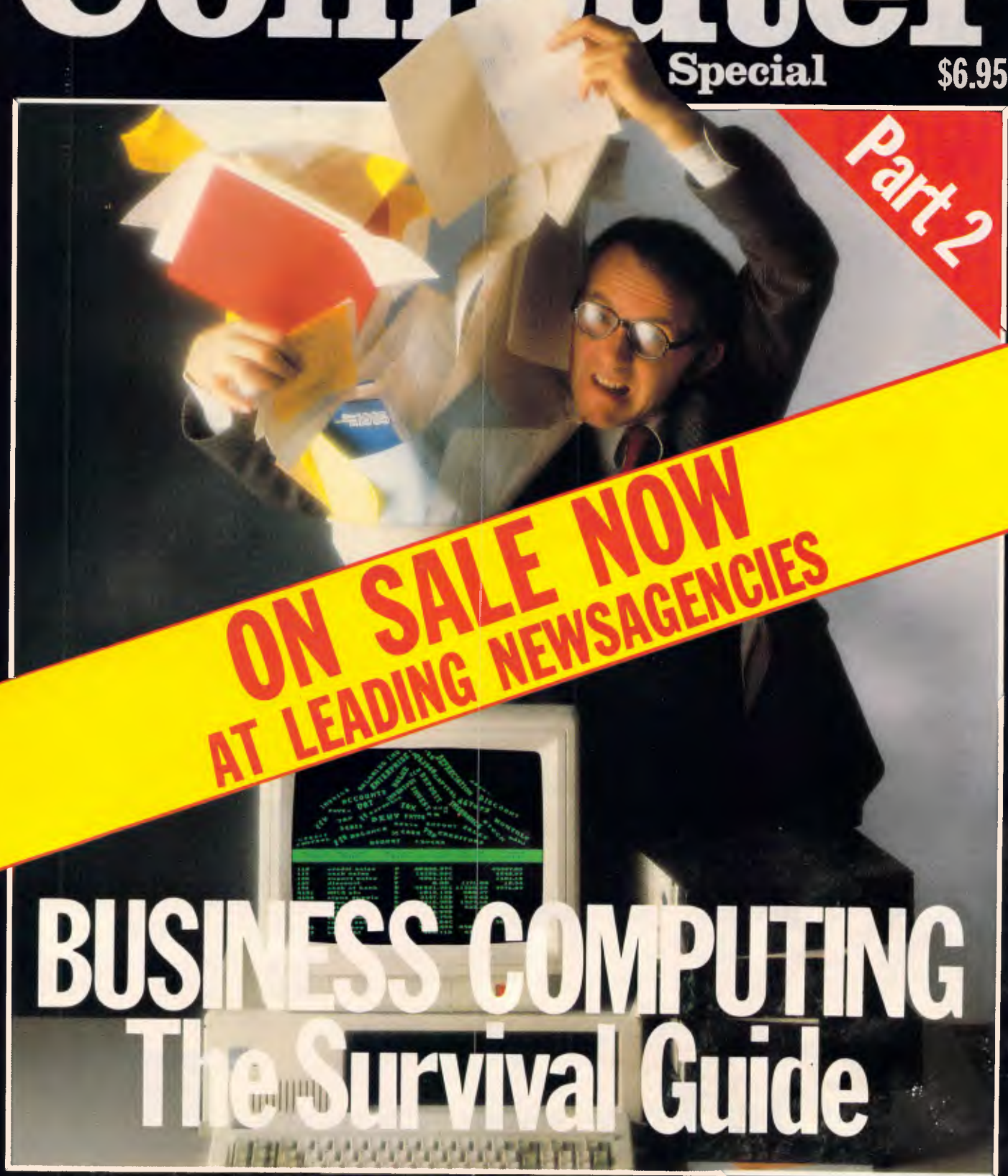

Part 2

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BUSINESS COMPUTING
The Survival Guide

PC '87

It appears there will be more machines launched at this year's show than at any other PC show ever held in this country. Kester Cranswick elaborates on the rumours.

THE EIGHTH AUSTRALIAN
PERSONAL COMPUTER SHOW

CENTREPOINT

PC 87

SYDNEY 17-20 MARCH 1987

It's on again, the *Australian Personal Computer* Show. This time it is number eight, and on in Sydney from 17-20th March, a Tuesday through Friday. We'll be there, and you'll be there too if you want to keep abreast of latest developments in the personal computer industry.

Over 70 exhibitors will be taking part. All the big names, plus many small ones, will be showing their hard and soft wares, tempting you to shell out for the newest, bestest and fastest gear around.

No PC show would be complete without a range of new PCs, and the main interest this year will be on the new PC compatibles with low, low price tags.

Archives Computers will be demonstrating a budget PC workstation. At under $1,500, the Santa Clara PC Terminal is a diskless IBM compatible PC with 256k of memory, expandable to 640k, two expansion slots, keyboard, monitor, boot ROM and a LAN interface card. Designed for networking, it looks to be remarkable value for money.

Commodore is rumoured to be showing its sub-$1,000 PC, with that price including a monitor. Eastern Micro Electronics is also hoping to have secured the distribution rights to the $1,500 Hyundai Blue Chip, a PC that is sold through supermarkets in the US and is as hot as a branding iron. Watch out Amstrad.

A new Tandy PC may pose a threat too. The Tandy 1000EX is a base level PC with the keyboard and cpu integrated into one unit. Pay $1,500, plug in a monitor and away you go. The 1000EX has a dual speed cpu, three expansion slots, 256k RAM, expandable to 640k, 90 keys and a single 360k disk drive.

Also in the 1000 ranges is the 1000SX. For $2,300 you get a conventional PC-compatible with 384k RAM, five expansion slots, twin disk drives and a colour card.

Further up the Tandy spectrum are two new 3000 models, the 3000HD and the 3000HL. The 3000HL costs $4,000 and is a PC/XT compatible designed for networking. It has a dual speed 80286 processor, 512k RAM, a single disk drive and an optional 1.2Mbyte floppy. The 3000HD runs the multi-tasking Xenix operating system, has an internal 20Mbyte hard disk and a single 1.2Mbyte floppy. It costs $9,000.

There will be new PC compatibles aplenty. Osborne has a new range of AT compatibles and Archives has a 286 micro from Arc, called The World. Vision Computer Corporation will have such a machine on show, the Vision 80386, using the powerful Intel 80386 processor.

Mobex, the Australian Atari distributor, has four new products for release at the show. Most attention will go to the new Atari PC. In the US, it has a dual speed 8088 cpu, 512k RAM expandable to 640k, 256k dedicated display RAM, a single 360k disk drive, EGA, CGA, Hercules and mono display capability, parallel and serial ports, a mouse and Gem. It is expected to be very cheap too.

Also launched by Atari is the Mega ST, in 1Mbyte, 2Mbyte and 4Mbyte configurations. It has a separate keyboard, a real time clock, and can take expansion cards. Based on the 1040ST it has a built-in hard disk drive, to up the data storage capacity. The new Atari 300 dots per inch laser printer may also find its way to PC '87, where, if it is in line with the $US1,500 price tag, it will represent a real breakthrough in the laser printer market. The

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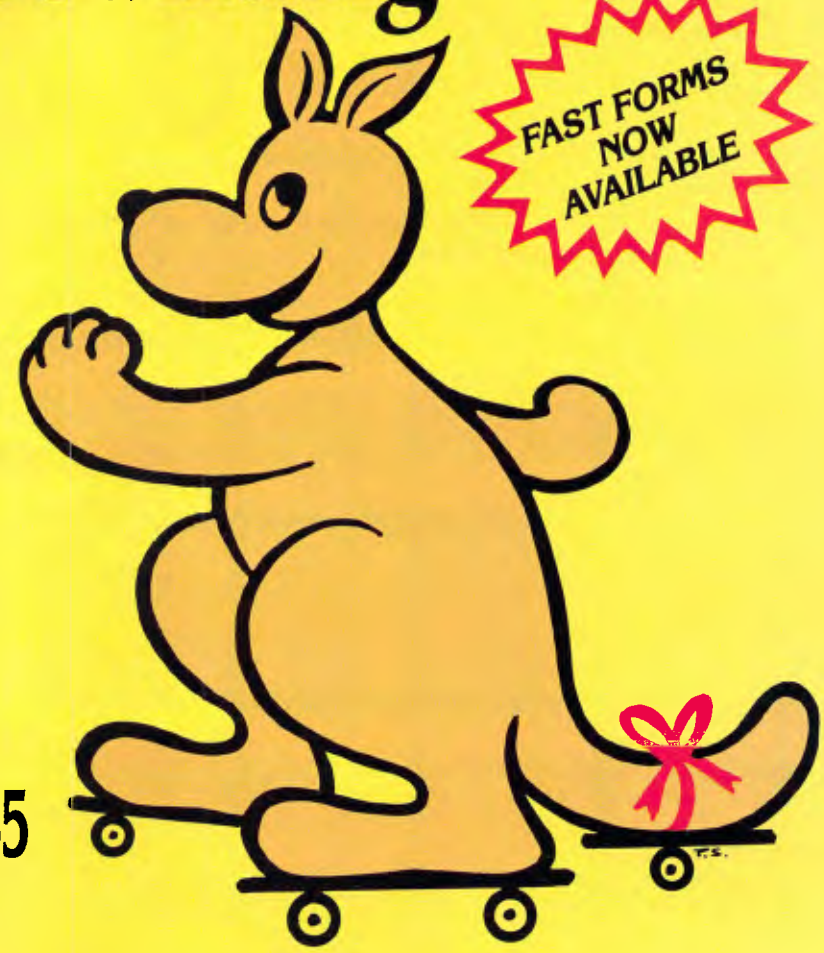

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price is low because the laser printer uses memory in the computer to hold fonts and page images.

In the area of dinky laptops, look out for some new Grid machines. The Gridlite is priced at $3,600, and has a black ABS plastic case, 1Mbyte RAM, a large enhanced LED display, in IBM-compatible 71 key keyboard and an internal 2.5in drive.

Then there is the Gridcase Plus, an improvement on the rugged Grid. It has an expanded keyboard, up from 57 to 71 keys, 1Mbyte RAM and an optional 10Mbyte internal hard disk. The price is from $5,490, depending on the display.

Wang will have a new portable too, the updated PC Portable, with a built-in 10Mbyte hard disk and MS-DOS 3.2. The new model can be connected to Wang VS and OIS systems.

Microbee Systems is launching a new product, dubbed the Microbee 256k. It is a completely new Microbee, internally, with a 126k RAM disk, and planned to have 1Mbyte RAM in the future. It is twice as fast as the Microbee, has an IBM-style keyboard and will sell for $1,295 with an internal 800k 3.5in disk. A twin disk version will sell for $1,599.

Microbee is also launching Simply Write, a WYSIWYG word processor with menus, help screens and a $69.50 price tag.

Look out for some new Apple products too. Again, they are only rumoured at this stage, but we believe there may be a colour version of the Macintosh, another Mac with expansion slots and a third party board that will let the Mac run MS-DOS applications.

Though the show is a PC show, there will be a new supermicro, or minicomputer on show for the first time. Distributed by Sanyo Office Machines, the Sanyo-Icon MPS020-2 has been developed in America by Icon, a company in which Sanyo holds 44% equity.

The Sanyo-Icon MPS020-2 boasts multiple 32-bit Motorola MC68020 microprocessors, enabling it to run, concurrently, applications under MS-DOS, Pick, Unix and IBM Systems 370 operating systems. There's an Intel 80286 processor too, so the machine is AT-compatible.

There will be plenty of new software to see too. Watch out for two beaut new Aussie communication packages from Arcom Pacific — Gateway and Upstart. Gateway is a videotex package, and both applications were developed by Cybersoft.

Arcom will also be showing Eureka, The Solver, a high powered mathematical and scientific calculator package, Turbo Basic for the PC, a lightning fast Basic, Turbo Prolog Toolbox, containing

80 tools and 40 sample programs and Turbo Numerical Methods Toolbox, for scientific and engineering applications.

Dick Smith Electronics will be hoping that show visitors take a punt on the DSE Multitech Superform Online package, a computerised racing analysis and form system developed by top pundit, Don Scott. He will be making personal appearances too.

Imagineering will be showing the latest from Lotus — Hal and Manuscript.

For Macintosh fans, Busiware will be demonstrating Midwrite, a thought organizer with multiple windows and able to read Macwrite and Think Tank files. Look on the Arcom Pacific stand too, where you'll find Mac versions of Reflex and Turbo Pascal, plus a new release of Borland Sidekick.

Write Now is a new word processor for the Mac, from SCA. Developed by Steven Jobs, it has ultra-fast document formatting, is memory efficient, gives even spacing between letters and is very, very fast. Then there is Filemaker Plus, a cross between a database manager and a desktop publishing application.

SCA also has a new CAD package for the Mac, called MGM Station. The distributor claims it is the first professional CAD package for the Mac.

On the peripherals front, Arcom Pacific has a range of new modems from Scitec. Netcomm has new modems too, including two security-featured models designed in Australia. The DataLock modems have speeds from 300 to 2400 baud, depending on the model.

Also new to the NetComm range are 9600baud models for the business market, and the company is also shipping modems for Commodore, PC and Apple users that come with bundled software.

IDEAssociates will be showing the All Board 286, described as a 'multi multifunction board' for the XT and AT. The same company will also have a dual 10Mbyte removeable hard disk cartridge drive for less than $7,000 and called the Diskit 2.

There will be more peripherals too, such as JRAM, JLaser, JSpool and JDiskette add-on boards from Minicomp, a 60Mbyte tape system from Micro General and NEC V20 and V30 microprocessors to turbocharge PCs from John Waugh Components.

On the Macintosh front, Symbiotic Computer Systems has three new HyperDrives, including the HyperDrive 2000 with 20Mbytes storage, 1.5Mbyte RAM, a second 68000 processor, a maths co-processor, which 'makes the Mac the most powerful pc on earth', according to the blurb. Symbiotic will also be showing new tape back-up devices, a colour video board, A4 monitors and more for the Mac.

A new plotter, the Sakata A3 SPL-3000 will be shown by Emona Computer. It is a six colour device, selling around $2,000. Emona will also have a new range of Perfect uninterruptable power supplies.

There will be new monitors, from National Panasonic and Taxan. Look out too for the Nashua Keyword 7000, which enables files to be converted from one word processor format to another.

SCA will be unveiling the Microtek image scanner, with software that enables it to scan documents and resolve up to 300 dots per inch. It will work with PCs and Macs, and could mean a lot less keying in of typed documents.

There will be more surprises too, and the only way you'll find out what they are is to be at PC '87. See you there.

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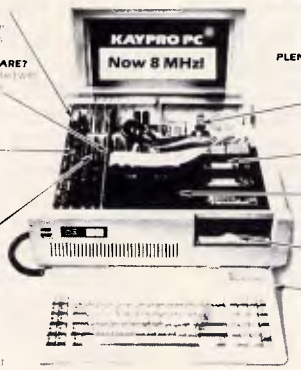

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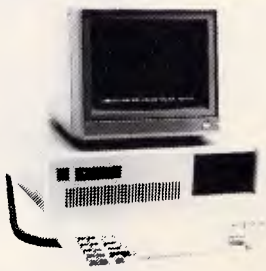

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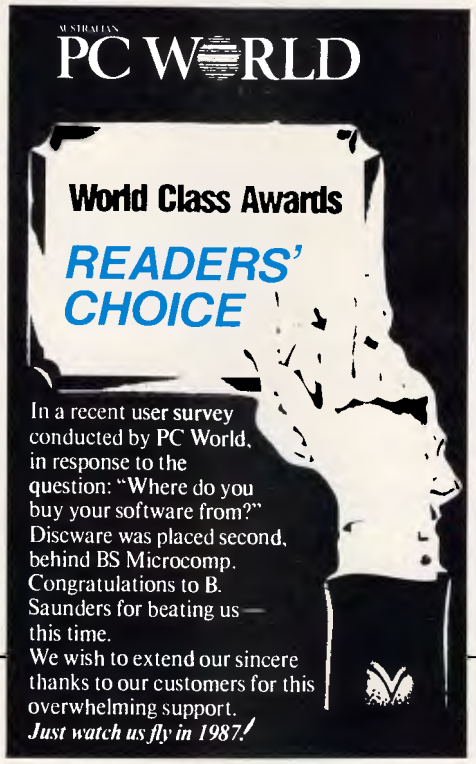

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SCREENTEST

Lotus' HAL

Lotus' HAL is an add-in application which allows large numbers of complex 1-2-3 functions to be carried out via the latter's source code. Geof Wheelwright conveys his impressions.

It's hard to take a computer software product called HAL very seriously. After all, wasn't HAL the evil, egomaniacal computer in *2001: A Space Odyssey* that set the cause of popular computing back at least 10 years by having the poor taste to murder its users?

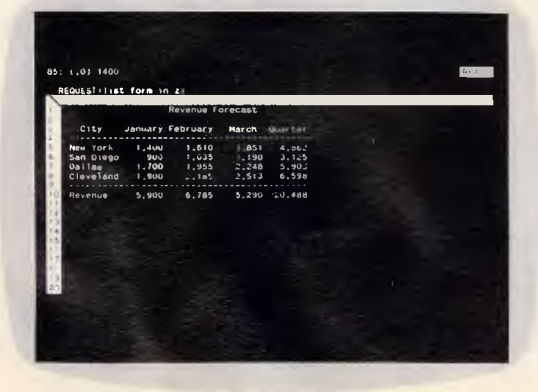
These considerations do not, however, seem to have bothered Lotus Development Corporation in releasing its new Human Access Language (otherwise known, of course, as HAL) - the latest (and probably greatest) 'add-in' application for the best-selling Lotus 1-2-3 spreadsheet.

History

Literary allusions aside, you really have to take a quick look at the recent history of Lotus to get an idea of the whys and wherefores of HAL. The company started with a bang in 1982 when it released Lotus 1-2-3 for the IBM PC, and almost immediately gained a permanent place in the business software Top Ten sellers list.

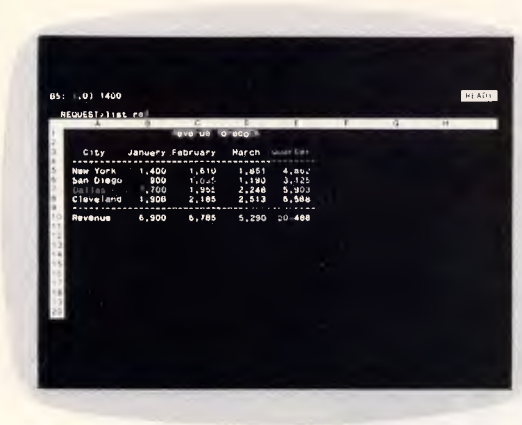
By 1984 Lotus was busy developing an 'encore' to its hugely sucessful debut product, and rode the wave of integrated software popularity with its all-in-one word processor/database/spreadsheet/graphics/comms suite, Symphony. Despite the fact that Symphony made a brief appearance in the Top Ten charts and achieved steady sales therafter, it never gained the popularity of 1-2-3. Users realised the inevitable trade-offs in flexibility and power that were made by shoving so many applications into a single package.

The company's next big splash was made with Jazz - an integrated suite for the Macintosh that promised far more than it eventually delivered. Sales were slow, and Lotus eventually



HAL is a great improvement on Lotus 1-2-3. To list all the formulae in a spreadsheet for example, you give the command LIST FORM and then designate where you want to place them (in this case, Z1)

The results of the LIST FORM command are shown here, with the cell formulae listed from left to right, starting with those in column B and moving right to column E (note how neatly this data is presented)



Finding where the formulae reside is all very well, but sometimes you need a way of quickly determining the relationships between various formulae. This is undertaken by the LIST REL command

The LIST REL command is automatically placed directly below the current work, so that you can see both the relationships and the cells they refer to at the same time

had to admit that Microsoft's Excel graphics/spreadsheet/database application was going to be the winner in the Mac software sweepstakes as it soared to the top of the Macintosh software sales charts.

Given the difficulties faced by Jazz - and, to a lesser extent, Symphony - it perhaps isn't surprising that apart from the Manuscript professional word processor (released at the same time as HAL), Lotus has concentrated on doing what it does best: making excellent spreadsheet and spreadsheet-companion products. The company has accomplished this in recent months by developing its own spelling-checker and micro-mainframe add-ins for Symphony, and by buying-in third-party software (and often the companies which go with them) such as Spotlight, Freelance - and HAL.

Development

HAL was developed by Californian software engineer Bill Gross, who hit upon the idea that a lot more people would use the full power of 1-2-3 if they could get at it without having to hit hundreds of '/'commands. Unlike other people with the same idea, however, Gross was enterprising enough to 'attach' his 1-2-3 add- on directly to the source code, as opposed to the more common practice of building new Lotus interfaces from Lotus' own macro command language.

The result was an extremely fast system which allowed large

numbers of complex functions to be carried out via simple English commands such as 'GRAPH JAN TO FEB AS PIE', instead of the corresponding series of six or seven keystrokes.

Not surprisingly, Lotus took one look at the work Bill Gross had done and decided it had to have the product. In February 1986 Lotus bought HAL and the company that created it, and hired the man who developed it. And on November 28 1986, Lotus started shipping HAL in the US.

In use

Although Lotus is selling HAL for only $334, you shouldn't get the idea that it is in any way a lightweight offering. Here are its main features:

- HAL is an English language-style command system which is accessed via the '\' key (as opposed the '/' key used by standard Lotus commands). This command system accepts a huge variety of English words (such as 'show', 'this', 'delete', 'clear' and 'average'), and allows you to reference cells and rows by their labels.
- It incorporates an UNDO command which allows you to take back the last change you made to the spreadsheet, thus increasing the degree of flexibility offered in 'what if?' calculations.
- It allows dynamic linking of multiple spreadsheets so that dependencies can - for the first time in Lotus 1-2-3 - be created on sheets that aren't loaded into memory simultaneously.
- It includes commands for highlighting and showing dependencies, formulae and precedents, so that you can immediately see and understand the structure of a spreadsheet.
- It offers a 'transcript file' system that will record all HAL requests and 1-2-3 commands in a DOS file, which can then be used for creating macros or reviewing work (HAL commands now become part of macros).

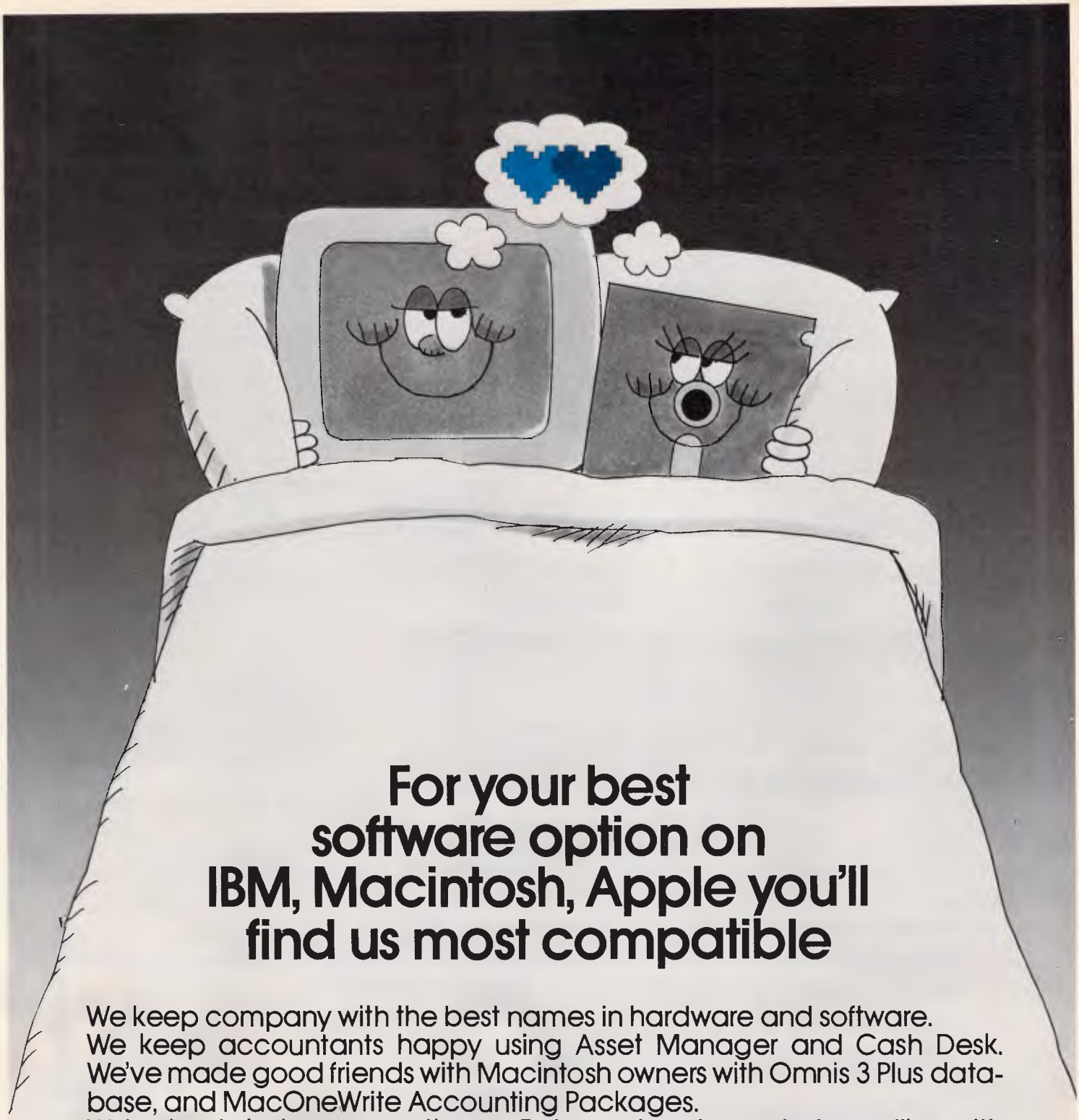
All these new facilities are important, but the most crucial are the ones which didn't previously exist in 1-2-3. The huge base of existing 1-2-3 users may be happy to bumble along with shortcuts to existing commands, as they will have perfected their own keystroke dexterity, but even they may be tempted by the worksheet linking, the UNDO command and the ability to easily see formulae and dependencies.

User image

I was initially sceptical about HAL, and thought that it was simply a way of buffering the inexperienced 1-2-3 user from the harsh realities of the program's command structure. But the more I used it, the more I was tempted to move away from tried and true 1-2-3 commands to HAL's simpler requests. To be able to give, for example, the HAL request to 'SORT BY DIRECTOR' my list of videotaped films, instead of the usual procedure of range defining, primary key specification and waiting around, is a real bonus. Even the simple command ENTER JAN TO DEC IN ROW, which sets up a spreadsheet with column labels listed sequentially from January to December, made life a lot easier.

I also began to see the possibilities of how listing formulae, dependencies and relations could help enormously in debugging a complex spreadsheet. If for example, you were getting constant addition errors and used the HIGHLIGHT FORM command to show all the formulae in a large worksheet, you might find that you had erroneously overwritten a formula with data.

Installing HAL is also quite simple. I



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ran 1-2-3 on a hard disk and copied the HAL files (which come on two 51/4in disks) onto the hard disk. As Lotus hasn't copy-protected the software (presumably because it can only be used with *bona fide* copies of Lotus 1-2-3), I just copied the files and typed 'HAL' at the C prompt.

HAL then booted itself and 1-2-3, presenting me with the familiar 1-2-3 opening screen in just a few more seconds than I was used to. After that, however, 1-2-3 works in exactly the same way as it always has, except the HAL 'request' commands are available via the '/' key.

Documentation

HAL's documentation is fair, but I found little need for it. The system includes an extensive online help facility which is accessed by hitting F1 at the HAL request prompt (or by typing 'Help'), and includes examples of every command you're likely to need.

Conclusion

You're probably wondering what the catch is. I'm happy to tell you that there isn't one - or, at least, not a big one. You'll need at least 512k of RAM, as HAL is overlaid on 1-2-3 directly in memory, and you will have to use Release 1A, Release 2 or Release 2.1 of 1-2-3. HAL does not currently operate with 1-2-3 on the IBM PC Convertible or Release 1A for the IBM 3270 PC.

One other incompatibility is that HAL doesn't work with any of the 1-2-3 'clone' spreadsheets. It hooks directly into the 1-2-3 source code, and the clones' source code is (or had better be, if they don't want to be sued) different from that of the original 1-2-3.

It looks as though Lotus has a winner on its hands. I can think of no reason why experienced or novice 1-2-3 users alike wouldn't want this software. At $334, it doesn't cost a great deal, it adds more to 1-2-3 than any other add-in application I've seen, and makes the world's most famous spreadsheet as easy to use as it is powerful.

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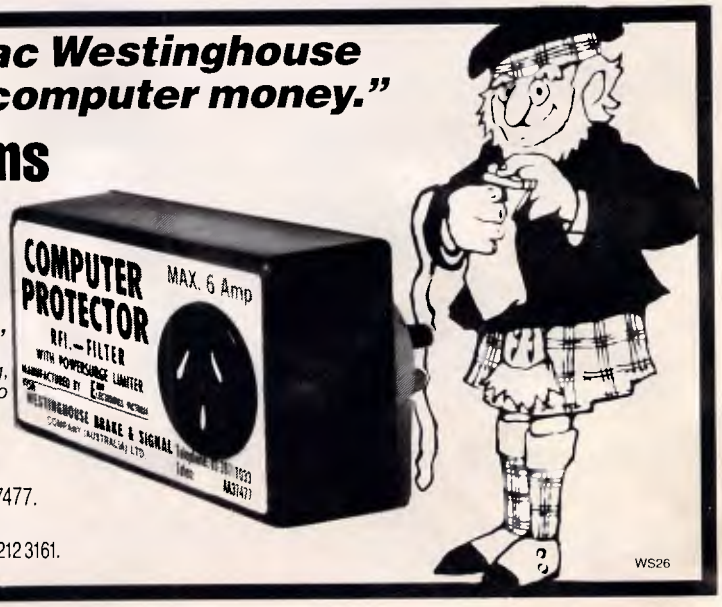

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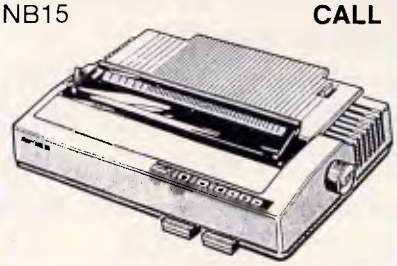

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PROGRAMMING

MS-DOS programming

Ian Davies' series on system programming for MS-DOS based computers continues this month, introducing memory resident software and illustrating the techniques with a handy utility for controlling the speed of your machine.

Many popular commercial products are of the memory resident variety. Users seem to prefer them because the software is always just a keystroke away, accessible from within other packages and ready for instant use. Memory resident keyboard enhancers, calculators, directory managers, diaries, communications utilities and print spoolers abound. This article illustrates some of the techniques required to write memory resident utilities.

First of all, what is meant by 'memory resident' ?

Simply, MS-DOS can normally only run one program at a time. When a program finishes executing, RAM is taken away from it and all trace of that program has vanished, except for its image on disk. A memory resident program, however, finishes execution but keeps a portion of itself in RAM for later use. The portion left in RAM may become active at some later time, for example, when an interrupt occurs or a key is pressed. Other normal programs may be loaded from disk and run, without affecting the memory resident software. The memory resident program may even become active when a normal application is running.

MS-DOS provides some built-in capacity for the support of memory resident software. However, it stipulates virtually no standards for the behavior of such software. As such, we now have the situation where the more enthusiastic users load up several hundred kilobytes of memory resident software at boot time, much of which fails to coexist peacefully with the other memory resident software. This has created the ridiculous situation where third parties are selling utilities to manage collections of memory resident utilities.

A software developer who aims to find out the tricks involved in memory resident software seems to progress through three phases. The first phase is where the budding author is just starting to look through manuals, and feels that memory resident software must be terribly complicated and totally different to normal software. The second phase comes when the MS-DOS manual has been deciphered, and suddenly resident software seems incredibly easy and straight forward - almost to the point where it could be written in interpretive Basic. The final phase occurs when the programmer has actually tried to write some memory resident software, and has found the many restrictions not really highlighted in the MS-DOS manual. The task once again appears formidable.

The program and techniques presented this month will take you up to stage two. Memory resident software will seem incredibly easy and we won't really be getting into the many problems which occur in more ambitious projects. Next month, however, we'll delve into the undocumented MS-DOS features which all writers of resident software (yes, even Borland) utilise to negotiate the MS-DOS 'gotcha's'.

An example

The example presented this month ser-

ves an incredibly useful purpose, but you will probably never see a commercial product which performs the same function. The program allows you to slow your machine down to an arbitrary extent.

Now, it may seem a little strange that when everybody in the market is busily inventing software and hardware to make PCs go faster, that someone should actually bother to create a utility to slow them down. Strange as it may seem, such a utility can prove very useful.

Many, if not most PC users today run systems faster than the original IBM PC with its 8088 processor and 4.77MHz clock. There are times, however, when the faster systems can be a bugbear. Computer aided instruction packages are one example, where the software gives the user a short period of time to answer a question before deciding he's a hopeless case, or displays a message just long enough for you to read it. Much of the older CAI software was written with delay loops hard coded into the program. This means that on M24 and AT machines, these packages sometimes pause for unacceptably brief periods of time. Most software vendors are rewriting their software to generate delays based on the real-time clock, but some of the old stuff is still around.

Speed control is also useful in games. I have run public domain arcade games on my machine (good ones, too) which upon being asked to start play, present me with a mad flurry of activity on the screen followed by the message "game over, you lose". Speed control allows you to downgrade your fast machine to a speed approximately equal to a normal IBM PC. Alternatively, you can slow the machine even more to assist you in debugging software or to really beat the pants off those arcade games.

The program takes the form of a 211 byte COM file called SPEED. The program accepts a single parameter in the range 0 to 9, where nine indicates top speed and zero delivers lowest speed. When the program is first run, it loads itself into RAM and remains resident. The program may be run many times specifying various speed settings, and on these subsequent runs, will locate the original resident portion of itself and alter the speed setting in that fragment, rather than reloading a fresh resident portion each time.

Like most memory resident utilities, the program can be removed from memory by rebooting the machine. It is possible to create memory resident software capable of de-installing itself, but the task of complete de-installation is tedious. Several commercial memory resident utilities with de-installtion options only partially remove themselves from the system.

Resident concepts

To begin with, a resident program is a program just like any other. It gets loaded from disk into memory; is allocated chunks of RAM and DOS passes control to it.

The details of the environment when a program commences execution depends on whether the program is of the '.COM' or '.EXE' type. These two types of program are quite distinct. The COM format is designed for small utilities which occupy little disk space, load quickly, are less than 64k in size, have no format stack and reference no segment addresses directly. The EXE format is for full scale applications which may be larger than 64k. The EXE file contains a relocation table at the front which the DOS loader uses to adjust any segment address references within the program. A COM file, on the other hand, is loaded into memory at an arbitrary address and is assumed to be totally relocatable without the assistance of DOS (and therefore must be contained within a single segment, or 64k). COM programs are allocated all of available memory, whereas EXE programs are allocated just the amount they claim to require.

EXE programs can be converted to COM programs, (if they have been written according to the rules), through the EXE2BIN command followed by a RENAME. The SPEED utility has been written as a COM file and assumes the initialisation conditions guaranteed by DOS for COM files: those being that the code commences at offset 0100h within the segment, that all four segment registers point to the segment allocated to the programs' use, that all user memory is dedicated to the program and that the IP register is loaded with 0100h. Additionally, the first 0100h bytes within the segment has been filled with a Program Segment Prefix control block (PSP). A PSP is created by DOS for every program currently in RAM and provides a means of communication between the program and DOS. Fig 1 shows the structure of a PSP.

Every program is provided with a PSP, and through the PSP, may nominate routines to be activated upon

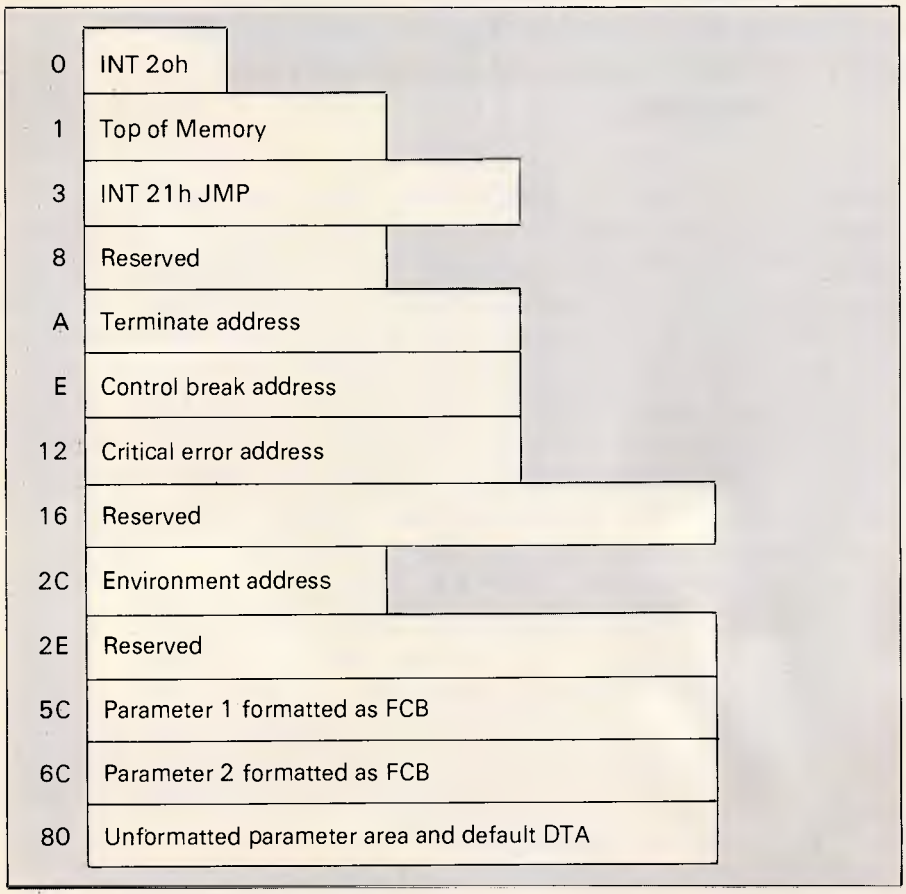

Fig 1: Structure of DOS PSP

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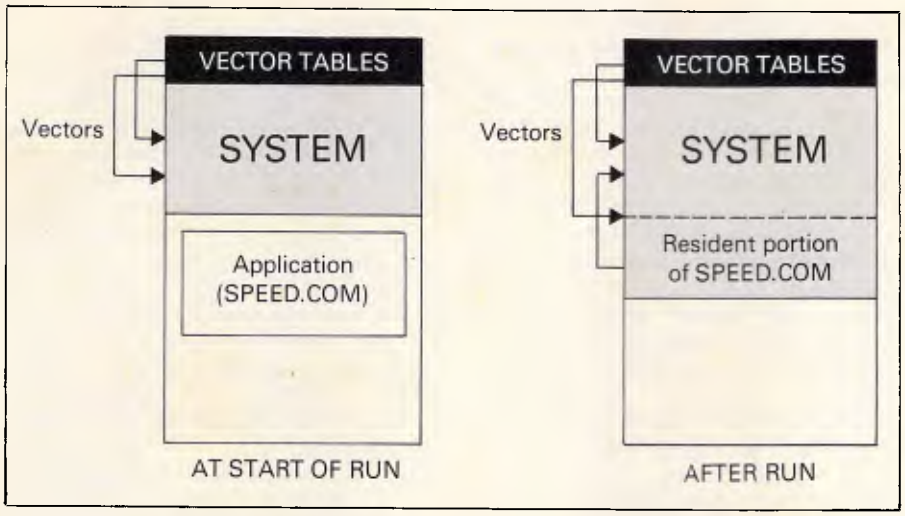

Fig 2: Structure of system upon first execution of SPEED.COM in which it makes itself resident.

critical errors, control-break keystrokes or program termination. Additionally, access to the DOS environment string (SET command) is provided through the PSP, as are the command line parameters.

A program may normally terminate its execution in one of five ways. It may execute a jump to offset zero in its PSP, issue an INT 20h instruction with CS:0 pointing at its PSP, issue an INT 21h function request with AH set to zero and CS:0 pointing at the PSP, issue an INT 21h function with AH set to 4Ch and a return code in AL, or issue a long call to location 50h in the PSP with AH set to zero or 4Ch.

Although DOS provides this rich variety of termination choices, the only recommended technique is the INT 21h/4Ch method. That is, issue an INT 21h instruction to access the DOS function dispatcher, and load register AH with the value 4Ch which requests DOS to terminate the program. As part of the termination, all memory owned by the program is returned to the system pool and all files opened via the handle based calls are closed. A return code in register AL may be passed back to the parent process, and accessed via another DOS call or by the ERRORLEVEL variable in .BAT files. All the other termination techniques are old DOS 1.0 facilities, and its use can foreshadow the use of some other DOS 2.x capabilities.

Programs terminated via function 4Ch are gone without trace. However, an alternative termination call is function 31h, 'terminate, but stay resident'. It performs much the same job, except allows you to specify an amount of memory which you want retained. That portion of your program persists in memory, complete with its PSP. To use the function, register AH is loaded with 31h and AL with a return code, but additionally, register DX is loaded with the number of 16 byte paragraphs you want to retain. Executing an INT 21h instruction to access the DOS function dispatcher then performs the work.

Now, a program terminated via this mechanism is left in memory along with its PSP, but to a certain extent is orphaned. Control is passed back to the parent process, usually DOS, and the system continues with its normal life. Other applications may be run and there is no sign that a program has remained resident apart from the fact that a small amount of memory is no longer available to other programs.

In order for a resident program to once again be executed, it must hook itself in to some interrupt vector. For example, a resident program might point the communications interrupt at itself so that whenever any activity on the communications port takes place, control is passed to the resident program. Of course, it must hook into these vectors before it terminates and stays resident, as once termination has taken place, the program will not get another chance to run unless it has hooked itself in.

Thus resident programs are really two programs in one.

The first part is loaded from disk and runs like a normal program, performing whatever it likes and initialising itself by hooking into one or more vectors. It then terminates via the DOS 31h function request, asking DOS not to reclaim all of memory, but to save a certain amount for the resident portion of itself.

The second part is the resident portion, and lives in the mysterious world of resident software. It is not really a program in its own right - more a fragment of code floating around in the system being called from time to time depending on external events. It might be called many times every second, or may be called once per day, depending on the vectors it has hooked into. Whenever it is called, it must always return control back to the operating system in a special way, and should make no assumptions about its entry and exit conditions, as it may be interrupting an application such as Lotus 1-2-3 and should take pains to ensure it does not disturb Lotus' environment. It cannot really ask DOS for additional memory and expect to get it, as the rest of sys-

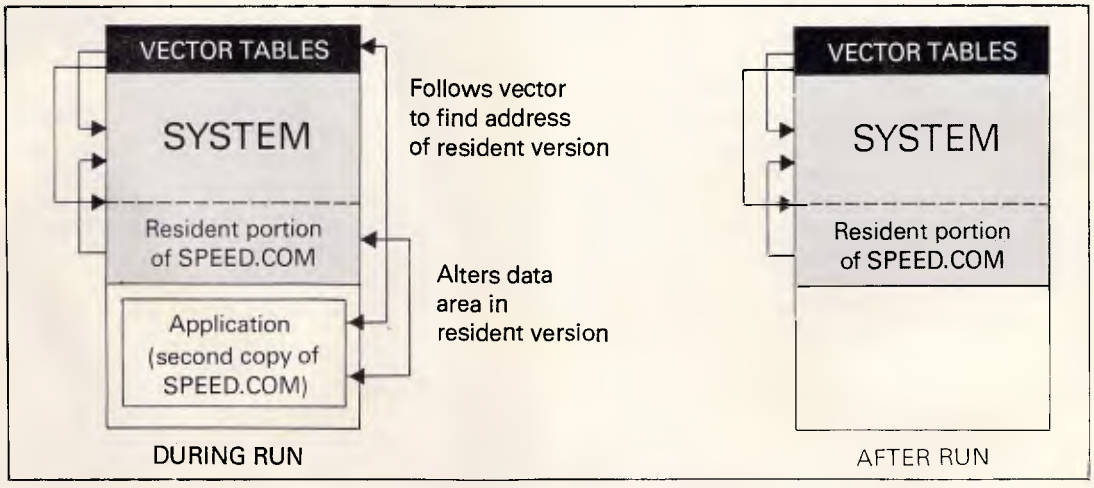

Fig 3: Structure of system upon subsequent executions of SPEED.COM in which foreground version affects background version

tem memory may have been allocated to another program. Whereas a normal program may run around the system doing anything it likes, a resident program is like a guest, and must obey the rules are tread carefully. Any transgression results in spectacular system crashes.

Moreover, because a resident program may find itself executing at absolutely any time, it can find itself in some strange situations. For example, it can be running while a critical error is in progress, or while a disk access is taking place - a time during which the system normally just waits around for the access to finish. Of particular importance is the fact that the resident program is very likely to find itself executing while DOS has control of the system. This is where things get very tricky, as the DOS function dispatcher is not re-entrant. That is, DOS functions with numbers greater than 10h cannot call other DOS functions with numbers greater than 10h. This means that a resident program may not be able to utilise DOS functions, as DOS may actually be active at the time it wishes to do so.

This single factor is what makes the creation of advanced resident software very tricky, as to a large extent it places file I/O, date and time, memory management, sub-processes, directory manipulation and virtually everything else of any use completely out of bounds. Programmers involved with memory resident software are easily identified by the strange topology of their haircuts - brought about by frequent sessions of tearing their own hair out. Fortunately, a series of undocumented DOS features exist which are used almost universally to make the task somewhat feasible. We'll be looking at these next month.

The vectors which a resident program chooses to hook up to depends upon the job being performed by that program. For example, a communications program might intercept the communications interrupts, whereas a keyboard enhancer would connect itself to the keyboard interrupt and a print spooler might hook into several interrupts. It is quite acceptable for a single memory resident program to be vectored to from several interrupts, and quite practical for one interrupt to invoke several resident programs. This is done by daisy chaining. When a program sets a vector to point to itself, it first takes note of whatever the vector was originally pointing to, and specifically calls that routine whenever it, itself, has been called.

One of the most useful interrupts is the timer tick, which causes an interrupt to be made every 18.2 times per second (approximately). The ticker is used for all sorts of things internally, such as stopping the disk drive motor a couple of seconds after the last disk access and updating the current time and date, on some machines. Print spoolers often utilise the ticker so that they may regularly feed more data to the printer. On older microcomputers, programmers would often use the keyboard scan vector for similar purposes, as it would always be called periodically. However, a hardware generated ticker is far superior, as it provides a far higher degree of accuracy and allows the resident program to run even when the system appears to be totally dedicated, for example, during a disk access or trying to access a nonexistent printer.

SPEED.COM constitutes perhaps the minimal memory resident program and, as such, forms a very good example of the techniques involved without obscuring them by masses of conventional code.

Structure

Most reasonably simple memory resident programs follow very similar structures, and SPEED is no exception. The program consists of the initialisation and resident portions. They are both the one program, but with an imaginary line drawn between them.

The resident portion is coded first, as this allows the initialising portion to be deleted once it has been used. This happens because the DOS function 31h call uses register DX to indicate how much memory you want retained for your resident portion. The memory size is set in paragraphs, starting from the beginning of the segment in which the program resides. If DX is set such that you claim all the memory up to the end of the resident portion, but excluding the initialisation portion, the end effect is that DOS will nicely slice your program into two halves once the initialisation is complete, and return the memory occupied by the non-resident portion back to the system pool. This means that the initialisation code is not left lying around in RAM, thereby minimising the memory overhead of the utility.

It is, of course, important to ensure that all variables, subroutines and data items required by the resident portion are in that area of memory actually retained by the operating system, otherwise your utility may end up calling routines which have been overwritten by DOS or by other application programs.

The initialisation portion takes the form of a normal program, reading command line parameters and whatever else it might need to do. It has the full functionality open to a normal program, and may call DOS without restriction. Its final tasks should be to set vectors to the resident portion and terminate, reserving the appropriate amount of memory. Before setting vectors, it should normally read the existing value for each vector and place it in an area of memory accessible to the resident portion. This allows the resident portion to daisy-chain through to other interrupt handlers.

The resident portion is programmed as an interrupt handler. That is, it should assume that all registers must be saved before use, should avoid calling DOS functions (unless the undocumented features are used) and should return to its called via a IRET instruction. In practice, however, most handlers will daisy-chain through to another handler. If there is no other handler, DOS will generally have initialised the vector to point to an IRET instruction in ROM somewhere. During its execution, the resident portion should assume that the system is in an unstable or unknown state, and if it changes any environmental settings, must reset them before exit. For example, if a resident program wishes to display a message on the screen, it may find that the screen is in APA high-resolution graphics mode, in which case directly writing to video memory will not work (unless the characters are meticulously etched onto the screen).

Essentially, the resident portion must vanish without a trace when it finishes an execution. It cannot assume, as normal programs do, that DOS will clean up for it. The program it interrupted will not tolerate conditions suddenly and unexpectedly changing within itself.

Segment addresses

Because the resident software is loaded into an 'arbitrary' location in memory, the program should avoid any hard coded dependency upon the position in which it will be loaded. Some degree of dependency is acceptable in '.EXE' files, as segment references will be adjusted by the loader.

Normally in an assembly language program, the code can be written based upon all sorts of assumptions. However, when the resident portion of a program becomes active, only one item of information is known: the segment address of its PSP. This is held in the CS (code segment) register and

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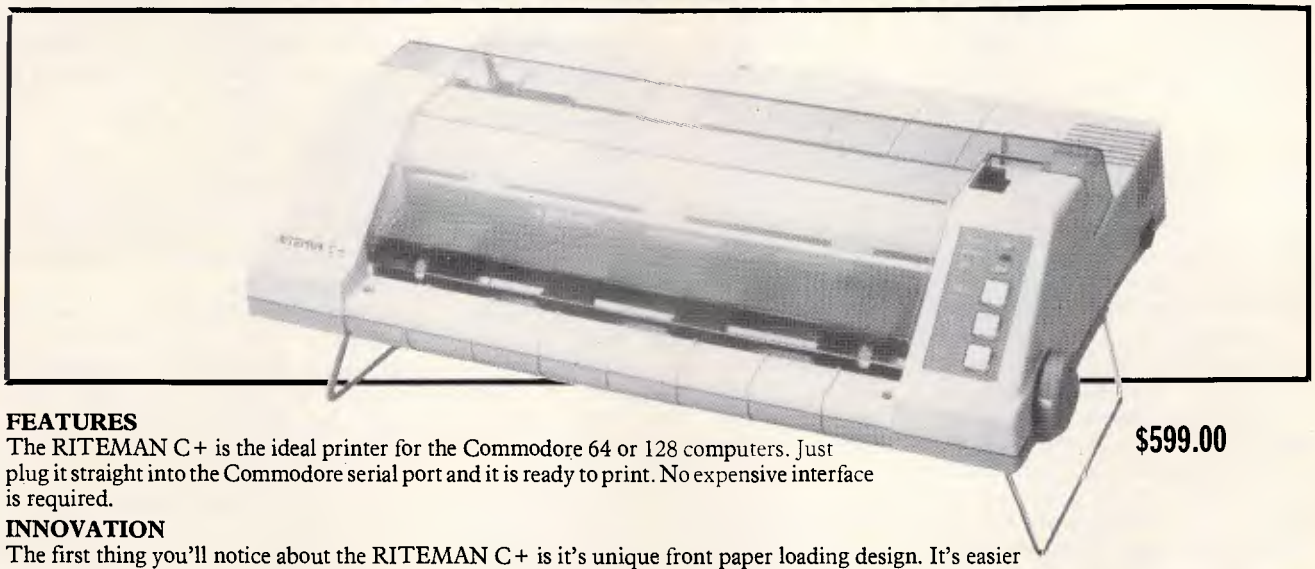

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is made available purely by the fact that the resident program currently holds the CPU. All references to data must be via the CS register, although it is usual to copy it to the DS (data segment) register for efficiency and convenience reasons. You cannot create a multiple segment resident program with the ASSUME psuedo-ops, as you will not necessarily know the address of the other segment (although you could arrange for it to be known). Everything your resident program needs to know at execution time must be derived from the contents of the CS register. This is not as bad as it sounds, just demands a little more discipline and a little less flexibility than you may be accustomed to.

If you have created multiple interrupt handlers within the one resident program, these handlers can readily swap information since they will all share the same code segment value.

A common requirement is for another program to establish communication with a resident program. This may be used for setting flags within the resident program, for example, pausing a print spooler or picking up buffer information. Alternatively, it may be used to see whether the resident program is, in fact, resident. This is commonly used to ensure that a resident program does not load itself twice. In the SPEED example, we use the technique to suppress SPEED from loading itself more than once and to also allow a duplicated foreground version of SPEED to reset the speed setting of a resident background version before throwing itself away.

At first glance, it may seem quite difficult to establish communications with a resident program from a foreground program. DOS has loaded the code into an arbitrary location and isn't going to tell us where. The resident program knows where it lives, but can't tell us because we don't know where it lives in order to ask. The effect is as though the resident program has disappeared inside the system and is no longer accessible.

However, there is one lead which can direct us to the resident program. Various interrupt vectors have been set to point at it, and if we follow one of those vectors then we should find ourselves looking at the resident program, buried deep inside the system somewhere. The SPEED utility uses this fact to prevent multiple loads of itself. Three bytes in from the start of the interrupt handler appears a special marker, 'Ap'. The code branches around this marker to ensure that the marker is not executed as though it were an instruction. Each time the initialisation portion of SPEED runs, it follows the timer tick vector and checks for the characters 'Ap' three bytes on from where the vector points to. If it finds these bytes, then it's a safe guess that a previous incarnation of itself is resident. Also, the foreground version knows where that previous incarnation lives, and may alter any of its variables at will.

There are various other techniques available to find the location of resident software, including utilising unused interrupt vectors, to avoid the situation where another piece of resident software daisy-chains itself off the same interrupt and makes it look as though the first program is no longer present, thereby leaving the way open for multiple loads. Since there are currently no standards for such things, many commercial products are not compatible with each other, and software designers use techniques which they think are 'unlikely' to be used by other vendors. Eventually there will be standards emerging for resident software.

It might be argued that a two byte marker is a little brief, and that would be quite correct. In a commercial product an eight or 16 byte marker could be used which might even include the software version number, thereby guarding against incompatible foreground and background versions attempting communication. We use a two byte marker here purely because it illustrates the technique without cluttering the code.

Fig 2 shows the effect upon the system of an initial execution of a memory resident program such as SPEED. The software loads and starts running as a normal program, however, upon termination, it has hooked itself in as part of the operating system via interrupt vectors, and has left a piece of itself behind to join the core of the operating system in low memory. It has effectively vanished, and become an integral part of the operating system.

Fig 3 illustrates what happens upon further executions. The program loads again as a normal application program. It picks up the timer tick interrupt vector and follows it to see if the special marker appears in the appropriate place. Having determined that the marker exists, the program concludes that there is another version of itself resident in low memory, and that the vector it just followed points to the start of the segment in which the resident version resides. Using this information, the foreground version of the program may then alter the data area of the background version, thereby altering its speed setting. Having done this, the foreground version terminates in the usual way, evicting itself completely

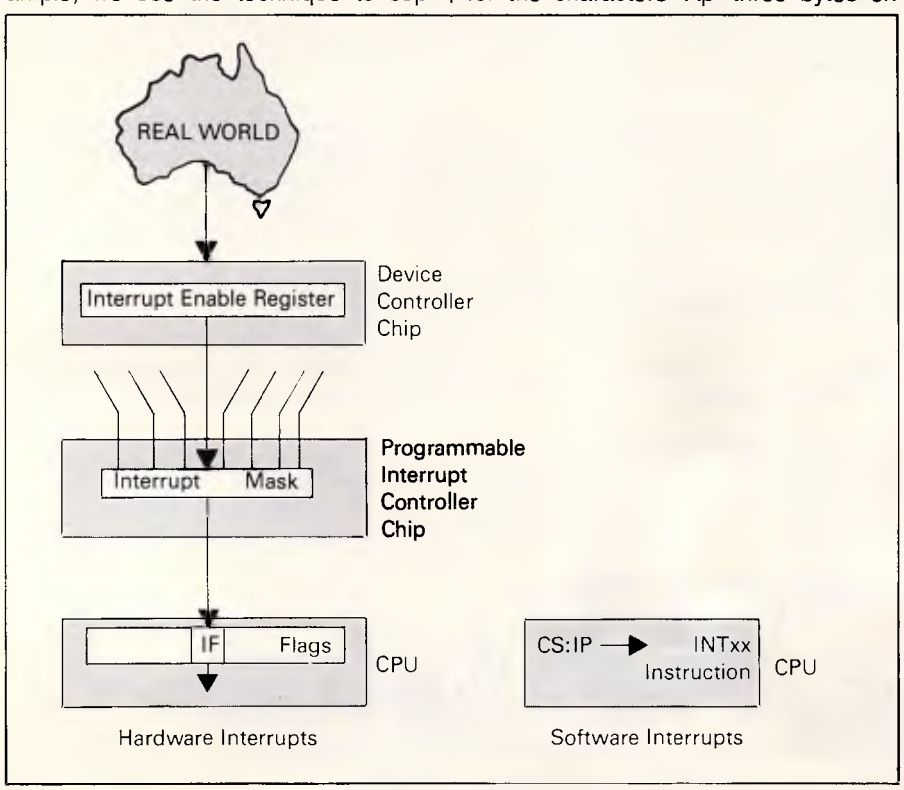

***Fig 4: Sequence of events for the CPU to** act on hardware and software interrupts*

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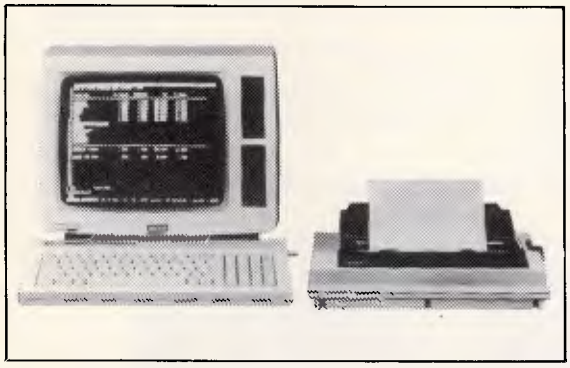

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from the system. Of course, it is pointless for the foreground version to change its own data area, as it isn't the version hooked into the interrupt vectors.

Complex resident software may consist of a series of background programs, plus a collection of foreground utilities, all of which must communicate information to each other. Although the only facts upon which each can rely are their own segment addresses and the forever constant interrupt numbers, these meagre leads are enough to make the whole thing hang together.

Setting interrupts

One of the important aspects of interrupts is that they really are interrupts. As such, they can occur at the most inconvenient of times. For example, a timer tick interrupt may occur just as you are setting the timer tick interrupt vector.

Any manipulation of the interrupt vectors should be done assuming that an interrupt will occur at the earliest possible moment. That is, at the time you reset a vector to point at some of your own code, that code must be ready to run. For this reason, interrupt vectors are usually set in the very last stages of initialisation. Additionally, interrupt vectors should be manipulated with interrupts disenabled.

As we have discussed in previous articles, there are two types of interrupt which may occur in the system. Software interrupts are instructions executed by programs which result in an efficient transfer of control to some other program, just as if a hardware interrupt had occurred. Hardware interrupts are generated by external events. In both cases, the result is exactly the same. For an interrupt of number 'N', the CPU picks up the four byte address stored at location 'N*4', pushes the code segment, instruction pointer and flag registers onto the stack and commences execution at the new address. The difference lies in the sequence of events which must occur before the interrupt is actioned.

For hardware interrupts, the sequence of events starts with the real world signalling some condition to a device controller, such as the carrier detect line dropping on the communications port. If the device controller is enabled to generate interrupts, it will do so by raising a logical '1' on one of its output pins. This pin will run into one of the eight inputs on the 8259A programmable interrupt controller chip (PIC). On AT-compatible machines, two PICs are daisy-chained together to provide 15 interrupt levels, whereas on the PC and XT there are only eight. The PIC contains a bit mask which controls which of the eight interrupts it should allow to be passed through to the CPU. If the appropriate bit is enabled, the PIC will raise the IRQ line on the CPU. However, the CPU will only acknowledge the interrupt if the interrupt enable flag (IF) in the flags register is set.

Thus, once an external event has occurred, there are three conditions which must be met before a machine interrupt will take place: the device controller, the PIC and the CPU must all be prepared to accept the interrupt. If any one of these devices refuses the interrupt, then program execution will continue as though nothing happened. Two instructions, STI and CLI are provided for altering the IF flag in the status register. Clearing the IF flag (CLI) will effectively mask off all interrupts, except for the non-maskable variety (NMI). It is not a good idea to leave the interrupts disenabled for more than a fraction of a millisecond, as dozens of interrupts occur every second, and failure to act upon many of these will result in an inaccurate system time, or even worse.

Software interrupts are much simpler. As we have said, they are instructions which programs may execute and whose action is indistinguishable from that of a hardware interrupt. They do not rely upon the PIC mask or IF flag for their acknowledgment - if a program executes an INT instruction, then that interrupt will occur no matter what. Because they are driven by programs rather than external events, software interrupts cannot occur asynchronously. That is, there is no way a software interrupt can occur while one of our programs is running unless we have asked for it (or unless a hardware interrupt handler has caused one to be done). This means than executing a CLI instruction will guarantee that no interrupts, other than NMIs, will occur until we reset interrupts with an STI instruction.

The explanation is more complicated than the code we would need to write to manipulate interrupt vectors safely without fear of interruption. Happily, DOS provides standard functions for the manipulation of interrupt vectors which guarantee than no asynchronous events will interfere with setting or reading a vector. DOS function number 35h may be called with the AL register containing the interrupt number desired, and will return with the ES:BX registers pointing to the handler for that interrupt. To set vectors, function 25h may be called, again with AL holding the interrupt number, and will set the vector to the contents of register pair DS:DX.

These two DOS functions allow our programs to safely and cleanly sense and set absolutely any interrupt vectors of our choice. Since interrupts are the basis upon which MS-DOS works, this mechanism is crucial to any serious systems work.

Timer ticks

The SPEED utility presented in this article makes heavy use of the system timer, a resource which is worthy of further examination.

The system timer is an Intel 8253-5 programmable interval timer (PIT). This device consists of three independent counters driven from a master clock of

Function Number	Input Conditions	Output Conditions
09h	DS:DX points to ASCII string terminated by '$'	String is printed upon current display device
25h	AL holds interrupt number DS:DX point to handler	Vector is reset
31h	Al holds completion code DX hold memory size in paragraphs	Program terminates but stays resident
35h	AL holds interrupt number	ES:BX points at handler
4Ch	AL holds completion code	Program terminates

Note: all DOS functions are called by loading register AH with the required function number, and executing an **INT 21h** instruction

Table 1: DOS Functions used this month

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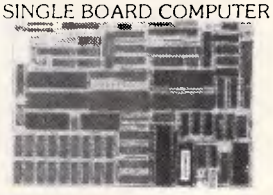

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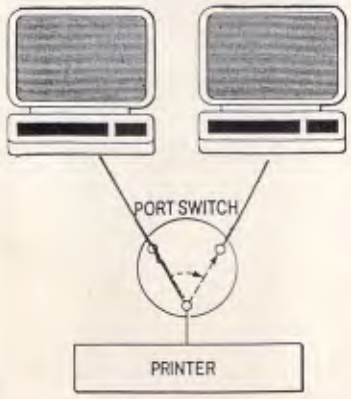

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1.19318MHz. Each counter may be programmed to increase or decrease once every 1 to 65536 clock cycles in either binary or binary coded decimal (BCD). Each counter may be set to one of five modes. In one shot mode, the counter will count down to zero and then trigger its output and go no further. In the rate generator, the usual setting, after triggering its output the chip will reset the count and repeat the operation. In square wave mode, the output remains high for one half of the count and then toggles to low for the other half, resulting an an output which is high and low for equal amounts of time. The other two modes generate strobes, and are rarely used. Each of the timer registers may be read and written while the counting progresses. The device appears at the four I/O ports starting at I/O port address 40h.

The output of the 8253-5 consists of three discrete pins on the chip. Each of these pins is hardwired via tracks on the circuit board to various destinations. Timer 0 output runs to the IRQ 0 input on the interrupt controller (PIC), thus attracting the attention of the CPU when it triggers. Timer 1 feeds to the DMA controller chip, and timer 2 interfaces to the speaker.

Timer 1 is very important and is generally set to trigger quite rapidly. Timer 2 can be used to generate tones on the speaker, commonly set to produce square waves. Note that once you have started timer 2, the speaker will continue to produce the tone until you stop timer 2, and your program may continue with other work. Timer 0 is used for operating system timing purposes, and is initialised by DOS to count as slowly as possible, that is, the timer will trigger 1,193,180/65,536 times per second, or about 18.2Hz. The timer generates a type 8 interrupt, which will be acknowledged by the CPU if all of the enables are set, and if no higher priority interrupt is pending. User programs should not alter the rate at which timer 0 runs, as this will adversely affect timing dependent operations of the computer, such as disk delays.

A signal on the IRQ 0 interrupt input on the PIC causes the CPU to branch to interrupt vector number 8. The handler for this vector takes care of the various house keeping tasks the operating system performs periodically, such as timing out the disk drive and incrementing the time. After the handler completes its work, it executes a software interrupt instruction to branch to vector number 1Ch. This vector normally just returns without doing anything, but user programs may redirect the vector to themselves thereby providing them with a 'heart beat'.

The SPEED utility operates by redirecting interrupt 1Ch to a small resident handler which loops, continuously looking at the timer 0 register, and not returning until the timer has reached a certain point in its count down to the next trigger point.

Port	Function
40h	Programmable Interval Timer (PIT) command word 7 6 5 5 4 2 1 0 SC1 SC2 RL1 RL0 M2 M1 M0 BCD
41h	PIT Timer 0 read/write
42h	PIT Timer 1 read/write
43h	PIT Timer 2 read/write

Command word bit assignment meanings:

SC1	SC0	
0	0	Select counter 0
0	1	Select counter 1
1	0	Select counter 2

RL1	RL0	
0	0	Latch current count
1	0	Read/write MSB only
0	1	Read/write LSB only
1	1	Read/Write LSB, MSB

M2	M1	M0	
0	0	0	Command
0	0	1	Programmable one-shot
X	1	0	Rate generator
X	1	1	Square wave generator
1	0	0	Software triggered strobe
1	0	1	Hardware triggered strobe

Table 2: I/O ports used in this example

The program

As we have now examined most of the system resources used by the example program, let us now look towards Listing 1, the assembly language source code of SPEED.COM.

The entire program is defined to lie within a single segment, and the assembler is to assume that the CS and DS registers point to the start of that segment.

The first fragment of code is the interrupt 1Ch handler itself. The code commences with a marker to detect an already resident version of the utility, and a branch around the marker. The handler then outputs a zero to port 43h, which tells the 8253-5 PIT chip that we want to read the current contents of the timer zero register. We then read the 16 bit counter from port 40h, LSB first, then MSB. A compare instruction checks that the counter has reached the required point in its count back to zero, and the program loops if it has not. Note that the compare instruction does not test for exact equality, as it is possible that the program may not access the counter at the precise instant that it holds the required value. When the counter has reached the required point, the handler performs an inter-segment jump to wherever the 1Ch vector used to point before SPEED was loaded. This allows

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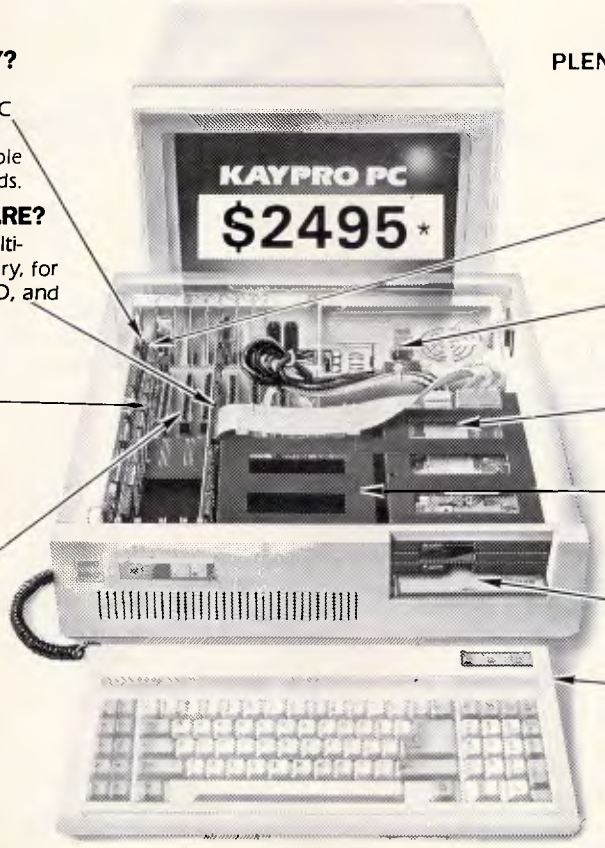

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more than one handler to daisy-chain off the 1Ch vector. We assume that the handler we branch to executes an IRET instruction to pass control back to the operating system. And that is the entire resident portion of SPEED.

The non-resident portion commences at the label INITS. This portion establishes addressibility by copying the code segment register into the data segment register (via the stack). It then loads AH with 35h, the function code to find the value of an interrupt vector, and AL with 1Ch, the vector we are concerned with. DOS is called by an INT 21h instruction, passing control to the DOS function dispatcher. When DOS returns control to our program, the ES:BX register pair point to the interrupt handler and we can use a compare instruction to see if our marker is where it should be.

If the marker is found, we know that a previous version of SPEED is currently resident and can display a message using DOS function number 9, and then call the READ_PARM subroutine to alter the FACTOR variable in that resident copy. Once this is done, the foreground copy may then dispose of itself by calling DOS function number 4Ch, with a return code of zero to indicate successful completion.

If the marker is not found, then the program branches to the label NOT LOADED and takes steps to make itself resident. First it displays a message, and then stores the current value for vector 1Ch in a place the resident copy will be able to access it, namely the variable OLD_INT_1C. It then loads the DS:DX register pair to point at the interrupt handler portion of itself, and calls the DOS function dispatcher with AH containing 25h (set vector function) and AL containing 1Ch (the vector to set). The command line parameter is then read by a call to READ_PARM. Finally, the routine loads DX with the offset of the end of the resident portion. This is how many bytes of code need to be kept by the system when the program terminates, and is everything up to the INITS label. The byte count is converted to a paragraph count by dividing by 16 and rounding up. The program then terminates itself, but stays resident, through the use of DOS function 31h.

The READ_PARM subroutine reads a single digit parameter from the command line. It does this by using the command line parameters passed to the program in its PSP, courtesy of DOS. As you may recall, the PSP is a 100h byte area at the front of each program, and for COM files, you can be sure that CS:0000h points at the

```
Microsoft (R) Macro Assembler  Version 4.00

Speed Controller

                                        Page 60,132
                                        TITLE Speed Controller
                                ;
                                ;
                                ;               PC Speed Controller
                                ;               ===================
                                ;
                                ;       Australian Personal Computer Magazine, January, 1987.
                                ;       Should be assembled as .COM file.
                                ;       Usage is: SPEED 0..9, where 9 is top speed.


0000                            Codeseg         Segment Para
                                                Assume  CS:Codeseg,DS:Codeseg,SS:Nothing,ES:Nothing
0100                                            Org     100h


0100                            MainProg        Proc    Far
0100  EB 24 90                                  Jmp     Inits                   ; Perform initialisation


                                ;       ******************************************************
                                ;       *         New TimerTick Interrupt Handler      (1Ch)  *
                                ;       ******************************************************

0103  EB 03 90                  Handler:        Jmp     Delay
0106  41 70                     Marker:         Db      'Ap'
0108  32 C0                     Delay:          Xor     al,al
010A  E6 43                                     Out     43h,al                  ; Read Timer0 with latching
010C  E4 40                                     In      al,40h
010E  8A E0                                     Mov     ah,al
0110  E4 40                                     In      al,40h                  ; Grab current count
0112  86 E0                                     Xchg    ah,al
0114  2E: 3B 06 0120 R                          Cmp     ax,cs:[factor]
0119  77 ED                                     Ja      delay                   ; loop until reached
011B  2E: FF 2E 0122 R                          Jmp     dword ptr cs:[old_int_1c]

0120  FFFF                      Factor          dw      0ffffh
0122  ????????                 old_int_1c      dd      ?

                                ;               ************************
                                ;               *  Initialisation      *
                                ;               ************************

0126  0E                        Inits:          Push    cs
0127  1F                                        Pop     ds                      ; Addressability via DS
0128  B8 351C                                   Mov     Ax,351ch                ; Find INT 1c Vector
012B  CD 21                                     Int     21h                     ; Result in ES:BX
012D  26: B1 7F 03 7041                         Cmp     word ptr es:[bx+3], 'pA'
0133  75 0F                                     Jne     Not_Loaded              ; Are we resident ?
0135  BA 0199 R                                 Mov     dx, offset msg1
0138  B4 09                                     Mov     ah,9
013A  CD 21                                     Int     21h                     ; Display message
013C  E8 016D R                                 Call    Read_Parm               ; If so, reset speed
013F  B8 4C00                                   Mov     ax,4c00h
0142  CD 21                                     Int     21h                     ; Terminate
0144  BA 01A6 R                 Not_Loaded:    Mov     dx, Offset msg2
0147  B4 09                                     Mov     ah,9
0149  CD 21                                     Int     21h                     ; Display message
014B  89 1E 0122 R                              Mov     word ptr [old_int_1c],bx
014F  8C 06 0124 R                              Mov     word ptr [old_int_1c+2],es
0153  BA 0103 R                                 Mov     Dx, Offset Handler
0156  B8 251C                                   Mov     Ax, 251ch               ; Set TimerTick to Handler
0159  CD 21                                     Int     21h
015B  0E                                        Push    Cs
015C  07                                        Pop     Es                      ; Copy CS to ES
```

Listing 1: Assembler source for the speed utility

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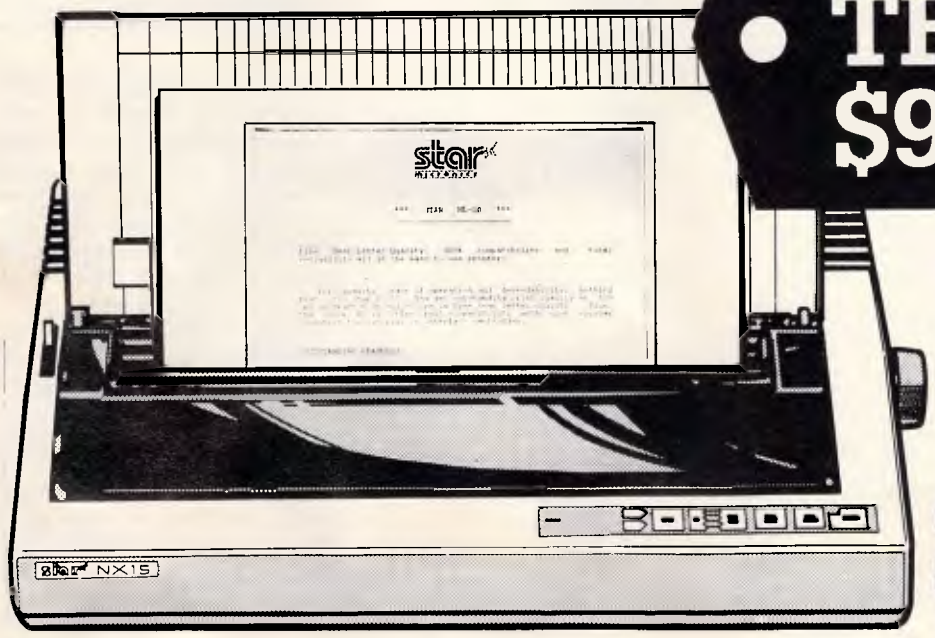

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```
015D  E8 016D R                           Call    Read_Parm           ; Set speed

0160  BA 0126 R                           Mov     dx, offset inits    ; Find size of resident
0163  B1 04                               mov     cl, 4               ; portion
0165  D3 EA                               shr     dx,cl               ; Convert to paragraphs
0167  42                                  Inc     dx                  ; Round up
0168  B8 3100                            Mov     Ax,3100h            ; Set return code to 0
016B  CD 21                               Int     21h                 ; Terminate & Stay Res.


016D                          Read_Parm   Proc    Near
016D  2B DB                               Sub     bx,bx               ; clear BX
016F  8A AF 0080                          Mov     ch,[BX+80h]         ; grab parm length

0173  BF 0009                             Mov     di,9                ; result in here
0176  80 FD 00                Dig_Loop:  Cmp     ch,0                ; last parm byte ?
0179  74 13                               Je      End_parm            ; jump if so
017B  8A 87 0081                          Mov     al,[bx+81h]         ; get character
017F  2C 30                               Sub     al, 30h             ; Convert from ASCII
0181  3C 09                               Cmp     al, 9
0183  77 04                               Ja      Skip_Dig            ; skip if not numeric
0185  32 E4                               Xor     ah, ah
0187  8B F8                               Mov     di, ax              ; else take result
0189  FE CD                   Skip_Dig:   Dec     ch
018B  43                                  Inc     bx
018C  EB E8                               Jmp     Dig_Loop
018E  D1 E7                   End_Parm:   Shl     di, 1               ; double for offset
0190  8B 85 018F R                        Mov     ax,ds:[SP_Table+di] ; look up delay factor
0194  26: A3 0120 R                       mov     Es:[Factor],ax      ; and pass to handler
0198  C3                                  Ret
                              Read_Parm   Endp

0199  53 70 65 65 64 20 52    Msg1        db      'Speed Reset.$'
      65 73 65 74 2E 24
01A6  53 70 65 65 64 20 43    Msg2        db      'Speed Controller Loaded.$'
      6F 6E 74 72 6F 6C 6C
      65 72 20 4C 6F 61 64
      65 64 2E 24
018F  0001                    SP_Table    dw      1                   ; Setting 0
01C1  0008                                dw      8                   ; Setting 1
01C3  0010                                dw      16                  ; Setting 2
01C5  0020                                dw      32                  ; Setting 3
01C7  0032                                dw      50                  ; Setting 4
01C9  0044                                dw      68                  ; Setting 5
01CB  0200                                dw      512                 ; Setting 6
01CD  0800                                dw      2048                ; Setting 7
01CF  1000                                dw      4096                ; Setting 8
01D1  FFFF                                dw      65535               ; Setting 9


                              Mainprog    EndP
01D3                          Codeseg     EndS
                                          End     Mainprog            ; Set entry point



Segments and Groups:

                N a m e                 Size    Align   Combine Class

CODESEG  . . . . . .                    01D3    PARA    NONE

Symbols:

                N a m e                 Type    Value   Attr

DELAY  . . . . . .                      L NEAR  0108    CODESEG
DIG_LOOP . . . . . .                    L NEAR  0176    CODESEG

END_PARM . . . . . .                    L NEAR  018E    CODESEG
```

beginning of the PSP. Offset 80h in the PSP contains the length of the command line parameters, and offsets 81h onwards contain the parameters themselves. The subroutine simply scans the characters until it finds an acceptable numeric, then looks up a corresponding value in the SP_TABLE array. The value retrieved is placed in ES:[FACTOR], that is, the offset of FACTOR relative to the extra segment pointer. If this is the first load of SPEED, then ES has had CS copied into it, and the FACTOR affected is the one in the foreground copy of the program. If this is a subsequent run, then ES happens to point to the 1Ch vector, and the FACTOR affected is the background copy.

The SP_TABLE table allows customisation of the various speeds from zero to nine. Taking speed 1, for example, the sequence of events when a timer tick occurs is as follows: the timer 0 counter has reached zero, and so the 8253-5 chip resets the count

'Running with a speed of zero produces an incredibly slow system. Normally fleeting operations such as scrolling the screen one line suddenly seem to take forever'

back to 65536 and interrupts the CPU. After the CPU has finished its own tasks, it passes control to our routine through interrupt 1Ch. Our routine loops, as the 8253-5 counter continues counting backwards towards zero. Our routine does not return until the 8253-5 count reaches a value of eight - moments before it is due to generate its next interrupt. At that instant our routine relinquishes control, and the CPU resumes its primary task, Space Invaders or whatever it may be. The primary task is allowed to execute for the time it takes to count from eight down to zero (at 1.19 million counts per second), and then is interrupted again. Thus the lower the value in SP TABLE, the more severe an effect is imposed on performance.

Running with a speed of zero produces an incredibly slow system. Normally fleeting operations such as scrolling the screen one line suddenly seem to take forever. The action takes place is small bursts - the brief periods

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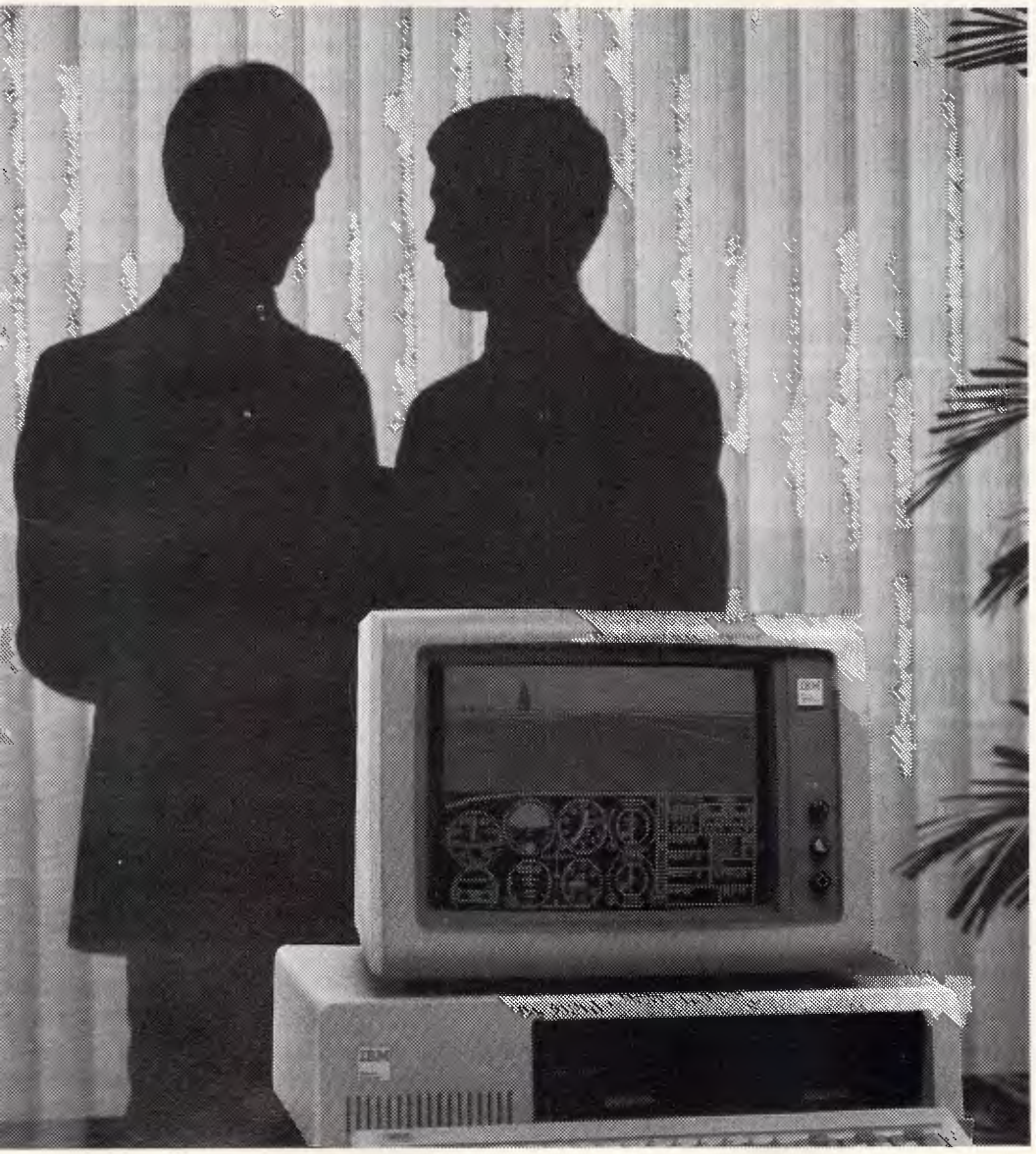

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WHEN RELIABILITY IS THE DECISIVE FACTOR

```
FACTOR . . . . . .        L WORD  0120   CODESEG
HANDLER . . . . . .       L NEAR  0103   CODESEG
INITS . . . . . .         L NEAR  0126   CODESEG
MAINPROG . . . . . .      F PROC  0100   CODESEG Length = 00D3
MARKER . . . . . .        L NEAR  0106   CODESEG
MSG1 . . . . . .          L BYTE  0199   CODESEG
MSG2 . . . . . .          L BYTE  01A6   CODESEG
NOT_LOADED . . . . . .    L NEAR  0144   CODESEG
OLD_INT_1C . . . . . .    L DWORD 0122   CODESEG
READ_PARM . . . . . .     N PROC  0160   CODESEG Length = 002C
SKIP_DIG . . . . . .      L NEAR  01B9   CODESEG
SP_TABLE . . . . . .      L WORD  01BF   CODESEG

    116 Source  Lines
    116 Total   Lines
     37 Symbols

  49266 Bytes symbol space free

      0 Warning Errors
      0 Severe  Errors
```

18.2 times per second when the CPU actually has the opportunity to do useful work. The interesting point, however, is that other timing dependent processes within the system should not be affected. For example, a communications package may continue to run and the operating system should maintain the correct time and date. The disk drives will still time-out the normal period after usage. Of course, you may find one or two funny things going on in your system, and some software which uses loops for internal timing rather than taking a lead from the hardware may find itself very confused.

As we have said, the resident portion of this program is almost the smallest possible. Eager beavers might like to enhance the utility, intercepting the keyboard vector to allow 'hot-key' access to a speed selection, or perhaps inventing something useful or entertaining for the system to do while it is waiting around. Anything really ambitious will require calling non-reentrant DOS functions (function numbers above 10h), and until you know the undocumented tricks, this can result in lots of intermittent system crashes.

Creating the utility

The SPEED utility can be created in a similar fashion to our previous utility.

Readers who have access to an assembler and who are interested in trying their own enhancements and modifications should simply type in the assembly language source shown in Listing 1. The program can then be assembled and linked using the following commands:

```
MASM SPEED;
LINK SPEED;
EXE2BIN SPEED
COPY SPEED.BIN SPEED.COM
ERASE SPEED.EXE
ERASE SPEED.BIN
```

This will produce a '.COM' file ready for execution.

Readers without assemblers, but with access to Microsoft Basic interpreters may key in the program shown in Listing 2. This consists of a small 'loader' followed by data statements required to generate the utility. Running the program produces a disk file called 'SPEED.COM' which may then be run as a normal utility. The program file produced by the assembler and the one produced by the Basic program are identical. Remember, however, that the Basic program includes various checks to catch keying errors, and if any of these errors are reported by the program, you should check your data statements most carefully. Don't just continue on after the loader has detected a keying error. If you are unsure, you may like to consult the first installment of this series (Novermber 1986 *APC*) for further details.

To readers of either persuasion who find keying listings quite tedious, both the assembler and Basic versions are available on Microtex 666 for telesoftware download.

Next Month

The series continues next month and covers the mystical side of memory resident software - the undocumented DOS facilities that everyone really needs to know about, but no one seems prepared to talk about.

Additionally, we'll be getting into keystroke activated programs, and having a look at how to directly address the screen and determine screen types.

END

```
100 '              Australian Personal Computer Magazine
110 :
120 '              ==========================================
130 '
140 '                    .COM & .EXE file Generator
150 '                     ------------------------
160 '
170 '
180 DEFINT A-Z
190 READ FILENAME$
195 ON ERROR GOTO 510
200 KILL FILENAME$
205 ON ERROR GOTO 0
210 OPEN FILENAME$ AS #1 LEN=1
220 FIELD #1, 1 AS OUTPUT$
230 COUNTER = 0
```

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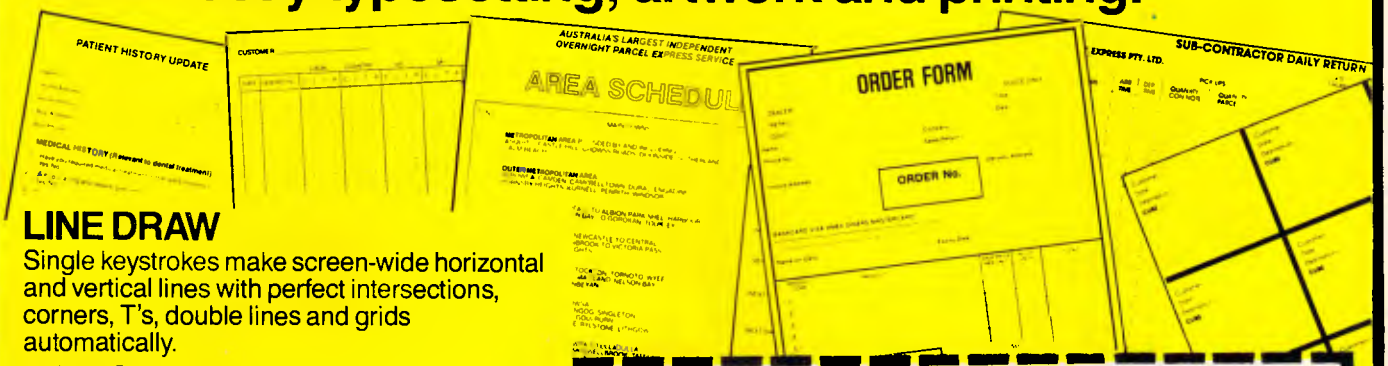

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```
240 PRINT "Generating....."
250 READ LINE.IDENT$
260 IF LINE.IDENT$ = "END" THEN GOTO 430
270 CHECKSUM=0
280 BYTE.POS=0
290 READ ITEM$
300 IF ITEM$ = "$" THEN GOTO 390
310 BYTE = VAL("&h"+ITEM$)
320 BYTE.POS=BYTE.POS+1
330 COUNTER = COUNTER + 1
340 CHECKSUM=CHECKSUM + (BYTE.POS * BYTE)
350 IF CHECKSUM > 9999 THEN CHECKSUM= CHECKSUM - 9999
360 LSET OUTPUT$=CHR$(BYTE)
370 PUT #1
380 GOTO 290
390 READ VERIFYSUM
400 IF CHECKSUM = VERIFYSUM THEN GOTO 250
410 PRINT "Incorrect data at DATA line commencing "; LINE.IDENT$
420 STOP
430 READ SIZE
440 IF SIZE = COUNTER THEN GOTO 490
450 PRINT "Error - bytes missing."
460 PRINT "Expected "; SIZE; " bytes, only read ";COUNTER
470 STOP
480 CLOSE #1
490 PRINT "Generated file "; FILENAME$
500 END
510 RESUME NEXT
520 '
530 '
540 '
550 '
1000 DATA    "SPEED.COM"
1010 DATA    1 , EB, 24, 90, EB, 03, 90, 41, 70, 32, C0, E6, 43,   $,  9613
1020 DATA    2 , E4, 40, 8A, E0, E4, 40, 86, E0, 2E, 3B, 06, 20,   $,  7374
1030 DATA    3 , 01, 77, ED, 2E, FF, 2E, 22, 01, FF, FF, 00, 00,   $,  7776
1040 DATA    4 , 00, 00, 0E, 1F, B8, 1C, 35, CD, 21, 26, 81, 7F,   $,  6B85
1050 DATA    5 , 03, 41, 70, 75, 0F, BA, 99, 01, B4, 09, CD, 21,   $,  7568
1060 DATA    6 , E8, 2E, 00, B8, 00, 4C, CD, 21, BA, A6, 01, B4,   $,  8720
1070 DATA    7 , 09, CD, 21, 89, 1E, 22, 01, 8C, 06, 24, 01, BA,   $,  5204
1080 DATA    8 , 03, 01, B8, 1C, 25, CD, 21, 0E, 07, E8, 0D, 00,   $,  4953
1090 DATA    9 , BA, 26, 01, B1, 04, D3, EA, 42, B8, 00, 31, CD,   $,  9080
1100 DATA   10 , 21, 2B, DB, 8A, AF, 80, 00, BF, 09, 00, 80, FD,   $,  9024
1110 DATA   11 , 00, 74, 13, 8A, 87, 81, 00, 2C, 30, 3C, 09, 77,   $,  5201
1120 DATA   12 , 04, 32, E4, 8B, F8, FE, CD, 43, EB, E8, D1, E7,   $,  5586
1130 DATA   13 , 8B, 85, BF, 01, 26, A3, 20, 01, C3, 53, 70, 65,   $,  7411
1140 DATA   14 , 65, 64, 20, 52, 65, 73, 65, 74, 2E, 24, 53, 70,   $,  6586
1150 DATA   15 , 65, 65, 64, 20, 43, 6F, 6E, 74, 72, 6F, 6C, 6C,   $,  8050
1160 DATA   16 , 65, 72, 20, 4C, 6F, 61, 64, 65, 64, 2E, 24, 01,   $,  5142
1170 DATA   17 , 00, 08, 00, 10, 00, 20, 00, 32, 00, 44, 00, 00,   $,  1352
1180 DATA   18 , 02, 00, 08, 00, 10, FF, FF,                       $,  3421
1190 DATA END,  211
```

Listing 2: Basic loader and data statements for speed utility

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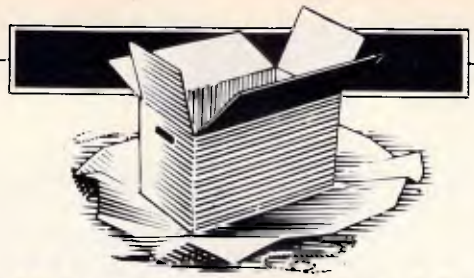

WHAT'S NEW

Ian Davies checks out the most interesting new micro products announced over the last month.

Aussie AT with distinction

Starcard Australia has released the StarCard-286 AT-compatible computer. This machine was designed locally by an ex-IBM design engineer, and is being constructed within Australia, supplementing Starcard's hardware with products from other Australian manufacturers.

The machine looks impressive in terms of price and performance. The 80286 CPU may be run at 6, 8 or 10MHz, includes 640k of memory, EGA adaptor, and a 30Mbyte voice coil hard disk with an average access time of 28ms (compared with 40ms on an IBM PC/AT). All this for just $5950, excluding tax. A 44Mbyte version is also available for $6600.

Starcard Australia claims that the machine features a full 16-bit bus, attesting to its true AT design, and runs the *de facto* standard Phoenix ROM, thereby achieving a high degree of compatibility. The motherboard provides eight expansion slots, serial and parallel ports, and makes heavy use of CHIPS gate arrays. The EGA board is also Australian designed, but sourced from another supplier. The StarCard-286 is supplied with a monochrome monitor which can be easily replaced by a colour screen to obtain the most from the EGA. The machine comes complete with DOS 3.1 and a menu manager.

More information is available from Starcard on (02) 27 4517.

Orchid 12.5MHz board

Hot on the heels of December's announcement of a 16MHz 80386 expansion board, Orchid Technology has released a 12.5MHz 80286 expansion board, claimed to be the fastest add-on available.

The PCturbo 286-12 is suitable for the PC, XT, PC/AT and compatibles, and features 1Mbyte of RAM with support for 4Mbytes of EMS memory. The board plugs into an expansion slot and works in tandem with the original processor. This means that it can coexist with 8088, 8086, 80186 and 80286 based systems, and can take advantage of the second processor by delegating certain I/O functions to it. This also means that the board would presumably run in an Olivetti M24, a machine usually precluded from go-faster cards since the CPU is on the reverse side of the board to the expansion sockets.

Orchid claims the board runs eight times faster than a PC, and 2.5 times faster than an AT. The PCturbo 286-12 is supplied complete with configuration, disk cache, print spooling and RAM disk software. Australian pricing is yet to be determined, but since its US pricing is the same as the 80386 card, it should work out to around $2900.

More information is available from Porchester Computers on (03) 537 2722.

Intel gets serious

Intel Corporation has released ten (count them, ten) new single board computer systems.

Four of these are 80386-based cards for the Multibus architecture, and feature surface mount technology and 64k of CPU cache for zero wait-state memory access. The four different machines vary only in memory size, with options on 1, 2, 4 or 8Mbytes of 32-bit RAM. All of the boards can be upgraded through the use of expansion modules to 16Mbytes. The computers actually sport two buses: one is 32 bits wide for interaction between the CPU, cache and dual ported memory, and the other is 16 bits wide for transfers over the Multibus or iSBX bus. For operating systems, a choice between iRMX 286, Xenix and Unix is available.

The other six machines are 80286-based, with memory sizes of 1, 2, 4, and 8Mbytes and a processor speed of 8 or 10MHz. Again, maximum memory is 16Mbytes, with zero wait-states

Intel think these products should prove useful for

dedicated high performance workstations, real-time control and test equipment. Intel is represented by Total Electronics, on (03) 288 4044.

Wyse AT-compatible

MPA has released the

Wysepc 286 AT-compatible computer which is capable of operating at 6 or 10MHz, switch selectable.

Priced at around one half the equivalent IBM system, the Wysepc features 640k of RAM, a choice of keyboards, DOS 3.1 and GW-Basic. Three configurations with disk sizes ranging from 20 to 80Mbytes are available. MPA claims the PC is compatible with the Wyse series of terminals, forming the ideal base for a multi-user system.

MPA is on (03) 894 1500.

Sanyo Supermicro Minicomputer

Hmm, Super . . . Micro . . . Mini . . . ?

Whereas a microcomputer is a tiny computer based on a microprocessor; a minicomputer is a small fully fledged multi-user computer; and a supermini is a really powerful mini which seems almost too powerful to be a mini.

A Supermicro Mini, *ergo,* is a minicomputer which has been constructed out of many supermicros. And a supermicro, *ipso facto*, just has to be a small computer based on a microprocessor which seems almost too powerful to be a microprocessor.

Anyway, Sanyo has been appointed Australian distributor for one of the above mentioned. The Sanyo-Icon MPSO20-2 is a joint American and Japanese development, based around lots of 68020 processors, each of which may run different operating systems while accessing a common database. Sanyo claims that the supermicro is capable of running IBM system 370 (?), Unix BSD, Unix V, Pick and MS-DOS concurrently.

Separate processors deal with terminals, program execution, files, cache management and the like. An 80286 processor provides IBM PC/AT compatibility. The basic unit supports 16 users, and can handle up to 1000 when fully expanded to 32 processing units. Starting price is around $55,000.

Sanyo is on (02) 439 2411.

New DataFlex release

Australian Microcomputer Solutions has announced the availability of DataFlex release 2.2.

The new release features support of Unix V in addition to MS-DOS: and includes enhancements such as pop-up windows and pull-down menus, through an enhancement to the PAGE command. Additionally, the DataFlex compiler is now 30 per cent faster, and can perform numeric processing more quickly as well as providing an extensive query operations.

Additionally, full MS-DOS and Unix path name conventions are supported for all file references. A utility is provided to convert dBase II databases directly to DataFlex databases, thereby easing the migration process.

AMS is on (052) 21 1300.

ADE OPAL AT-286

ADE can now supply you the OPAL AT-286 PC/AT-compatible computer.

This machine features an 80286 CPU running at 8MHz without wait states, switchable to 6MHz. The 640k of RAM is expandable to 15Mbytes, and a 20Mbyte hard disk is included. Other standard equipment consists of serial and parallel ports, battery backed clock/calendar, AT-style keyboard and a choice of colour or monochrome graphics card.

More information is available from ADE, on (03) 568 7877.

Hand held Organiser

An interesting looking box, this one. The hand held Organiser II is an appointment book, multi alarm clock, database, and data capture unit with a memory capacity of up to 304k.

Using EPROM Datapaks, applications such as finance, maths and spell checking may be installed. Optional hardware extras include a mains adaptor, RS-232C interface, bar code reader, magnetic card reader, PC-based development system and bulk Datapak copier/eraser.

Looks great, complete with all the tools to produce your own vertical applications. The unit is supplied by RCS Design, which, (obviously not organised) forgot to supply either its address or phone number.

Entry level CAD

Hitech Design offers a low cost entry level CAD system based around the AutoCAD package, and includes bundled support.

The system comprises an IBM-compatible running an 80286 at 10MHz with 80287 coprocessor,

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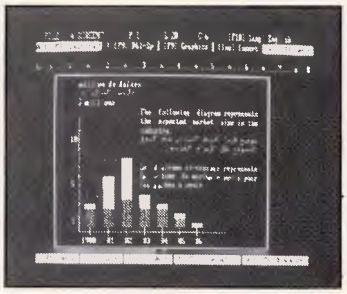
The cost of the system is $17,500, which looks pretty good. Hitech Design is on (03) 419 3713.

Cosmopolitan WP

Computers Anyware, Inc has released a new word processor for European consumption which can support multiple languages simultaneously.

Interword is available in several configurations, each of which features different combinations of languages selected from Danish, English, Finnish, French, German, Icelandic, Italian, Norwegian, Portugese, Spanish, Swedish, Arabic and Farsi. Computers Anyware claims that Interword differs from most other multi-language word processors in that language switches are performed in a keystroke, without the need to load disks. Words and letters from one language may be inserted in documents written in another language, and full text editing and formatting facilities are included. For machines not equipped with an EGA display adaptor, the package comes complete with an EPROM chip. Output may be produced on dot matrix, laser or Qume-compatible daisy wheel printers.



Computers Anyware is not yet represented in Australia, but may be contacted on (703) 442 7910 in the US; telex 901020 ANYWARE.

Insolvency software

It must be a sign of the times. Pannell Kerr Forster has developed a package designed for accountants specialising in insolvency administration.

The Insolvency Data Processing System (IDPS) consists of more than 30,000 lines of dBase III code, compiled through Clipper. The package ensures that all data complies with the various company codes, supreme court rules and the bankruptcy act. Functions include creditor claims, cashbook, debtors register, lodgement, returns and a history register. It is expected to assist liquidators and trustees in the control and monitoring of their insolvency administrations.

PKF is on (08) 223 5711.

Ten user AT

When the IBM PC/AT was first introduced as a 'multi-user' PC, the user population naively tried to plug additional terminals into the back. Of course, MS-DOS isn't multi-user, so neither is the PC/AT in its native environment. And thus the search began for suitable multi-user operating environments.

Pick runs on the AT, and Techcom KSH has announced a new version which can support up to ten users. Pick is being seen as a serious alternative to Unix, as both offer availability across a wide range of machine sizes and brands. However, Pick provides the major advantage in that Pick applications generate psuedocode, not directly executable machine code. This means that programs may be ported from one environment to another without recompilation. Unix cannot do this, as although its environments are compatible, different machines, for example an IBM 4300 and a VAX 750, run different instruction sets. This means that Pick offers an extremely good upgrade path from an AT-based system.

Techcom KSH is on (03) 209 2266.

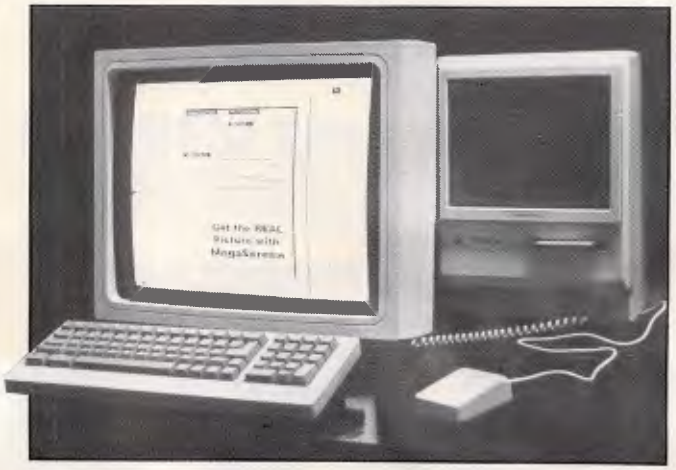
Access security and data protection

UNIXbuilt has secured the agency for two packages related to data security.

Protec provides access control for PCs at the logon, file and boot levels. All access is controlled via passwords, and the system cannot be bypassed by booting from a floppy disk. Optional data encryption is available using either DES or a proprietary algorithm. Selected files may be locked as non-copyable for anti-theft protection, and an audit trail logs attempted unauthorised activities. Protec includes a disk cache and menu system which avoids the need for users to master MS-DOS.

Sybil offers security against accidental data loss through a collection of utilities which can undelete files and unformat hard disks. Other programs include a print spooler, bit image screen printer, advanced diagnostics, ASCII character graphics generator, file finder, advanced file compare, disk sector editor and a COMBINE utility for applying systematic modifications to text files.

Protec costs $595 and Sybil costs $144.95. To date 25,000 and 3000 copies respectively, have been sold overseas. UNIXbuilt is on (03) 561 1275.



Mac MegaScreen

PICA Pty Ltd has announced the introduction of the Macintosh MegaScreen to Australia.

The MegaScreen is a 19.5in monochrome display which runs alongside the normal Mac Plus display. Using a graphics resolution of 1024 x 900, the MegaScreen allows the normal Mac work space to be expanded by a factor of five. This means that entire document pages may be

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Storage: dual 360k FDD (Tandon, Weltec)	**Monitor:** TTL monochrome/color/dual frequency
Video controller: Hercules compatible/colour graphics adaptor	**Operating system:** fully licensed MS-DOS
Multi I/O: parallel, serial (2nd optional) and games ports, real time clock, disk drive controller	**20MB Winchester (optional):** Tandon
Keyboard: 84 keys with LED indicator (AT type)	**Warranty:** 12 months

Dealer enquiries only: NSW — contact **Michael Wee** 516 5573, 519 8240 Qld — contact **Roger Hunt** 076 39 1110

Hal authorised dealers: New South Wales: **Drummoyne,** Microstation, 819 6348; **Dubbo,** Technical Office Machines, 068 82 3833; **Chippendale,** Computer Exchange, 698 8855; **Brookvale,** The Computer Factory, 938 2522; **City,** Data Discounts, 238 2195; **St. Leonards,** Advance Technical Sales, 437 6844; **Hornsby,** Intelsoft Aust., 476 4543; **Parramatta,** Foremost Office Equipment Pty Ltd, 635 5477; **Newcastle,** Pacific Office Machines, 044 22358; **Lismore,** Lismore Electronics, 066 21 7998; **Grafton,** Grafton Computer Centre, 066 42 6790; Queensland: **Maryborough,** Kellor Electronics, 07 21 4559; **Ipswich,** Computer Magic, 07 816 1830; **Nambour,** Nambour Electronics, 071 41 1604; **Toowoomba,** Hunts Computer Shop, 076 385001; **Rockhampton,** Access Electronics, 079 27 8757; **Warwick,** Audivision, 076 61 3131; Victoria: **Melbourne,** Cybernetic Research Pty Ltd, 03 529 4844; **Geelong,** Referred Business Computer, 052 94477; ACT: **Canberra,** Actcomp, 062 51 4477; WA: **Perth,** Perth Computer Mart, 09 370 2166.

HAL Australian sole distributor: Tufula Pty Ltd, subsidiary of Eastern Resources of Australia Ltd.

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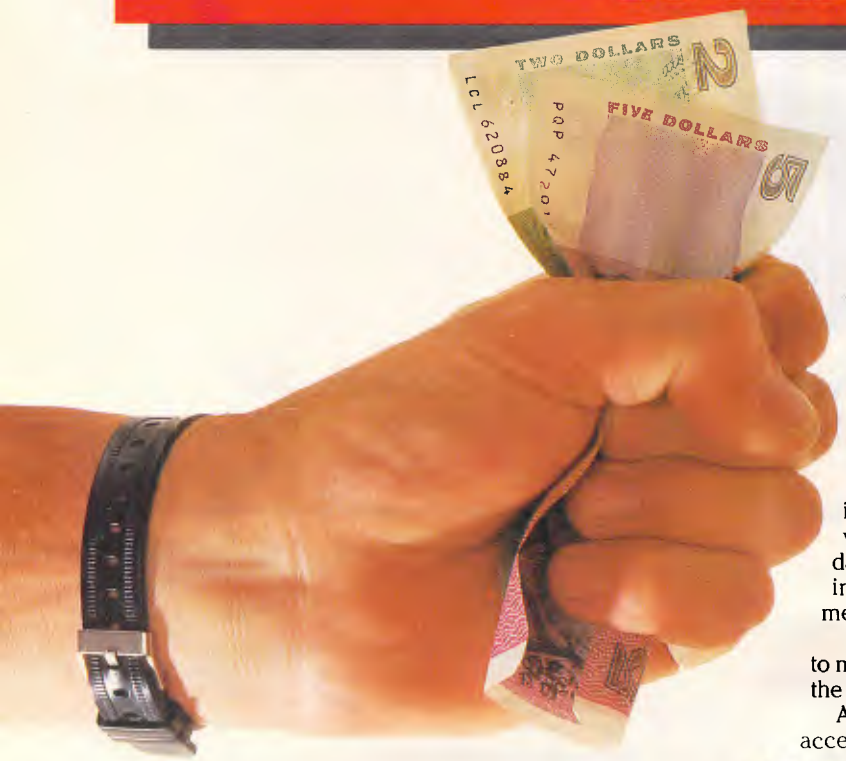

Finding the time and then the relevant information that is succinct, and accurate, on the state of the PC and microcomputer market was a near impossible task.

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the UN 608

viewed and spreadsheets may be wider and deeper. For CAD work, large designs may be manipulated without continuously scrolling to reveal hidden portions.

Interface circuitry must be installed within the Mac Plus, and must be done by an authorised technician.

Configuration software allows selection between the MegaScreen and the normal Mac Plus display.

The MegaScreen is priced at $6360, and is available from participating Apple dealers, or from PICA on (03) 370 3566.

Gateway correction

In the December issue, I made some comments about the Gateway videotex emulator from Cybersoft.

Cybersoft has kindly (and with great restraint) pointed out that my comments were based on a pre-released version of the product, and that the communications shortcomings were resolved before any production version was released. After running up their current version, I will now amend my original comment to 'great logo, terrific screens, *and very strong on communications*'.

For anyone interested in Videotex and ASCII communications, Gateway is well worth a look, and includes many unique features. It is being distributed by Arcom Pacific, on (07) 52 9522.

Robocom CAD

Robocom Australasia has announced the introduction of one new CAD package and the enhancement of another.

The RoboSOLID package is a PC-based 3-D solid modelling product which operates using internal specifications of solids, rather than wire frame and surface modelling. Since the solids are completely specified, complex combination and subtraction processes may be performed through single commands. RoboSOLID is priced at $4200.

Major enhancements to the RobCAD package means that it now offers colour, layering and support of expanded memory. Up to 256 colours may be used, even on monochrome displays through the use of colour numbers. When combined with the layering feature, PCB designs can be greatly clarified.

Robocom is on (03) 817 6176.

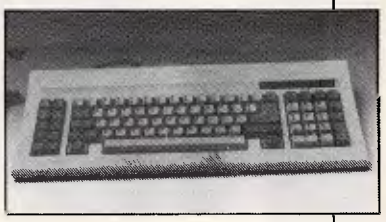
Brother printers

Brother has released three new high performance printers.

The M1709 is a 240 cps dot matrix printer with IBM and Epson compatibility, a 2k buffer and an NLQ mode capable of 50 cps. The printer costs $1299. The M1109 is an Apple compatible dot matrix printer with a draft speed of 75 cps, 19 cps in NLQ, and a recommended retail price of $649. The HR20 is a daisy wheel designed for high quality output at a speed of 21 cps. The HR20 is actually an upgrade of the HR15XL, and features reduced noice output and greater carriage width, and a price of $999.

The printers are available from Brother dealers, or phone (02) 211 2144.

AT keyboard



For all those people who feel the AT keyboard is vastly superior to the PC layout, but are not prepared to upgrade to an AT just to get the keyboard, Electronic Solutions has the answer.

It now stocks AT keyboards which may be connected to either PCs or ATs, depending on a switch setting. The keyboards follow the standard AT layout, and feature an 8.5ft coiled cable and 14 day money back guarantee.

Electronic Solutions is on (02) 427 4422.

Informix Lotus confluence

The producers of the Informix relational database and 4GL have utilised the Lotus developer tools to forge a seamless integration between the two products.

The Informix Datasheet Add-In preserves the 1-2-3-interface while allowing users to manipulate databases directly as though it were a spreadsheet. With menus and commands of Informix extending the efficiency of 1-2-3, users are no longer bound by memory constraints and data isolation. Additionally, Informix-4GL and Informix-SQL may be used to operate directly on the same databases.

The Datasheet Add-In will sell for $299.95 and is available from Rakon Computers on (02) 437 6777.

Calcomp PC CAD software

Calcomp, the company famous for engineering plotters, has just released a PC-based CAD package called Solid Vision.

Solid Vision operates in a world of walls, holes, cylinders and wedges instead of points and lines. Utilising an object oriented database, objects may be viewed in any of three dimensions. Rotations, view changes, frame generation and hidden line removal are all performed by the press of a button. A macro language allows the definition of new menu commands.

The product is being supplied by Datamatic, on (02) 888 1788.

Qume PageLINK

C & PA has announced the availability of the new Qume PageLINK interface unit for laser printers.

The PageLINK is a 10MHz PC type box which sits between networked PCs and the office laser printer. PageLINK supervises the

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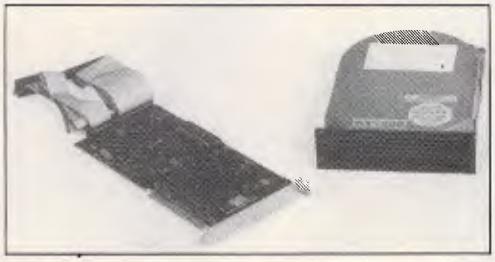
operation of the printer, attending to time consuming tasks such as special fonts. The system supports over 65 standard fonts, and can perform kerning, ligatures and justification.

PageLINK costs $3995 for two user support, or $5995 for nine users. C & PA may be contacted on (03) 544 3444.



ADE hard disk

ADE has announced the release of the KD550/551 hard disk system for PC-compatibles.

The system comprises a half height 20Mbyte disk and controller, complete with documentation and boot ROM. The controller can handle up to two drives, and installation can be completed within minutes using only a screwdriver. Since some older PCs have power supplies incapable of driving a hard disk, ADE can supply the K-524 150 watt replacement power supply.

ADE is on (03) 568 7877.

Machine independent assembler

Ptizan Computer Services has secured Australian distribution rights for the MOPI Universal Independent Assembler.

MOPI is designed to produce machine code for any 8 or 16-bit and most 32-bit processors in a machine independent, or partially independent fashion. Using instruction tables, MOPI may be used as a normal assembler, a cross assembler or even a low level compiler. This allows developers to easily support multiple machines from a single source code deck.

MOPI costs $175, and Ptizan may be contacted on (062) 58 6823.

Single Vcc RS 232 transceiver

The RS 232 standard is an inconvenience to most circuit designers because of its wide voltage requirements. Traditionally, RS 232 line drivers such as the 1488 and 1489 chips have been used, but these devices require a +12v and −12v supply which can be rather hard to arrange in portable gear where all the other chips are content with a single +5v supply.

Alphatron Industrial Electronics has introduced the MACRO-232C-1 hybrid ICs which contain four drivers, four receivers and a DC/DC voltage converter which can generate +9v and −9v. These voltages are made available externally for other uses. The chips are driven from a single Vcc of +5v.

Alphatron is on (03) 758 9000.

Cheap multi-function card

A multifunction card for ATs which provides serial, parallel and games ports with memory expansion up to 3Mbytes has been released by Pantek Australia. The MF 3000 allows memory to be added by the user, and may be provided with two serial ports. Memory starting address is switch selectable to 256k, 512k or above 1Mbyte. Split addressing means that the memory may commence below 1Mbyte, extend up to the 640k limit, and then continue noncontiguously above the 1Mbyte line.

Without any memory chips, the board is priced at $600. Pantek is on (03) 836 9633.

Free blind mice

Researchers at IBMs facility in New York have constructed an experimental 'mouse' for use by blind people.

But instead of using the mouse to point, the little rodent does the reading. Small pistons under the users fingertip are raised to form the braille equivalent of the character under the cursor. As the user moves the mouse around, the pistons reflect the character under the cursor at that time. This allows the user to 'browse' the screen.

No training is required if the person involved can read braille, and IBM suspect that the mouse might even be used to teach braille, perhaps in conjunction with a voice synthesiser.

High-res monitor

It makes sense, really, that if a document is to be printed on A4 paper, then it should be edited on an A4 screen.

Datatel has released the MDS 'Genius' screen and adaptor card, capable of displaying a full 66 lines of text on a true A4 size screen. The monitor features a 100MHz bandwidth and 64KHz horizontal scan rate. The display shows black characters on a white background, which is believed to reduce operator fatigue.

Naturally, your application software must know to produce 66 lines, and MDS has worked with software vendors to ensure that Lotus, AutoCAD, Framework, Supercalc, WordStar, Windows and many other products all take advantage of the Genius.

Datatel can be reached on (03) 690 4000.

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Apple Compatible Cards for IIe

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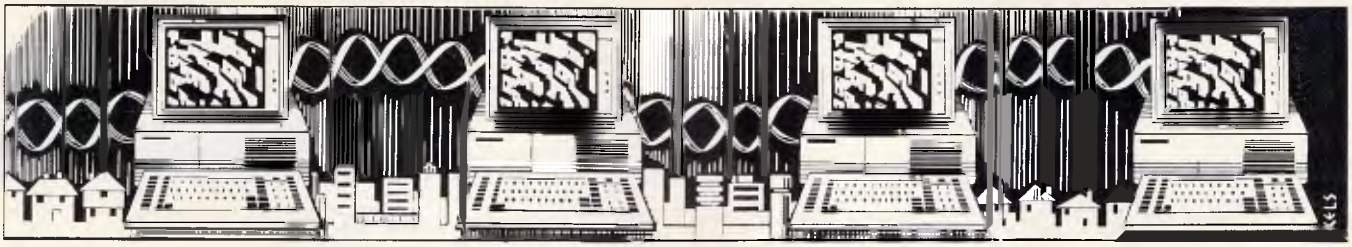

Telecom charges

This month Steve Withers airs his views on Telecom's proposed charges and presents his regular bulletin board update.

The introduction of timed local phone calls would put a big dent in the use of bulletin board systems, especially if the present 18¢ charge became the cost for every three minutes. Computing Australia recently quoted Bob McKinnon, Telecom's acting managing director as saying 'we are certainly thinking about local call charging. There's a lot of sense in it, but we are certainly not introducing it generally in 1987'.

Note the word 'generally'. Telecom is particularly concerned about the use of local calls for data links, and there is a very real risk that our hobby could be affected by measures taken against commercial organisations that tie up circuits for hours on end during peak periods. One option being considered by Telecom is the use of special equipment to charge the receiver of a data call. This poses an even bigger threat to bulletin board systems. While around 100 individuals and clubs have made the capital investment to set up bulletin boards, how many of them will baulk at a phone bill of over $35 per day? At 18¢ for three minutes, and 10 hours connect time per day (many boards are busier than that), that's the kind of money involved.

Things could get even worse. Telecom has set a charge of $6.50 per hour for its Value Added Service Access Service. If local call charges are set at a level to match this, we can say goodbye to non-commercial dial-up systems. Sysops have enough problems without having to install accounting systems on their systems. Oh yes, VASAS charges are levied at the receiving end.

Before anyone points out that bulletin boards exist in countries where local calls are timed, it should be realised that they only thrive where local calls are free or untimed. The UK with a population nearly four times that of ours (and a very high per capita ownership of micros) only has about one third as many bulletin boards.

At the risk of repeating myself, Telecom should realise that bulletin boards generate extra revenue. It might not be much, but bulletin boards are busiest outside of peak periods, so we aren't causing congestion.

Another quote from McKinnon: 'Telecom's attitude is that the untimed local call shouldn't be subverted to a commercial use for which it was never intended'. Perhaps we should all point out to Mr McKinnon that not all data calls are commercial, and ask that we receive some consideration.

Incompatible Modems

Over the last few months messages have appeared on various bulletin boards concerning the inability of certain modems to work together, even though they are both Telecom approved and purport to conform the same CCITT standards (V22 and V22bis).

I would like to hear from anyone with solid, first-hand information on this subject (especially modem manufacturers and importers). Such material will be collated and summarised in a future column. This information would be useful to those considering the purchase of a modem whether it is for use as part of a bulletin board system, or being bought to access them.

If Sysops could let me know what make and model of modem they use, I will add it to the system listings. That information, coupled with an 'incompatibility chart' would serve to reduce the number of wasted calls.

Microtex 666

Microtex 666 has gone through another of its periodic updates. The main menu now shows the 'headline', features, with one entry leading to the A-Z Guide, an index to all services and departments.

The bulletin boards (Chatline, Blackboard, Blue Board, and Debate 666) are now all continuously updated. In the past, messages were posted in batches at certain times of the day, but now the effect is the same as your friendly local bulletin board, except that it's multi-user and can be accessed from around the country without STD charges.

The Blue Board is not for followers of IBM, but an adults-only board where the usual restrictions on content do not apply. Curiosity got the better of me, so I can report that early messages were apparently posted by teenagers taking the opportunity to swear at each other. Ho-hum.

System News

It's been some time since I explained the format of the listings. Information is presented as follows: system name;

phone number; accessibility (P=public, M=members/registered users, V=visitors); operator's name; hours of operation; modem standards (all systems support V21 otherwise noted); and other notes as appropriate.

A complete (to the best of my knowledge) list appears in January and July. In other issues we publish details of new systems, plus any corrections or changes that have come to hand.

Information providers this month were Larry Lewis (as usual!), Tim Mansfield, Darryl Clayton, Mike Purdy, John Hambley, Leonard Holling, Martin Josephson, Greg Hope, and the person from Shannon Repairs (sorry, I couldn't quite read the signature).

New systems

NSW

Auz Line (02) 636 9027. 24 hours daily.

Australian Pick Users' (02) 631 8603. MV. Kurt Johannessen. 24 hours daily. V21, V22, V22bis.

Comm Link (02) 875 4817. MV. Michael Hayter. 24 hours daily.

Paragon (02) 597 7007. P. Jannifer Allen. 24 hours daily. V21, V22, V22bis, V23.

Samilon Fidonet (02) 80 3681. MV. Brian Houlahan. 24 hours daily.

ACT

ACT Amiga Users Group (062) 58 4055. MV. Mike Hurst-Meyers. 24 hours daily. V21, V22, V23.

Victoria

Aces High (03) 878 2918. 24 hours daily. V21, V22, V23.

The Further Regions (03) 725 3732. 'The Outsider'. 24 hours daily.

Bayside Fido (052) 51 4110. 'Paddy'. 24 hours daily. V21, V22, V23.

Queensland

Cynthia (07) 262 1269. Martin Josephson. 24 hours daily.

Datanet (07) 356 4541. P. Bill Bowden. 24 hours daily.

Soft-Tech (07) 203 6864. P. Alwyn Smith. 24 hours daily. V21, V22, V22bis, V23, and Bell.

Mackay High (079) 514 815. P. 3.30-pm-7.30am weekdays, 24 hours weekends.

WA

Oasis (09) 384 8431. MV. V21, V22.

Updates

NSW

Aus Talc. Off-line.

Bee-Hive (02) 520 5181. P. Paul Pinches. 9am-6pm Friday-Monday.

Sci-Fi (02) 646 4865. P. Greg Hope. 24 hours daily. V21, V22, V23.

Software Tools Remote (02) 449 2618. P. Bill Bolton. 24 hours daily. V22, V22bis only.

Warringah (02) 875 2606. MV. Bryan Wilde. 24 hours daily. V21, V22, V23, Bell 103, Bell 212. A FidoNet system. Previously listed as Frontier System.

Victoria

Castlemania. Off-line.

PC Domain (03) 789 8918. Darryl Clayton. 24 hours daily. V21, V22, V23. FidoNet 630/309.

Abacus (057) 83 1964. P. Maurice Copeland. 8am-noon, 4pm-11pm daily. V21, V23 (with auto back channel).

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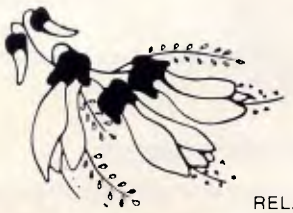

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COMMUNICATIONS

ACT

Commodore User Group (ACT) (062) 810 847. MV. James Hacker. 24 hours daily.

MICSIG (062) 85 1026. P. Ross Elliot. 24 hours daily. V21, V22, V23.

Tasmania

Tassie Bread Board System (003) 26 4248. MV. Ian Campbell. 24 hours daily. V21, V22, V22bis, V23.

WA

Mouse Exchange (03) 339 6890. Leonard Hollings. 24 hours daily. V21, V22, V22bis, V23, Bell 2400. FidoNet 690/901. Now caters for IBM and compatibles, Microbee, Commodore 64, and Macintosh.

Queensland

ACEA Off-line.

BEX II (07) 808 2125. MV. Rick Dalley. 24 hours daily. User Works Node 4.

Hotline (07) 353 3718. MV Lionel Theunissen. 24 hours daily. V21 (can switch to V23 or Bell 202 after logging on). User Works Node 3.

Kangaroo Point TAFE (07) 393 1763. Troy O'Malley and Tim Mansfield. 9am-10pm weekdays, 24 hours weekends. V21, V23.

MSL Off-line.

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BIBLIOFILE

Artificial intelligence and computer security are just two of the subjects under discussion in this month's book round-up by David Taylor

Bright sparks

TITLE: Artificial Intelligence
Theory, Logic and Application
AUTHOR: James F Brule
PUBLISHER: Tab Books (Thomas Nelson)
PRICE: $25

The hot pursuit of Artificial Intelligence (AI) is getting hotter by the day. As more and more data-processing muscle is scrummed into less and less chip, and as the chips pack shoulder to shoulder into boards of unprecedented density, it starts to seem as if machines smarter than men will be with us any minute. *They won't.*

Crystal-ball gazers are beside themselves, but it's too easy to get carried away at the ooh-er thought of 'thinking' machines. I prefer the pinch of salt approach as yet. Maybe we do have expert systems already. We're assured that fifth generation superchip computers are just around the parallel-processing corner. Fine — but none of that is by any means a match for old-fashioned brains.

Nor do many people think it's ever likely to be until we've said goodbye to the electronic computer and hello in its place to the brave new dawn of photonics. The fact of the matter may well be that what can be done with electrons is beginning to approach a limit — and it's a limit that falls far short of making machines to outsmart men.

Maybe the manipulation of photons and computers which are based on light, not electricity, will one day change all that. If SDI ever works, laser technology could go all kinds of ways!

Perhaps, but meanwhile there's no stopping the optimists. Here Mr Brule (who, by the way, is an information management specialist for an American mental health institution) begins by giving us a potted history of the famous old Turing Machine, proposed in the 1950s by mathematician Alan Turing as a test to find, say, by the year 2000, a computer which could win a parlour game. He reminds us about Eliza, a 1960s prototype of expert systems which could make people believe it was knowledgeable in the field of psychiatry. Then he scoots to current expert systems which can *mimic* human advice (like MYCIN, the doctor on a disk) or the new 'decision support' applications, and is off into colourful phrases like 'probing the other limits of business productivity'.

Up to a point, this book is fascinating stuff, just as expert systems are terrific fun to construct. You can try your hand at Knowledge Representation Schemes and play with Lisp and Prolog. You can tussle with 'fuzzy logic' or have a crack at algorithms to develop a simple AI program.

It's all good fun, but don't be fooled into believing that you and your expertly programmed micro are any cleverer than the information which some even cleverer person has fed in.

Really Brave New Artificial Worlds take a little time.

Mind how you gosub

TITLE: Computer Security:
A Handbook for Management
AUTHOR: Leonard H Fine
PUBLISHER: Heinemann
PRICE: $35

Published in association with the Irish

Management Institute (wipe that smile off your face, please), Leonard H Fine's handbook for managers on how to keep snoopers out of their business systems is here in its second updated edition. In other words, it now has a bit about the Data Protection Act.

The no-nonsense approach to all manner of catastrophe and upset is still there, mind: from theft, fraud, sabotage or disruption, strikes, terrorism or bent personnel — you name it. Take floods for instance. *'In many parts of the world,'* says Mr Fine, *'flood damage and risk is commonplace. The risk to computers is substantial . . . obviously the best approach is not to site the computer in areas where flood risk is a reality.'*
Well, he's right isn't he?

Then again: *'Installations in Europe and America have been physically attacked'* and *'The cleanliness of computer installations is important'* and *'Some organisations have introduced the practice of six-monthly or annual medical examinations for computer staff in high stress jobs. If adverse elements are detected, an individual's job may be temporarily restructured'.* So you can't be too careful.

It's cogent advice, it is, and it adds up to what the author calls his 'Total Security Concept' — a mix of policy, procedures and planning best managed by a special committee.

Useful, then, if too often awash with management jargon and led astray into wool-gathering around the blindingly obvious, not to mention euphemisms like *'an individual's job may be temporarily restructured.'*

Easy does it

TITLE: Computer Programming (Made Simple)
AUTHOR: J Maynard
PUBLISHER: Heinemann
PRICE: $12.95 (paperback)

More than 100 years ago, Charles Babbage lashed together his Analytical Engine, a mechanical number-cruncher which is now acknowledged (*ad nauseam*) to have pioneered the principle of computing.

Babbage had this to say about its limitations:

It is desirable to guard against the possibility of exaggerated ideas that might arise as to the powers of the Analytical Engine. In considering any new subject, there is frequently a tendency, first, to overrate what we find to be already interesting or remarkable; and secondly, by a sort of natural reaction, to undervalue the true state of the case when we do discover that our notions have surpassed those that were really tenable. The Analytical Engine has no pretentions whatever to originate anything. It can do whatever we know how to order it to perform.

The style of writing may now strike us as a bit archaic, but you cannot fault the level-headed sentiments. Certainly Mr Maynard takes them as his watchword as he prefaces this quite excellent book with some sanguine reflections on how the public tends easily towards a starry-eyed view of what computers can do. Yet at the same time he shrinks away from the task of trying to fathom how they do it.

Computers aren't nearly as smart as they're often made out to be, he asserts. They're immensely useful, of course, but not by any means a match for the human brain, either now or in the foreseeable future.

Clear away such mystique, he insists. Grasp that 'a computer cannot tell its user how to solve a problem but can only perform those calculations which it has been instructed to do'. Then you'll be in the right frame of mind to start learning how to program, bit by logical bit.

Developers of 'expert systems' or AI enthusiasts aren't going to warm to such a no-nonsense approach, but it should strike a chord with experienced programmers who scarcely need to be reminded that 'the preparation of work to be run on a computer can be one of the most mind-bending exercises encoutered in everyday life.'

Now programming, of course, isn't everybody's idea of everyday life. You can use computers without much of a foggiest on how to do more than boot-up a ready-to-run application. On the whole, I'd sooner drive a car than build it from a thousand bits; sooner use computers as tools than fiddle about feeding them line-by-line instructions.

But if you feel in all conscience that you *should* know more about the innards, or if you'd like at least to explore whether you have the patience and aptitude to program, then a jargonless and authoritative all-in-one primer on getting to first grips with Cobol, Fortran and Basic would be handy.

This is it: a new edition of an old standby, still a snip at $12.95. It's a lot more like a school textbook than a rattling good yarn but it's lucid, well-structured, paced and supplied with exercises. It's very general, not tied to any micro — more about the big wide world of computers by the professional roomful.

It does indeed make programming seem easy. Well, fairly easy. Let's just say it's interesting. Up to a point.

See Jim hack

TITLE: Acorn/Cambridge Illustrated Dictionary for Young Computer Users
AUTHORS: Arthur Goodman & Tim Tregear
PUBLISHER: Cambridge University Press
PRICE: $17.50

Excellent value and a great little book of definitions, general description and potted history on computers, aimed at the 9 to 14-year-old age group, it says.

These days I'd not be surprised if there were 14-year-olds who could write it, never mind read it, but on the other hand there'll be plenty of baffled grown-ups who might appreciate taking a surreptitious peek over precocious kids' shoulders.

The illustrations are a bit ham-fisted, but at any rate they're colourful and peppered over every page. The text is very good, both short essays and definitions (which cross-refer).

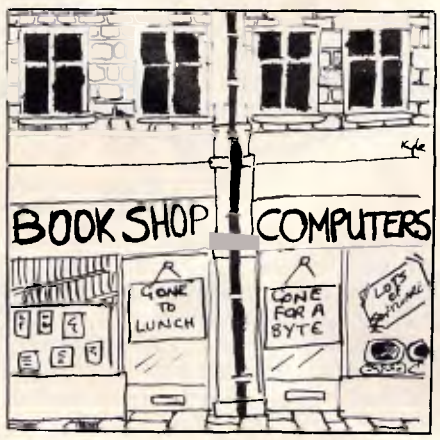
It's all short and snappy but it succeeds at the most difficult trick of simplifications for kids without banality or a patronising tone.

It's up-to-date, too, with fifth-generation computers included and, for example, this quick summary of AI:

'Much research is being carried out to try to produce a computer with artificial intelligence. Such a computer would be able to learn, adapt and correct mistakes as a program was run and re-run. Although several types of computers appear to be intelligent (modern chess programs are capable of beating very skilled players), the computer that possesses true artificial intelligence has yet to be developed. This may comfort those people who think that computers will eventually dominate the human race.'

Highly recommended for computer-mad kids of all ages.

END



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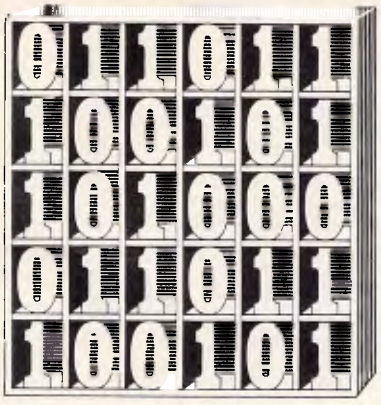

David Barrow presents more documented machine code routines and useful information for the assembly language programmer. If you have a good routine, an improvement or conversion of one already printed, or just a helpful programming hint, then send it in and share it with other programmers. Subroutines for any of the popular processors and computers are welcome but please include full documentation. All published code will be paid for. Send your contributions to Subset, APC, 2nd Floor, 215 Clarence Street, Sydney 2000

CP M PRINTER SETTING

Datasheet 1 from Jon Tarrant and Rachel Braverman is a straightforward routine to initialise a printer by sending control codes through an 8080 CP M-based system.

The routine is quite adaptable and allows entry direct from CP M (PRINTSET), or from any user program (PSETSUB).

The printer is accessed indirectly through BDOS and the routine should work on any compatible system, although with changes to the device number and system entry address. Some systems could require different register use for input — always the first point to check when you are adapting any software.

PRINTSET is designed for the Epson-compatible printers. Not all printers work to this standard and you should assemble the routine with the correct codes. Any different setting will mean inserting the correct command strings in the codes list and assembling PSCBYTES to the correct byte length of the list.

Jon and Rachel have terminated each command with a carriage-return byte 0DH. This is unnecessary as far as either the computer system or printer are concerned. It is, however, good programming practice since it clearly delimits each command.

DATASHEET 1

```
;PRINTSET.COM        Printset command file direct from CPM.
;CALL: PSETSUB       Printsetting subroutine, giving NLQ, USASCII and
;                    255 character width.
;
;CONCEPT             (System & language independent description)
;Prog. Structure     FOR codes bytes count
;                    {
;                      Read code byte.
;                      Output byte via system.
;                    }
;
;SYSTEM              (System implementation requirements)
;Processor           8080 (Z80 compatible code).
;Hardware need       Written for use on Amstrad CPC series computers.
;                    Compatible printer (Epson, Taxan Kaga, Canon PW1080A).
;Software need       CPM, BDOS.
;
;PROGRAM             (Specific coding and operation details)
;Input state         Printer must be online.
;Output state        Printer set to NLQ, USASCII, 255 column width.
;                    HL addresses last byte of codes list.
;                    A = 0, C = 5. Flags changed.
;                    Other registers not altered by routine.
;Misuse Errors       255 character right margin may be ignored by some
;                    printers if greater than maximum.
;                    Program will hang if printer not online.
;Optimisation        None.
;Register need       A C HL Flags.
;Location need       .COM file should be assembled at ORG 0100H.
;Program Bytes       43 (CPM routine 6, subroutine 24, codes list 13).
;Stack Bytes         6 + BDOS use.
;Clock Cycles        Not given.
```

```
;SUBSET CLASS     (Environmental hazard guide)
;-***--   2       Discreet:  ND     Interruptable: YES    Promable: YES
;                 Reentrant: YES    Relocatable:   ND     Robust:   NO
;
;...System addresses and parameters.
;
CPM      EQU  0000H          ;CPM entry address.
BDOS     EQU  0005H          ;BDOS entry address.
PRINTER  EQU  05H            ;Direction to list device.
PSCBYTES EQU  0DH            ;Number of command bytes.
;
;...CPM entry. Calls subroutine then returns to CPM.
;
PRINTSET CALL PSETSUB        ;Do printer set and                CD lo hi
         JMP  CPM            ;return to CPM.                    C3 00 00
;
;...Printer set subroutine - called from anywhere, any program.
;
PSETSUB  MVI  A,PSCBYTES     ;A = count of printer codes bytes. 3E 0D
         LXI  H,PSCODES      ;Address printer codes list.       21 lo hi
;
PSLOOP   MOV  E,M            ;Read next byte.                   5E
         MVI  C,PRINTER      ;C = printer number for BDOS.      0E 05
         PUSH H              ;Save codes list address           E5
         PUSH PSW            ;and codes bytes count.            F5
         CALL BDOS           ;Output to printer via BDOS.       CD 05 00
         POP  PSW            ;restore codes bytes counter       F1
         POP  H              ;and pointer.                      E1
         DCR  A              ;Count one byte sent and           3D
         JZ   PSEXIT         ;end if finished.                  CA lo hi
         INX  H              ;Else address next codes byte      23
         JMP  PSLOOP         ;and repeat until finished.        C3 lo hi
;
PSEXIT   RET                 ;Exit to calling program.          C9
;
;...List of printer command code blocks.
;
PSCODES  DB   0DH,0AH        ;Carriage-return, line-feed.    0D 0A
         DB   1BH,51H,FFH,0DH;Set column end = 255.          1B 51 FF 0D
         DB   1BH,52H,00H,0DH;Select USASCII.               1B 52 00 0D
         DB   1BH,28H,0DH    ;Select NLQ.                   1B 28 0D
```

Z80 WORD RECOGNITION

WORDREC (Datasheet 2) is from John Hardman and concludes his set of diary routines. The five other routines were printed in last month's SubSet.

The routine attempts to match an input abbreviation against a list of complete words and will flag different possible conditions. Ideally, it would be used in a program dealing with different types of limited input, such as dayname or monthname in a date-seeking section.

The program would prompt key input then call WORDREC, giving the address of the appropriate list, after each letter typed until a single match or a definite no-match. In dayname matching no more than two letters need be typed-in to identify any day.

DATASHEET 2

```
;
;CALL: WORDREC    Compare input abbreviation to list of complete words,
;                 returning address of any single word matched to extent
;                 of abbreviation or no-match/multiple-match information
;
;CONCEPT          (System & language independent description)
;Data Structure   STRING. Header:      none.
;                         Element:     byte, non-null ( )00H).
;                         Length:      variable )=0.
;                         Terminator:  null (00H).
;                 LIST.   Header:      none.
;                         Element:     STRING.
;                         Length:      variable ) 0.
;                         Terminator:  null (00H).
;Prog. Structure  match-flag = F.
;                 repeat-flag = F.
;
;                 IF (abbr-start) = EOS
;                 [
;                   null-string-flag = T.
;                 ;
;                   null-string-flag = F.
;                   list-point = list-start.
;                   UNTIL (list-point) = EOS OR repeat-flag = T
;                   {
;                     IF match-flag = F
;                     [
;                       match-address = list-point.
;                     ]
;                     abbr-point = abbr-start.
;                     UNTIL char-match-flag = F
;                     {
;                       char-match-flag = F.
;                       IF (abbr-point) = EOS
;                       [
;                         IF match-flag = F
;                         [
;                           match-flag = T.
;                         ;
;                           repeat-flag = T.
;                         ]
;                       ;
;                         IF (abbr-point) = (list-point)
;                         [
;                           char-match-flag = T.
;                           abbr-point = abbr-point + 1.
;                           list-point = list-point + 1.
;                         ]
;                       ]
;                     }
;                     IF repeat-flag = F
;                     [
;                       WHILE (list-point) ( ) EOS
;                       {
;                         list-point = list-point + 1.
;                       }
;                       list-point = list-point + 1.
;                     ]
;                   }
;                 ]
;
;SYSTEM           (System implementation requirements)
;Processor        Z80
;Hardware need    Memory for abbreviation string and word list.
;Software need    None.
;
;PROGRAM          (Specific coding and operation details)
;Input state      HL addresses 1st byte of abbreviation string.
;                 DE addresses 1st byte of word list.
;Output state     A changed. DE, HL, abbreviation & word list unchanged.
;                 Z=0: Cy=0: Single match, BC addresses matched word.
;                      Cy=1: Multiple match, BC addresses first.
;                 Z=1: Cy=0: Null abbreviation, BC unchanged.
;                      Cy=1: No match, BC changed.
;Misuse Errors    None.
;Optimisation     A "define data byte" is used to prevent an extra "POP"
;                 saving 4 clock cycles on the obvious "PUSH".
;Register need    AF BC DE HL
;Location need    Not specific.
;Program Bytes    59
;Stack Bytes      10
;Clock Cycles     Not given.
;
;SUBSET CLASS     (Environmental hazard guide)
;-*****   2       Discreet: NO     Interruptable: YES    Promable: YES
;                 Reentrant: YES   Relocatable:   YES    Robust:   YES
;
```

```
WORDREC  SUB  A             ;Set A=0 and                    97
         CP   (HL)          ;test abbreviation string       BE
         RET  Z             ;exit immediately if null.      C8
;
         PUSH DE            ;Else save list point,          D5
         PUSH HL            ;abbrev. string point           E5
         PUSH AF            ;and A=0 = no match yet.        F5
;
;...Start of (next) list word.
;
WRNEXTW  LD   B,D           ;Set BC = start of list-w for   42
         LD   C,E           ;exit pointer if match.         4B
         PUSH HL            ;Save abbrev. start address.    E5
;
;...Test for characters match in current list word.
;
WRTESTC  LD   A,(DE)        ;Get list-w char and compare    1A
         CP   (HL)          ;to abbrev. char.               BE
         JR   Z,WRNEXTC     ;Address next char if match.    28 27
;
;...Characters don't match.
;...If end of list word, then abbreviation longer than list word.
;
         OR   A             ;If list-w end then no match,   B7
         JR   Z,WRLASTW?    ;so try next list-word.         28 12
;
;...If end of abbreviation, then a match found.
;
         LD   A,(HL)        ;Get abbrev. char and test      7E

         OR   A             ;if end of abbrev. If not then  B7
         JR   NZ,WRENDLW    ;no match, so try next list-w.  20 09
;
;...Match found. Error if second list-word found to match.
;
WRGOTW   POP  HL            ;Restore abbrev. start addr.    E1
         POP  AF            ;and match flag, A.             F1
         OR   A             ;Test if previous match and     B7
         JR   NZ,WRGOT2     ;exit with error flag if so.    20 16
;
         PUSH BC            ;Else save matched list-w addr. C5
         INC  A             ;Set match found flag and       3C
         PUSH AF            ;save match flag                F5
         PUSH HL            ;and abbrev. start address.     E5
;
WRENDLW  INC  DE            ;Bump list point,               13
         LD   A,(DE)        ;reading and testing list-word  1A
         OR   A             ;characters until end of        B7
         JR   NZ,WRENDLW    ;current word found.            20 FB
;
;...End of current list-word, check if end of list.
;
WRLASTW? POP  HL            ;Restore abbrev. start address. E1
         INC  DE            ;Bump pointer to next list-w.   13
         LD   A,(DE)        ;Test 1st char of next list-w.  1A
         OR   A             ;for 2nd null (= list end) and  B7
         JR   NZ,WRNEXTW    ;go compare if not list end.    20 DE
;
;...End of list. Match address on stack only if A)0.
;
         POP  AF            ;List end. Restore match flag   F1
         POP  BC            ;and match address (?).         C1
         OR   A             ;If match flag ) 0 then BC is   B7
         JR   NZ,WREXIT     ;match address, so exit Cy=0.   20 04
;
;...No match address. Abbreviation address popped to BC, so re-save
;...and miss next "POP  BC" by cycle miser trick preserving stack.
;
         PUSH BC            ;Save abbrev. address for HL.   C5
         DEFB 6             ; + "POP  BC" = "LD   B,0C1H"   06
;
WRGOT2   POP  BC            ;Restore 1st match address.     C1
         SCF                ;Set error flag.                37
;
WREXIT   POP  HL            ;Restore abbreviation address   E1
         POP  DE            ;and list start address.        D1
         RET                ;Exit with correct information. C9
;
;...Abbrev. character matches list-word character.
;
WRNEXTC  OR   A             ;If terminator then abbrev. is  B7
         JR   Z,WRGOTW      ;full length, match found.      28 DD
;
         INC  HL            ;Else bump both abbrev. and     23
         INC  DE            ;list-w pointers to next char   I3
         JR   WRTESTC       ;and go compare them.           18 CE
```

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6502 LARGE DIVISION

Adrain Taylor, whose 1-256 bytes × 4 bytes division routine DINVAR was printed in September, has since investigated the routine's timing behaviour in some detail. His results show that even a deceptively simple re-ordering of instruction sequence can have a dramatic effect on perfomance.

DINVAR (Fig 1) compares the divisor with the current remainder, one byte at a time, beginning at the most significant byte. Three different actions are taken on the comparison results for each byte by a 'CMP cascade' ordered BCC, BEQ, BCS. END

Timings by 6522 VIA Timer 2 in single-shot mode averaged over 10,000 divisions of pseudo-random arguments. Cross-checked over identical pseudo-random sequence by free-running Timer 1 interrupt driven clock with 1000 CPU-cycle compensated period. 6502 processor at 1 MHz nominal clock frequency.

Random number generator:	40-bit shift register (Acorn Atom Basic)
Random number seed:	7B6B23D600H. Re-seeded after 20,000 generations to give even bit frequencies for all 32 bit position range.
Dividend generation (1st):	32-bit.
Divisor generation (2nd):	32-bit truncated for 24-, 16- & 8-bit. Zero divisor replaced by divisor + 1.

Method	Average clock cycles per division 32/32	32/24	32/16	32/8	Total
DINVAR (CMP, BCC, BEQ, BCS)	1646	2141	2640	3092	9519
DINVAR (CMP, BEQ, BCS, BCC)	1770	2180	2592	2900	9442
"Subtract first"	3976	3849	3716	3584	15125

Fig 1 Comparative timings of division algorithms

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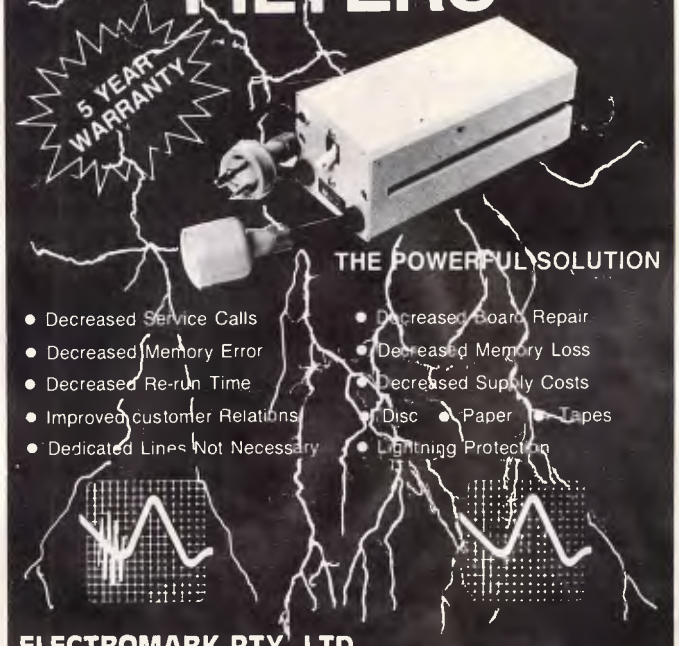

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USER GROUPS UPDATE

Below is a list of updates and additions to the full User Group Index published in the January issue of APC. The next full listing will appear in the June issue of APC.

New South Wales

The Albury Wodonga PC Users Group meets on the last Tuesday of each month at the Wodonga Technical School in Mitchell Street, commencing at 7.30 pm. For more details write to Brian Reid, Secretary, Albury Wodonga PC Users Group, PO Box 539, Wodonga Vic 3690.

A new user group has been formed, primarily to support the Sanyo MBC-550/555. For more details write to the Sanyo User Group, PO Box C118, Clarence Street, Sydney 2000.

Victoria

The Melbourne Commodore Computer Club meets on the third Tuesday of each month at the Nunawading Civic Centre at 7.30 pm. For more details write to the Secretary, Melbourne Commodore Computer Club, PO Box 177, Box Hill, Vic 3128.

Melbourne WordStar users are invited to attend a workshop being held by the Victorian Osborne User Group. The venue is the Ashburton Library, 152 High Street, Ashburton on February 22, 1987 commencing at 2 pm.

Queensland

The Brisbane 16-bit User Group has recently had its first general meeting. Mr Robert Way was elected as Secretary. For any further details write to: Secretary, Brisbane 16-bit User Group, 5 Magnolia Street, Margate Qld 4019.

The Gold Coast Computer Club (previously known as the Twin Towns Computer User Group) meets every second Tuesday at Elanora State School from 7 pm. For more details write to: Cyril E. White, Secretary, Gold Coast Computer Club, PO Box 645, Palm Beach, Qld 4221.

South Australia

The Aquarius Users Group publishes a bi-monthly newsletter. For more details write to: Benedict Sabel, 7 Duncraig Lane, Stirling SA 5152.

Northern Territory

A new group has recently been formed for Commodore Amiga users. For more details write to the Amiga Users of Northern Territory (A.U.N.T.), c/- 4/4 Armidale Street, Stuart Park NT 5790.

LAZING AROUND

Brain-teasers courtesy of JJ Clessa

Prize puzzle

In his will, old Ebeneezer left a 25-acre square field (pictured opposite) to be divided equally between his five grandchildren — subject to the following conditions:

(1) Each child should receive a plot comprising five adjacent squares.

(2) Each plot should be a different shape.

(3) Each plot should contain a different length of the original field's boundary.

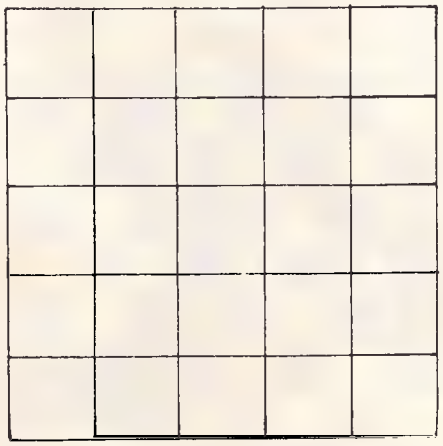
How was the field divided?

Answers on postcards please, or backs of envelopes, to reach us not later than February 27, 1987. Send your entries to *APC*, Prize Puzzle February, 2nd Floor, 215 Clarence Street, Sydney 2000.

October and November prize puzzles

Due to holidays, the October winner was not shown in last month's issue, so this month we have two winners to announce.

Both puzzles had the usual core of entrants. The October winner is Ricky Lee of Townsville; and the November winner is Natalie Wood of Wollstonecraft. The October solution is Napoleon had 9842 — most of them French, as one entrant confided; and the November solution is 52631579 — which is the smallest number, the single digit being '1'.



Puzzle: 25-acre square field.

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MICROCHESS

By now many of you will already know the results of the 1986 World Microcomputer Chess Championship, but several months prior to the game Kevin O'Connell had to speculate on the outcome. How did he score? Read on, and find out.

By the time you read this article, the 1986 World Microcomputer Championship will already be over. The event, which as I write is still in the future, promises to be fascinating since it features another battle between Fidelity (who has won the Championship every time it has played) and Mephisto (who shared first with Fidelity in 1984 and then took sole first in 1985), while Intelligent Chess Software can never be ruled out.

In anticipation of the World Championship in Dallas, it is interesting to see how the top of the line commercially available programs from the contenders shape up to each other. There is such great rivalry between all the leading chess computer manufacturers, and the outcome of games between their dfferent machines is of such commercial importance that it is extremely difficult to get any reliable comparative information about their various machines. *Computer Chess News Sheet,* published by Eric Hallsworth, is an invaluable source of just such comparative information, and I am indebted to it for the following games.

White: Fidelity Par Excellence. Black: Mephisto Amsterdam. Opening: Philidor's Defence.

1	e2–e4	e7–e5
2	Ng1–f3	d7–d6
3	d2–d4	Ng8–f6
4	d4xe5	Nf6xe4
5	Qd1–d5	

Nb1–d2 is more usual, but this is an acceptable line.

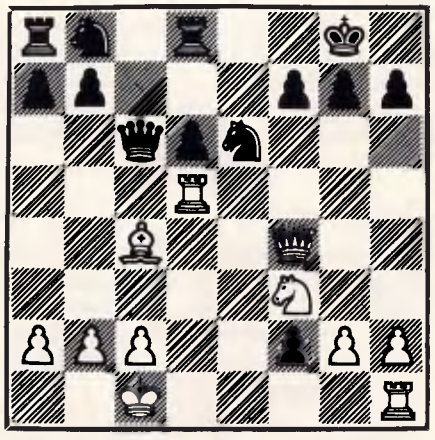
5	. . .	Ne4–c5
6	Bc1–g5	Bf8–e7
7	e5xd6	c7xd6

Here 7 . . . Qd8xd6 8 Nb1–c3 h7–h6 9 Bg5–e3 c7–c6 10 Qd5xd6 Be7xd6, with a level game, is 'book'.

8	Nb1–c3	Bc8–e6
9	Bg5xe7	Qd8xe7
10	Qd5–d4	O–O
11	O–O–O	Rf8–d8
12	Nc3–d5	Qe7–d7

I prefer the immediate 12 . . . Be6xd5 13 Qd4xd5 Nb8–c6.

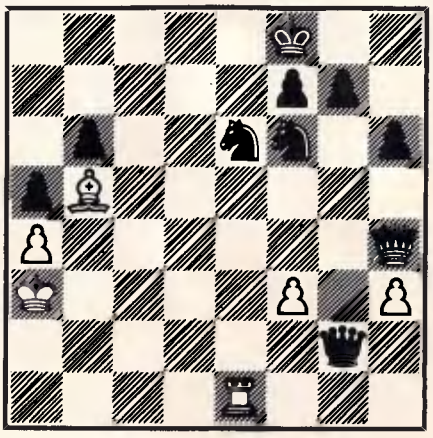
13	Qd4–f4	Be6xd5
14	Rd1xd5	Qd7–c6
15	Bf1–c4	Nc5–e6



White has a clear edge thanks to his lead in development, greater space and Black's weak d-pawn. Black's only real chance is a counter-attack along the c-file.

16	Qf4–e4	

Avant Garde vs Mephisto Amsterdam varied with 16 Qf4–g4 but Black triumphed in a long and interesting game: 16 . . . Nb8–d7 17 Rd5–d1 (avoiding the knight fork) 17 . . . Nd7–f6 18 Qg4–h4 Rd8–c8 19 Bc4–d3 a7–a5 20Rh1–e1 Qc6–c5 21 a2–a4 Rc8–c7 22 h2–h3 Ra8–c8 23 c2–c3 h7–h6 24 Bd3–c2 d6–d5 25 Bc2–f5 Rc8–e8 26 Nf3–e5 Kg8–f8 27 f2–f3 b7–b6 28 Bf5–d3 d5–d4! 29 Bd3–b5 d4xc3! 30 Bb5xe8 c3xb2+ 31 Kc1xb2 Qc5–c2+ 32 Kb2–a1 Rc7–c3 (threatening mate) 33 Rd1–d3 Rc3xd3 34 Ne5xd3 Qc2xd3 35 Be8–b5 Qd3–c3+ 36 Ka1–a2 Qc3–c2+ 37 Ka2–a3 Qc2xg2



(Black has regained material equality and has much the better position (White's king is in the open, White's bishop is a miserable piece and the knight pair can wreak havoc) 38Re1–f1 Qg2–d2 39 Qh4–g3 Ne6–f4 40 Rf1–e1 Kf8–g8 41 Re1–g1 Qd2–c3+ 42 Ka3–a2 Nf6–d5 43 Ka2–b1 Nd5–b4 44 Qg3–h2 (to stop the mate threatened by 44 . . . Qc3–c2+) 44 . . . Qc3xf3 45 Qh2–b2 g7–g6 46 Rg1–e1 Nf4–e6 47 Bb5–f1 h6–h5 48 Re1–c1 Ne6–c5 49 Qc2–c3 Qf3–e4+ 50 Kb1–a1 Nc5xa4 51 Qc3–d2 Kg8–g7 52 Bf1–g2 Qe4–e5+ 53 Ka1–b1 b6–b5 54 Rc1–f1 Na4–c3+ 55 Kb1–c1 Nc3–d5 56 Kc1–b1 Nd5–e3 57 Rf1–c1 Qe5–f5+ 58 Kb1–a1 Nb4–c2+ 59 Rc1xc2 (59 Ka1–a2 fails to 59 . . . Qf5–e6+ 60 Bg2–d5 — otherwise 60. . . Ne3–c4 forks king and queen — 60 . . . Ne3xd5 and 61 . . . Nd5–b4+, mating or getting an easily won queen and pawn ending) 59. . . Ne3xc2+ 60 Ka1–b2 Nc2–b4 61 Qd2–d4+ Kg7–h7 62 Qd4–d2 Nb4–d3+ 63 Kb2–b1 Nd3–f4+ 64 Kb1–a2 b5–b4 65 Qd2–f2 a5–a4 66 Bg2–f1 Qf5–d5+ 67 Ka2–b2 a4–a3+ 68 Kb2–c1 Qd5–e5 69 Qf2–a7 Qe5–b2+ 70 Kc1–d1 Kh7–g7 71 Bf1–c4 (this loses the bishop, but all was lost anyway) 71 . . . Qb2–a1+ 72 Kd1–c2 Qa1–c3+ 0–1.

16	. . .	Nb8–d7
17	Bc4–b5	Qc6–b6
18	Bb5xd7	Rd8xd7
19	Nf3–d4	Ra8–e8
20	Qe4–f5	

Another Avant Garde-Amsterdam game went rather better for White after 20 Rh1–d1 g7–g6 21 Nd4xe6 f7xe6 22 f2–f4 Re8–e7 23 Rd5–d3 d6–d5 24 Qe4–e5 Rd7–c7 25 Rd3–e3 Qb6–b4 with fairly level play.

The text is somewhat irrelevant since it gives Black too much time on the queen-side against the white king.

20	. . .	g7–g6
21	Qf5–g4	Qb6–b4
22	Rh1–d1	Qb4–c4

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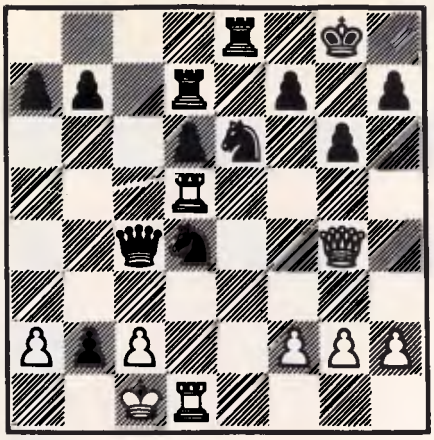

23 Nd4–f5?

The other Avant Garde-Amsterdam game varied here with the definite improvement 23 Rd5–a5 and then went on 23 . . . b7–b6 24 Ra5–a3 Ne6xd4 25 Rd1xd4 Re8–e1+ 26 Kc1–d2 Qc4–e6 27 Qg4xe6 Re1xe6 28 Ra3–d3 Kg8–g7 29 c2–c4 with a small but clear advantage for White.

23	. . .	Qc4xa2!

23 . . . Qc4xg4 is simply answered by 24 Nf5–h6+ and recapturing on g4.

24	Rd5xd6	Rd7–c7
25	c2–c3	Re8–c8
26	Qg4–g3	Qa2–a1+
27	Kc1–c2	Qa1–a4+
28	Kc2–c1	Qa4–a5
29	Nf5–h6+	Kg8–g7
30	Qg3–h4	

White's attack is illusory, but Black's is very real.

30	. . .	Rc7xc3+
31	Kc1–b1	

31 b2xc3 Rc8xc3+ 32 Kc1–b1 (32 Kc1–b2 Qa5–a3+ 33 Kb2–b1 Rc3–b3+ and 34 . . . Qa3–b2 mate) 32 . . . Rc3–b3+ and 33 . . . Qa4–c3 is mate.

31	. . .	Rc3–c4
32	Nh6–g4	

32 Qh4–e7 loses the knight and other queen moves allow mate after 32 . . . Rc4–a4.

32	. . .	Qa5–f5+
33	Rd1–d3	Rc4xg4
34	Qh4–e7	Ne6–f4
35	Qe7–d7	Qf5xd7
36	Rd6xd7	Nf4xd3
37	Rd7xd3	Rg4xg2
	0–1	

END

DIARY DATA

Melbourne	Finance '87 Contact: BPI Exhibitions 162 Goulburn Street Darlinghurst NSW 2010 (02) 266 9799	February 17-20, 1987
Canberra	International Technology Exhibition Contact: Total Concept Exhibitions (02) 938 2033	March 3-7, 1987
Sydney	PC87-The Eighth Australian Personal Computer Show Contact: Ms F Michael Australian Exhibition Services Suite 3.3, 424 St. Kilda Road Melbourne Vic 3004 (03) 267 4500	March 17-20, 1987
Dallas, Texas	APL 87 Contact: APL '87 Registrar 440 Northlake Shopping Centre Suite #210, Dallas, Texas US 75238	May 10-14, 1987
Perth	Ausgraph '87 Contact: Conference Secretariat PO Box 29, Parkville Vic 3052 (03) 387 9955	May 11-15, 1987
Melbourne	PC87-The Ninth Australian Personal Computer Show also incorporating Office Technology '87 and Communications '87. Contact: Ms F Michael Australian Exhibition Services Suite 3.3, 424 St Kilda Road Melbourne Vic 3004 (03) 264 4500	May 31-June 3, 1987
Taiwan	Complex Taipei Contact: 201, Tunhwa North Road, Taipei 10591 Taiwan, Republic of China (02) 715 1515	June 8-14, 1987
Chicago	NCC '87 Contact: American Federation of Information Processing Societies 1899 Preston White Drive, Reston, Virginia 2209 (703) 620 8955	June 15-18, 1987

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NUMBERS COUNT

Mike Mudge explains the relevance of Bernoulli and Euler numbers as related to Kummer's regular primes.

The subject area of Bernoulli and Euler numbers was proposed by Albert N Debono.

Let us begin with an optional mathematical digression:

(1) Some readers will be familiar with:

$e=1+1/1! + 1/2! + 1/3! + 1/4! \ldots \approx 2.718281828$; and also with the exponential function:

$\exp(x)=e^x=1+x/1!+x^2/2!+x^3/3!+x^4/4! \ldots$; convergent for all values of x.

It will come as no surprise to these readers to learn that:

$F(x)=x/(e^x-1)$

can be expanded as a power series in ascending powers of x. Thus we may write:

$F(x)=B_0+B_1x/1!+B_2x^2/2!+B_3x^3/3!+B_4x^4/4! \ldots$

This expansion defines the Bernoulli Numbers B_r, for $r=0,1,2,3,4 \ldots$

(2) We define a sequence of rational numbers $B_r=N_r/D_r$, (these are fractions expressed in their lowest terms; N_r and D_r having no common factors) by $B_0=1$, $B_1=-\frac{1}{2}$ and for $n \geq 2$ by:

Equation 2.1 ... $B_0/(n!\ 0!)+B_1/((n-1)!\ 1!)+B_2/((n-2)!\ 2!)+ \ldots +B_{n-1}/(1!(n-1)!)=0$.

(where 0! is defined to be 1 and $(n-1)!=1 \times 2 \times 3 \times \ldots \times (n-1)$).

Thus $B_0/(3!\ 0!)+B_1/(2!\ 1!)+B_2/(1!\ 2!)=0$ yielding $B_2=1/6$.

It is readily seen that $B_3=B_5=B_7=\ldots=0$ now $B_4=-1/30$, $B_6=+1/42$, $B_8=-1/30$, $B_{10}=+5/66$, $B_{12}=-691/2730$, $B_{14}=+7/6 \ldots$

$N_{36}=26315271553053477373$, $D_{60}=56786730$ where in these last two values any reference to sign has been omitted, for convenience in typing. Clearly in B_{4n} for integer n, either N_n or D_n must have a negative sign associated with them, in order to render B_{4n} negative, as the above pattern suggests.

Euler Numbers are defined in a similar manner using the secant function, thus:

$1/\cos x=\sec x =E_0-E_2x^2/2!+E_4x^4/4! -\ldots$

or alternatively:

$(1-x^2/2!+x^4/4! -\ldots)$

$(E_0-E_2x^2/2!+E_4x^4/4!\ldots)=1$.

It is readily seen that $E_0=1$, $E_2=-1$, $E_4=5$, $E_6=-61$, $E_8=1385$. However, it is somewhat more time-consuming to obtain:

$E_{24}=155145341635570869 05$.

Now Ernst Eduard Kummer (1810–1893) defined a 'regular prime', P, to be a prime number which does not divide any of the numerators of the Bernoulli Numbers up to B_{P-3}; all other primes are 'irregular'.

For example 37 is irregular since it divides $N_{32}=7709321041217=37 \times 208360028141$.

The sequence of irregular primes begins 37, 59, 67, 101, 103, 131, 149, 157; these were known to Kummer in 1874.

Subsequently E Stafford and HS Vandiver used desk calculators to determine all of the 'irregular primes' up to 617 by 1937.

The relevance of the above concepts are best demonstrated in *13 Lectures on Fermat's Last Theorem* by Paulo Ribenboim (Springer 1979).

This month's problems are:

(a) to construct a computer program (using equation 2.1 above or otherwise) incorporating a cancelling routine to determine, given a positive integer N, the members of $B_r=N_r/D_r$ for $r=0,1 \ldots N$.

(b) to use the N_r together with a table of prime numbers, or otherwise, to obtain a sequence of irregular primes; and

(c) to determine Euler Numbers together with their prime factors.

Attempts to solve these problems may be submitted to Mike Mudge, c/- *APC*, 2nd Floor, 215 Clarence Street, Sydney 2000, to arrive by 15 March 1987. It would be appreciated if such submissions contained a brief summary of results; together with thoughts relating to these problems, in a form suitable for future publication in *APC*.

These submissions will be judged using suitably vague criteria, and a prize will be awarded to the 'best' contribution received.

Mike Mudge welcomes correspondence on any subject within the areas of number theory and other computational mathematics. Particularly welcome are suggestions for future 'Numbers Count' articles; all letters will be answered in due course.

Please note that submissions can only be returned if a suitable stamped addressed envelope is provided.

Review: S_k sets & extensions

Readers wishing to study 'Sets in which xy+k is always a square' for x and y in the set and k given are referred to the paper of the above title by Ezra Brown in *Mathematics of Computation* (Vol 45, Number 172, October 1985, pp613-670).

That paper together with its bibliography represents the state of the art as far as is known to the author. Further information is welcome.

This month's prize-winner is Geoff Lockwood. Geoff programmed in Fortran to list S_k sets with elements less than any given number (up to 6000) for any value of k.

Prompted in some way by 'Numbers Count', a letter from Donald Cross, posed a number of Diophantine problems (as well as the issue of multi-grades). I hope to return to this topic at a later date. END

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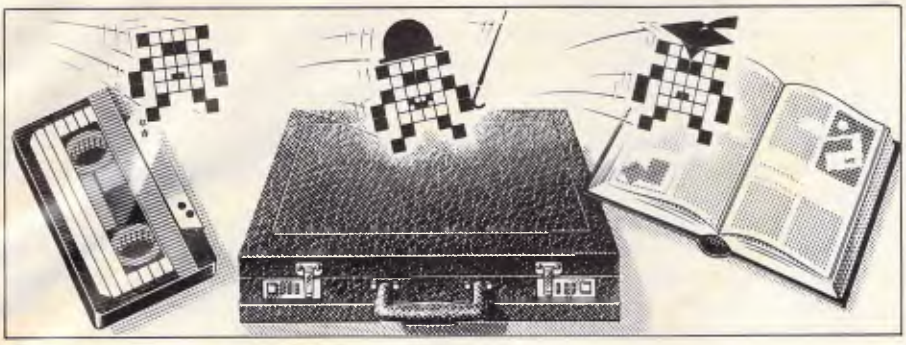

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Owen Linderholm selects the best of readers' programs. For details on submitting your own, see the end of this section.

One subject that crops up fairly regularly in readers' letters to Program File is that we ought to supply the programs on disk/tape, or get the author to do so. There are two problems with this. Firstly, *APC* can't supply the programs on disk, since we would need a different disk for each of the machines for which a program has been published. Organising this would be difficult.

The second alternative is to allow authors to supply disk or cassette copies for a small fee to cover their costs but this, unfortunately, brings the matter into the rather obscure realms of mail order law.

One of Program File's regular contributors, Mark Needham, has produced a shareware disk of improved versions of all his programs that have appeared in Program File. Most of the programs have been updated, and full documentation is included on the disk.

As the programs are in the 'shareware' domain, anyone who wants a copy to evaluate may have one; but if you make regular use of the program, then you must pay for it and become a registered user, which entitles you to product support.

As the original versions of these programs appeared in *APC* Program File, anyone who has taken the trouble to type them in is entitled to use their own copy of the program as they wish. However, if you then get a copy of the new version and use that, you still have to register.

I highly recommend all the shareware programs to users of the IBM PC and its compatibles, and a couple of the programs are also available for the BBC Micro. More information can be obtained from Mark Needham, c/- *APC*, 2nd Floor, 215 Clarence Street, Sydney 2000.

Sorry

A few errors have cropped up again. The first, in December's Program File, is a result of my careless typing. In the directory tip for the Apricot, a line was inadvertently omitted. After the first line 'Create a file DD.BAT . . .' should have appeared the line 'type DDD', so please insert this instruction in order to create a batch file.

The second error is a correction to a bug which was discovered in the BBC XREF program (*APC* September), by E Ayers. As it stands, the program fails with most calls that involve the line-number token &5D. The problem occurs in lines 900-920 where, if the detokenised line number contains a &00, the program goes into an infinite loop. The corrections are:

```
50 start = &1400
900 .movename LDA name:
  STA name2: LDA name + 1:
  STA name2 + 1:
  BNE moven2: RTS
910 .moven2 LDX#2
920 .moven3 LDA name,X:STA
  name2, X: INX: CMP #0:BNE
  move3:RTS
```

The final mistake occurred in last month's MacMand by Jack Weber. It contained a very small error that caused it to 'hang up' at the end of a full plot — after several hours of calculation and plotting. The final subroutine in the program should be changed to read as follows:

```
Finished:
  MENU 6,0,1
  MENU ON
  WHILE again%=0: WEND
RETURN
```

Reminder

After my recent remarks about the need for more original programs, I was heartened to receive this month's Program of the Month. Unfortunately, far too many unoriginal submissions are still coming in. I would like to see fresh, interesting programs that are fully documented from conception through the design, structure and writing of the program, to actual code and operating instructions.

The purpose of Program File is two-fold. It is not only meant to provide useful programs for readers to type in, but also to educate readers in programming techniques new and old, and to show, by example, how to write better programs.

If at all possible, documentation which accompanies programs should be double line spaced rather than single line spaced — it makes editing so much easier.

This month's programs

The Program of the Month is Darwin's Lens which was written for the Atari ST in C using the Megamax C compiler. The program is based on an article by Dr Richard Dawkins, author of *The Selfish Gene* and other works on evolution, which was published in the *New Scientist* of 25 September 1986. The article discussed a program the author had written to simulate natural selection using tree shapes as simple models, and then selecting the 'best' of a variety of mutant offspring. Richard Dawkins chose his offspring according to his own personal taste. Darwin's Lens takes a single objective, defined beforehand, to create a simple lens for focusing light — and selects the best offspring as the one which focuses light most effectively.

This is a more accurate model of the process of natural selection, although it is still far from complete. Neither program takes account of the fact that the occurrence of mutation

is extremely rare and happens only once in many generations rather than many times in one generation, which is how the program works. Also, a mutation which doesn't lead towards the selected criteria might, nevertheless, have advantages in other situations and so be successful in real life, despite having been discarded by the program.

Despite these differences, the program is extremely interesting and the principle could be easily adapted to other situations. One example that would be easy to create from this program is to set up two programs, one as described, and one modified for working in water which has a different refractive index. The two sets of results could then be compared with the lenses developing in the eyes of creatures which can see underwater, such as fish or penguins.

I hope that if anyone does modify the program and use it in other ways, they will let me know, since this type of program is both interesting and useful — just what I want to see in Program File.

Also included in this month's selection of programs is a multi-machine game that uses serial port connections to carry messages between the different computers. It was originally written for the BBC Micro, but can be adapted for other machines as long as serial communications can be implemented reasonably well. The game is rather like an extended and advanced Star Trek simulation, but the principle of communication between several computers could be applied to other programs.

For 8-bit Ataris there's a progam called GTIA+, which sets up a new graphics mode — 80 × 96 pixels in 256 colours — for general use by other progams.

For the Commodore 64, there's a machine language screen moving utility.

APC is interested in programs written in any of the major programming languages for all home and small business micros. When submitting programs please include a cassette or disk version of your program, brief but comprehensive documentation, and a listing on plain white paper — typed if you have no printer.

Please ensure that the software itself, the documentation and the listing are all marked with your name, address, program title, machine (along with any minimum requirements) and — if possible — a daytime phone number.

Check through the previous Program Files to see the kind of programs we prefer. As a rough guide, original ideas are always welcome, as are good implementations of utilities and applications. Obviously the programs should be well-written, easy to understand, and preferably not too long (remember that other readers have to type them in).

All programs should be fully debugged and your own original, unpublished work. We prefer to receive programs with a maximum 80-column width printed in emphasised typeface.

We will try to return submissions if they are accompanied by a stamped, addressed envelope of the appropriate size, but please keep a copy of everything. Programs are paid for at the rate of $20 per page of published listing.

Send your contributions to APC Programs, Att. Stephen Crowley, P.O. Box 666, Fitzroy 3065.

Programs may also be sent to APC through Microtex 666's Direct Upload Facility (DUF). It's available on (03) 419 0856, accepts baud rates of 300, 1200 and 2400 (8 data bits, one stop bit, no parity), and runs each week night from 5.30pm. The system accepts ASCII and Xmodem file transfer standards. It's not restricted to 666 members.

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Atari ST C Darwin's Lens

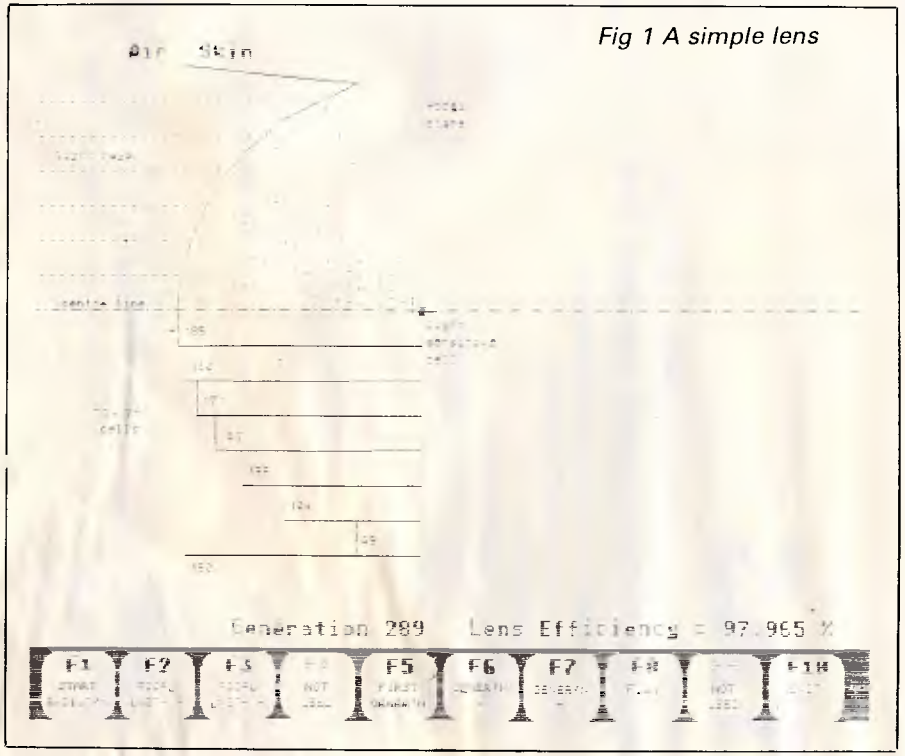
by David Wilson

This program was written in Megamax C for the Atari 1040ST, but since it uses arrays rather than pointers it should run on the 520ST. It was written for a monochrome monitor, but should not be too hard to adapt for colour output.

The program is based on an article by Dr Richard Dawkins in the 25 September issue of the *New Scientist*, which attempts to demonstrate how the theory of natural selection might have led to the evolution of an optical lens in the skin of an organism. It simulates the theory of natural selection, acting on the arrangement of cells in the skin of a simple organism to evolve a simple lens. One major drawback of the program is that it takes 25 minutes to evolve a lens of focal length of 450 units, and 90 minutes to evolve one with a focal length of 180 units.

It is assumed that the cells allow light to pass through them with some refraction. Several columns of cells are considered, surrounding a light-sensitive cell. The program alters the number of cells in each column until a final configuration is reached which resembles a simple lens (Fig 1).

Fig 1 A simple lens



The computer is used to generate possible cell configurations and assess the 'optical efficiency' of each one. This efficiency is a crude measure of how much the rays of light passing through the 'skin' are deflected towards the sensitive cell by refraction. Values range from zero per cent where no light is deflected towards the sensitive cell, up to 100 per cent where all the light falls on the cell.

The program displays each new 'generation' of lens, and when the evolution is complete the user can step forward and backward through the process or watch an animated film of the lens shape evolving.

The initial focal length of the lens can be specified to evolve a short or long focal-length lens.

Theory of natural selection

If the selection procedure to choose which of several random changes in the configuration were itself random, then the chance of hitting on the most efficient configuration would be:

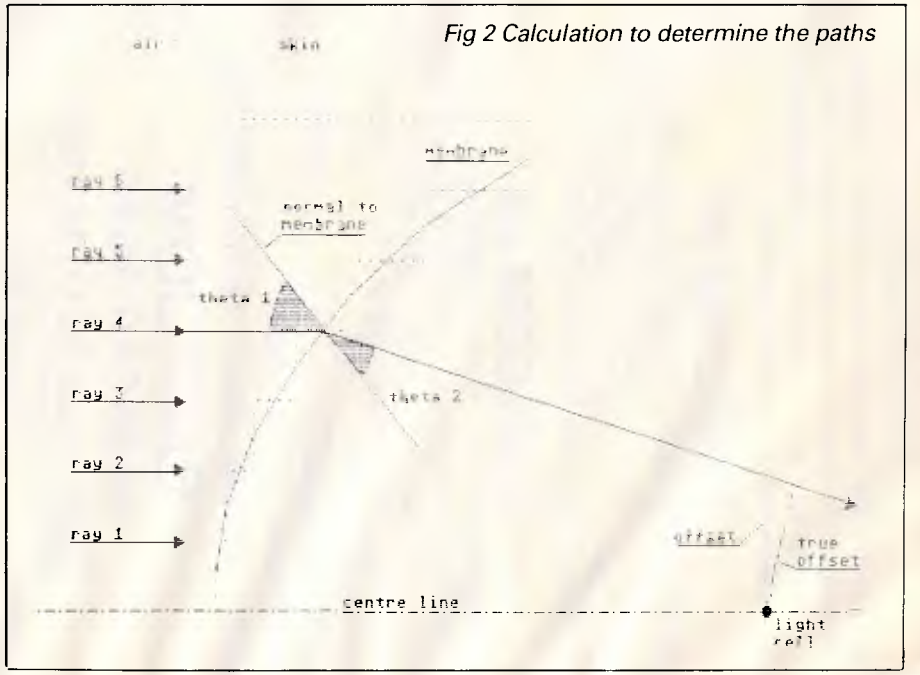
1/c * 1/c * 1/c * . . . *1/c (n times)

where c is the number of possible cells in each column and n is the number of columns of cells.

Even with a simple, crude case, as here, where there are only seven columns and a possible 450 cells in each, the chance of getting the most efficient configuration is 1 in 3.7 × 10E18. Allowing one second to evaluate each of these choices would take nearly 12 billion years, or just under the age of the universe. How, then, can things like the eyes you are using to read this have evolved?

The answer is that an organism which can 'see' to focus light more effectively is more likely to survive and reproduce, so the organisms will evolve into other organisms with a more efficient lens. Using the theory

Fig 2 Calculation to determine the paths



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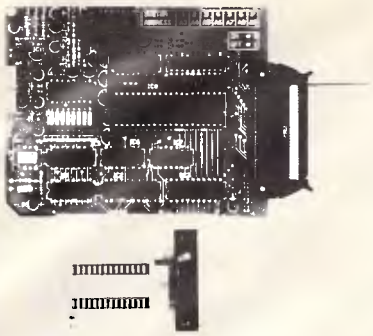

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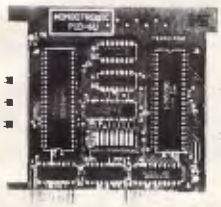

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of natural selection which effectively means that the more efficient lens will survive, the computer, calculating about once every second, can evolve a very efficient optical lens in about 25 minutes.

When a simple organism reproduces, it passes a 'blueprint' of itself into its descendants by its genes. Occasionally, a mutation of the gene occurs which produces slightly different characteristics in the organism's offspring. More often than not, this mutation is an inefficient or damaging one, but sometimes it is an improvement. When it *is* an improvement, the offspring which have the improvement will be better able to identify food and predators than those organisms without the mutation. They will survive better, and so produce better adapted offspring.

This growth continues until the genes of the beneficial mutation are spread throughout the species. Then the next beneficial mutation will repeat this process, and so on, resulting in a continually improving species. In real life these processes take an extremely long time, but the program assumes the appearance and adaptation of a beneficial mutation once every generation.

Details

For the lens model, I assume that a light-sensitive cell has evolved below the skin surface of a simple organism. The program studies, in isolation, how natural selection and mutation can alter the shape of the skin surface to focus the light from outside onto this cell, thus improving its efficiency.

The following simplifying assumptions are made:

1 The cells are mostly water, and are one unit deep and 20 units wide.
2 The light rays reaching the skin are parallel to each other and the centre line
3 By symmetry, only one half of the lens is considered.
4 The lens is only modelled in two dimensions.

The starting configuration assumes a flat area of skin above the sensitive cell which corresponds to an equal number of cells (say, 450) in each of the seven columns. The computer breeds 14 children from this parent, each of which differs from the parent by only one cell. Child one would have 451 cells in column one; child two would have 449 cells in column one, and so on.

Each child is then assessed for its ability to focus light on the sensitive cell. It is assumed that a membrane is stretched over the skin surface between the outer mid point of each cell column. Six rays of light are then shone through this membrane, and the paths after the rays have been bent by refraction are calculated as below (Fig 2).

The angle to the normal of the ray after it has passed the air-water interface can be derived from:

sin (theta1) = sin (theta2)*RI, where
theta1=angle to normal of ray in air;
theta2=angle to normal of ray in water
RI=index of refraction (air to water)

How close each of these rays passes to the sensitive cell is then summed, and the child with the minimum summed value is chosen as the parent for the next generation. Fourteen children, differing only by one cell from this parent, are then bred, and the most efficient of these becomes the next parent, and so on.

The above process is repeated until the computer finds the most efficient lens shape and the program halts. There is a check to do this, since the program will eventually oscillate between the two most efficient shapes.

Structure

The program is based around a DO ... WHILE loop in the main() function. This starts by calling the get_choice() function which can only return one of the function keys' values if they have been enabled. This loop continues until the F10 key is pressed.

The function key returned is called 'choice', and this is fed into the switch() statement which directs the program flow according to the value of choice.

F1 switches the program to the functions which perform the evolution of the lens: evolve_lens(), child_geometry and calc_efficiency(). If you want to rewrite the program in Basic, it may help to know that the variables within the function brackets are there to keep variables 'local' in C. In Basic, evolve_lens (focal_lens2) could be replaced by GOSUB EVOLVE_LENS.

Evolve_lens() starts by setting the number of cells in each of the seven columns to the focal length you have chosen. The cell count in each column at each generation is contained in the array parent [generation] [column], so to start the array, members parent [1] [1] to parent [1] [7] are all set to, say, 450. The function also calculates the constant tot_offsets which is the sum of the distances between the six rays of light and the light-sensitive cell at generation one. This constant is used as the basis on which the efficiency of the cell is later calculated.

The rest of evolve_lens is a loop which calculates the most efficient child at each generation and uses that child as the parent of the next generation. When the program is

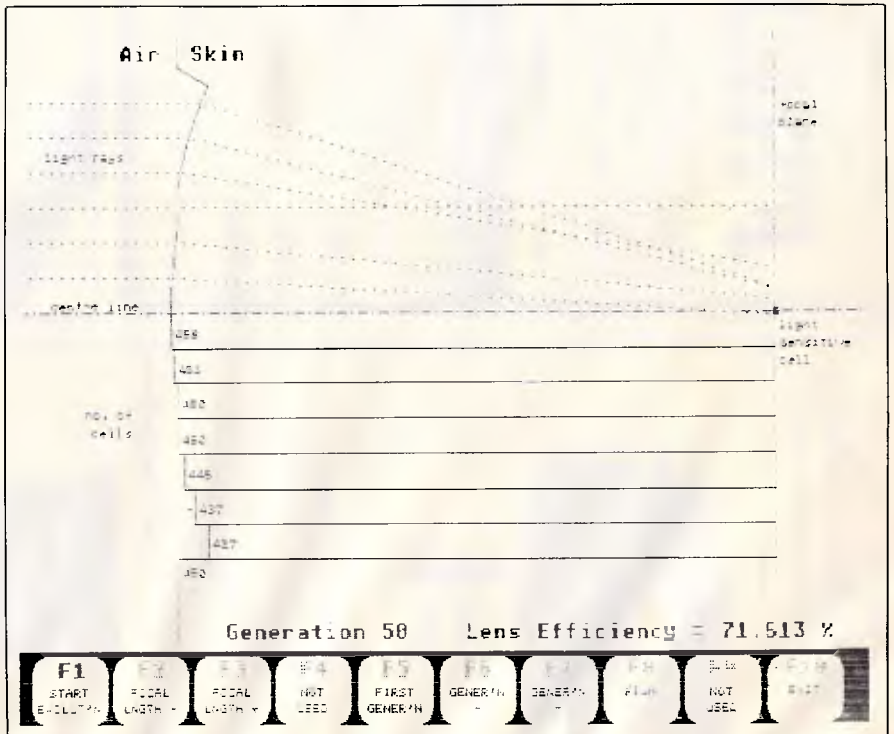

Fig 3 An evolving lens

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See quick reference guide on page 169 of October APC

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close to the ideal lens shape, there comes a point when the addition or subtraction of a cell from the parent lens does not give a more efficient lens. This is due to the somewhat crude and discrete nature of the program since it cannot work in fractions of a cell. When this point is reached, the program returns to the main() loop.

Evolve_lens calls on child_geometry() at the start of each generation to calculate the geometry of 14 children bred from the parent. The cell count in each column for each child is stored in the array no_cells [child] [column], and each is initially set to the same cell count as the parent. Each child then has one cell added or subtracted from one of its columns to produce 14 unique children.

These children are then assessed by calc_efficiency() which calculates how close the rays of light pass to the light cell in each child. A figure is produced in child_eff[child] which is the sum of the shortest distances between each ray and the light cell, and this figure is converted into a percentage by comparing it with tot_offsets.

The child with the highest percentage is then passed back to evolve_lens, and the parent of the next generation is assigned the cell counts of this child by the statements:

```
for ( i=1 ; i<=NO_COLUMNS
i++)
  parent [generation+1] [i] = no cells
    [best_child] [i];
```

F2 and F3 alter the focal length to be used to evolve the next lens shape. The first statement in each case is a neat way to alter a variable up to or down to a limit without using IF statements.

F5 draws the first generation of the lens which has just been evolved.

F6 and F7 step a completed evolution backwards or forwards by one step, and F8 quickly steps the evolution through from start to finish to give a 'film' of the process.

Screen output is handled by draw_screen() and screen_text() which show the main graphics and associated text, while print_focal_length() displays the focal length arrow. Draw_menu_boxes is only called at the start of the program, while the text in the boxes is updated by calls to menu_text().

```
#include "math.h"                                   /* enable trig functions */

                                                  /* ---- link with double.l ---- */

#define ENABLED 1                                    /* menu text flags      */
#define DISABLED 2
#define MIN_FOCAL_LENGTH 180                         /* programme limits     */
#define MAX_FOCAL_LENGTH 450                           /*   using arrays     */
#define CELLD 1                                      /* do not alter!        */
#define CELLW 20                                   /* CELLW*NO_COLUMNS!>140 */
#define NO_COLUMNS 7                                 /* positive odd         */
#define NO_CHILDREN 2*NO_COLUMNS
#define RI 1.33                                 /* refractive index air/water */
    /* air/quartz=1.46 air/glass=1.52 air/polythene=1.52 air/alcohol=1.36 */

#define MAX_GENERATION 300                           /* limit using arrays */
#define ON 1
#define OFF 0

/*-------------------------------------------------------------------------------*/

                                                     /* system parameters */
int contrl[12],intin[128],ptsin[128],ptsout[128],intout[128];
int handle,i,phys_handle,int_in[11];
int int_out[57],ap_id,dummy;
                                                    /* global variables */
int function[11],parent[MAX_GENERATION][NO_COLUMNS+1];
int no_cells[NO_CHILDREN+1][NO_COLUMNS+1],text_flag;
double efficiency[MAX_GENERATION],child_eff[NO_CHILDREN+1];
double offset[MAX_GENERATION][NO_COLUMNS+1];
double child_offset[NO_CHILDREN+1];

char temp[100];                                     /* scrap string variable */
char line1[11][10]={                                    /* menu button text */
        "   ","START","FOCAL","FOCAL","NOT",
        "FIRST","GENER'N","GENER'N","FILM","NOT","EXIT"
        };
char line2[11][10]={
        "   ","EVOLUT'N","LNGTH -","LNGTH +","USED",
        "GENER'N","  -  ","  +  ","","USED",""
        };

/*-------------------------------------------------------------------------------*/
/* MAIN                                                  NO RETURNS              */
/*-------------------------------------------------------------------------------*/

main()

{
int generation,focal_len1,key,total_generations,choice;

int focal_len2,i;

        initialise();
        instructions();
        generation=1; focal_len1=focal_len2=300;
        text_flag=ON;
        for ( key=1 ; key<=10 ; key++ )              /* set menu buttons */
                function[key]=ENABLED;
        for ( key=4 ; key<=9 ; key++ )
                function[key]=DISABLED;

        for ( i=1 ; i<=NO_COLUMNS ; i++ )            /* initialise 1st    */
                parent[1][i]=focal_len2;             /* generation arrays */
        for ( i=1 ; i<=NO_COLUMNS-1 ; i++ )
                offset[1][i]=i*CELLW;

        draw_menu_boxes();
        menu_text();
        draw_screen(generation,focal_len2,0);      /* draw 1st generation */
        print_focal_length(focal_len2);

        do {

                choice=get_choice();                /* get button pressed */
                switch(choice) {

                case 1:                            /* start evolution process */
                        generation=total_generations=evolve_lens(focal_len2);
                        vst_height(handle,8,&dummy,&dummy,&dummy,&dummy);
                        v_gtext(handle,250,20,"Evolution Complete");
                        focal_len1=focal_len2;
                        print_focal_length(focal_len2);
                        break;

                case 2:                              /* decrement focal length */
                        focal_len2-=(focal_len2>=MIN_FOCAL_LENGTH+1);
                        print_focal_length(focal_len2);
                        break;

                case 3:                              /* increment focal length */
                        focal_len2+=(focal_len2<=MAX_FOCAL_LENGTH-1);
                        print_focal_length(focal_len2);
                        break;

                case 5:                                /* show 1st generation */
                        start_replay(focal_len1);
                        generation=1;
                        print_focal_length(focal_len2);
                        break;

                case 6:                            /* show previous generation */
                        generation-=(generation>1);
                        draw_screen(generation,focal_len1,0);
                        print_focal_length(focal_len2);
                        break;

                case 7:                                /* show next generation */
```

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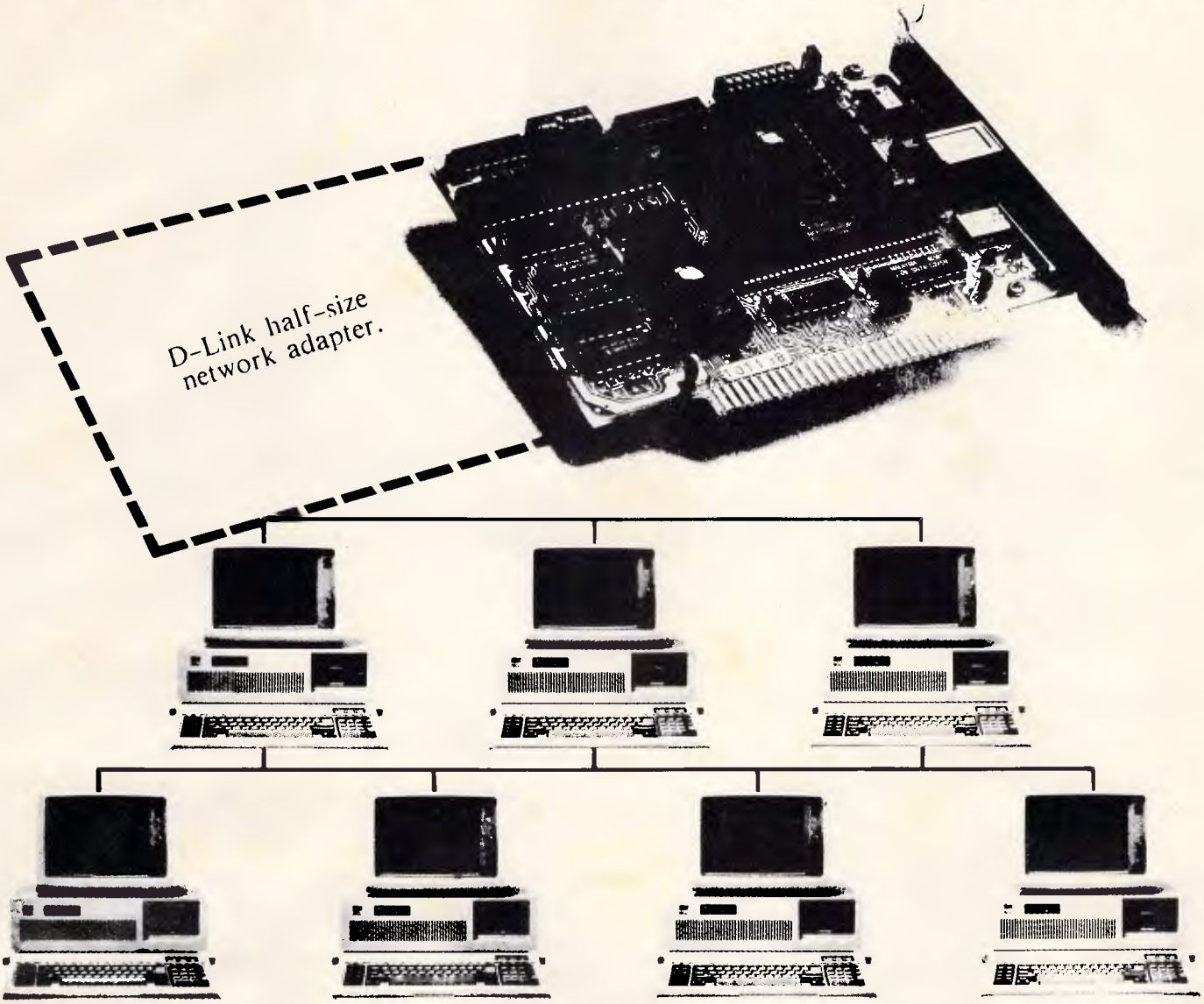

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```
                        generation+=(generation<total_generations);
                        draw_screen(generation,focal_len1,0);
                        print_focal_length(focal_len2);
                        break;
                case 8:
                        text_flag=OFF;   /* flick through all generations */
                        auto_replay(total_generations,focal_len1);
                        text_flag=ON;
                        generation=total_generations;
                        draw_screen(generation,focal_len1,0);
                        print_focal_length(focal_len2);
                        break;

                case 10:
                        break;
                }
        } while(choice!=10);

        exit_programme();
}

/*-------------------------------------------------------------------------*/
/* INITIALISE                                        NO RETURNS            */
/*-------------------------------------------------------------------------*/

initialise()                            /* set up virtual work station */

{
int i;

        ap_id=appl_init();
        handle=graf_handle(&dummy,&dummy,&dummy,&dummy);
        for ( i=1 ; i<10 ; i++ )
                int_in[i]=1;
        int_in[10]=2;
        v_opnvwk(int_in, &handle, int_out );
        graf_mouse(256,&dummy);
        v_clrwk(handle);

}

/*-------------------------------------------------------------------------*/
/* DRAW_MENU_BOXES                                   NO RETURNS            */
/*-------------------------------------------------------------------------*/

draw_menu_boxes()                       /* draw 10 function key boxes */

{
int box_no,pxy[4];

        pxy[0]=0;pxy[1]=399;pxy[2]=639;pxy[3]=358;/* clear base of screen */
        vsf_color(handle,1);
        v_bar(handle,pxy);
        vsf_color(handle,0);

        for ( box_no=1 ; box_no<=10 ; box_no++ ) {          /* draw boxes */
                pxy[0]=10+(box_no-1)*61.6;pxy[1]=399;
                pxy[2]=pxy[0]+56.6;pxy[3]=361;
                v_rfbox(handle,pxy);
                }
}
/*-------------------------------------------------------------------------*/
/* MENU_TEXT                                         NO RETURNS            */
/*-------------------------------------------------------------------------*/

menu_text()                             /* print text in function key boxes */

{
int i,x,dummy;

        for ( i=1 ; i<= 10 ; i++ ) {                        /* large text */

                vst_height(handle,8,&dummy,&dummy,&dummy,&dummy);
                vst_effects(handle,function[i]);  /* normal or feint text */
                sprintf(temp,"F%d",i);
                x=38+(i-1)*61.6-5*strlen(temp);
                v_gtext(handle,x,372,temp);
                vst_effects(handle,0);
                                                            /* small text */
                vst_height(handle,4,&dummy,&dummy,&dummy,&dummy);
                x=38+(i-1)*61.6-3*strlen(line1[i]);
                v_gtext(handle,x,383,line1[i]);
                x=38+(i-1)*61.6-3*strlen(line2[i]);
                v_gtext(handle,x,392,line2[i]);
                }
}

/*-------------------------------------------------------------------------*/
/* DRAW_SCREEN                                       NO RETURNS            */
/*-------------------------------------------------------------------------*/

draw_screen(generation,focal_length,best_child)

int generation,focal_length,best_child;

{
int pxy[10],i,df,tx,ty;

        clear_screen();

        for ( i=1 ; i<=NO_COLUMNS ; i++ ) {          /* draw cell columns */
                pxy[0]=pxy[2]=120+focal_length-parent[generation][i];
                pxy[1]=pxy[7]=pxy[9]=165+i*CELLW;
                pxy[4]=pxy[6]=120+focal_length;
                pxy[5]=pxy[3]=165+(i-1)*CELLW;
                pxy[8]=pxy[0];
                v_pline(handle,5,pxy);
                }

        pxy[0]=pxy[2]=120;                        /* draw lower skin outline */
        pxy[1]=357;
        pxy[5]=pxy[3]=165+CELLW*NO_COLUMNS;
        pxy[4]=120+focal_length-parent[generation][NO_COLUMNS];
        v_pline(handle,3,pxy);
        pxy[0]=pxy[2]=120+focal_length-parent[generation][1];

        pxy[1]=165;pxy[3]=165-.5*CELLW;       /* draw upper skin outline1 */
        v_pline(handle,2,pxy);
        for ( i=1 ; i<=NO_COLUMNS-1 ; i++ ) {          /* draw lens shape */
                pxy[0]=120+focal_length-parent[generation][i];
                pxy[1]=165-(i-1)*CELLW-.5*CELLW;
                pxy[2]=120+focal_length-parent[generation][i+1];
                pxy[3]=165-(i)*CELLW-.5*CELLW;
                v_pline(handle,2,pxy);
                }

        pxy[0]=pxy[2];pxy[1]=pxy[3];          /* draw upper skin outline2 */
        pxy[2]=pxy[4]=120;
        pxy[3]=165-NO_COLUMNS*CELLW;
        pxy[5]=0;
        v_pline(handle,3,pxy);

        vsl_type(handle,4);                                  /* draw axes */
        pxy[0]=5;pxy[1]=pxy[3]=165;pxy[2]=635;
        v_pline(handle,2,pxy);
        pxy[0]=pxy[2]=120+focal_length;
        pxy[1]=5;pxy[3]=175+CELLW*NO_COLUMNS;
        v_pline(handle,2,pxy);
        vsl_type(handle,3);

        for ( i=1 ; i<=NO_COLUMNS-1 ; i++ ) {          /* draw light rays */
                pxy[0]=5;
                pxy[1]=pxy[3]=165-i*CELLW;
                df=(parent[generation][i]+parent[generation][i+1])/2;
                pxy[2]=120+focal_length-df;
                pxy[4]=120+focal_length;
                pxy[5]=165-offset[generation][i];
                v_pline(handle,3,pxy);
                }

        vsl_type(handle,1);                  /* draw light sensitive cell */
        vsf_color(handle,1);
        v_circle(handle,120+focal_length,165,3);
        vsf_color(handle,0);

        if ( text_flag==ON )                            /* show screen text */
                screen_text(generation,focal_length,best_child);

}

/*-------------------------------------------------------------------------*/
/* CLEAR_SCREEN                                          NO RETURNS        */
/*-------------------------------------------------------------------------*/
```

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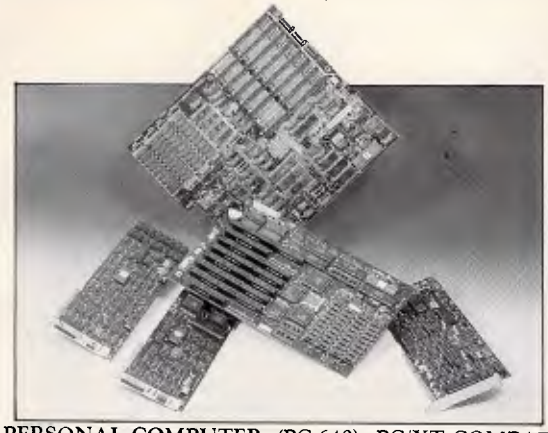

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```
clear_screen()                          /* clears upper part of screen */

{
int pxy[4];

        pxy[0]=0;pxy[1]=357;
        pxy[2]=639;pxy[3]=0;
        v_bar(handle,pxy);
}
/*------------------------------------------------------------------------*/
/* SCREEN_TEXT                                              NO RETURNS    */
/*------------------------------------------------------------------------*/
screen_text(generation,focal_length,best_child)       /* show screen text */

int generation,focal_length,best_child;

{
int tx,ty,i;

        vst_height(handle,8,&dummy,&dummy,&dummy,&dummy);   /* large text */
        sprintf(temp,"Generation %-3d   Lens Efficiency = %-5.3lf %%",
                        generation,efficiency[generation-1]);
        v_gtext(handle,155,350,temp);
        v_gtext(handle,76,20,"Air");
        v_gtext(handle,130,20,"Skin");

        vst_height(handle,4,&dummy,&dummy,&dummy,&dummy);   /* small text */

        for ( i=1 ; i<=NO_COLUMNS ; i++ ) {               /* cell numbers */
                sprintf(temp,"%d",parent[generation][i]);
                tx=124+focal_length-parent[generation][i];
                ty=165+(i-1)*CELLW+.5*CELLW+4;
                v_gtext(handle,tx,ty,temp);
                }

        if ( best_child!=0 && generation!=1 ) {            /* show + or - */
                i=(1+best_child)/2;
                tx=113+focal_length-parent[generation][i];
                ty=165+(i-1)*CELLW+.5*CELLW+4;
                if ( best_child%2==0 )
                        v_gtext(handle,tx,ty,"+");
                else
                        v_gtext(handle,tx,ty,"-");
                }

        sprintf(temp,"%d",focal_length);
        v_gtext(handle,124,165+(NO_COLUMNS)*CELLW+10,temp);
        v_gtext(handle,124+focal_length,50,"focal");
        v_gtext(handle,124+focal_length,60,"plane");
        v_gtext(handle,124+focal_length,175,"light");
        v_gtext(handle,124+focal_length,185,"sensitive");
        v_gtext(handle,124+focal_length,195,"cell");
        ty=165-(NO_COLUMNS-3)*CELLW-7;
        v_gtext(handle,20,ty,"light rays");
        v_gtext(handle,25,163,"centre line");
        v_gtext(handle,50,165+(NO_COLUMNS/2)*CELLW,"no. of");
        v_gtext(handle,55,175+(NO_COLUMNS/2)*CELLW,"cells");
}

/*------------------------------------------------------------------------*/
/* GET_CHOICE                          RETURN FUNCTION KEY PRESSED        */
/*------------------------------------------------------------------------*/

get_choice()                            /* get function button pressed */

{
int key_pressed;

        do {
                key_pressed=evnt_keybd();

                if ( key_pressed/256>=59 && key_pressed/256<=68
                        && key_pressed%256==0
                        && function[key_pressed/256-58]==ENABLED )
                        return(key_pressed/256-58);

        } while();

}
```

```
/*------------------------------------------------------------------------*/
/* EVOLVE_LENS                          RETURN TOTAL NO. GENERATIONS      */
/*------------------------------------------------------------------------*/

evolve_lens(focal_length)

int focal_length;

{
int key,i,best_child,generation,column;
double tot_offsets;

        tot_offsets=0;

        for ( key=1 ; key<=10 ; key++ )          /* set function key text */
                function[key]=DISABLED;
        function[1]=ENABLED;
        menu_text();

        for ( i=1 ; i<=NO_COLUMNS ; i++ )    /* initialise 1st generation */
                parent[1][i]=focal_length;

        for ( i=1 ; i<=NO_COLUMNS-1 ; i++ )    /* calculate total offsets */
                tot_offsets+=offset[1][i]=i*CELLW;

        for ( generation=1 ; generation<=MAX_GENERATION ; generation++ ) {
                draw_screen(generation,focal_length,best_child);

                                /* calculate geometry of each child of parent */
                for ( column=1 ; column<=NO_COLUMNS ; column++ ) {
                        child_geometry(generation,column);
                        }

                                                /* select most efficient child */
            best_child=calc_efficiency(generation,focal_length,tot_offsets);
                /* most efficient child becomes parent of next generation */
                for ( i=1 ; i<=NO_COLUMNS ; i++ )
                        parent[generation+1][i]=no_cells[best_child][i];
                                                        /* evolution complete? */
                if ( efficiency[generation]==efficiency[generation-2] ) {
                                                        /* set function key text */
                        for ( key=1 ; key<=10 ; key++ )
                                function[key]=ENABLED;
                        function[4]=function[9]=DISABLED;
                        menu_text();

                        draw_screen(generation-1,focal_length,0);
                        return(generation-1);
                        }

                }


}

/*------------------------------------------------------------------------*/
/* CHILD_GEOMETRY                                           NO RETURNS    */
/*------------------------------------------------------------------------*/

child_geometry(generation,column)       /* calculate geometry of children */

int generation,column;

{
int i;

        for ( i=1 ; i<=NO_COLUMNS ; i++ ) {
                no_cells[column*2-1][i]=parent[generation][i];
                no_cells[column*2][i]=parent[generation][i];
                }

        no_cells[column*2-1][column]=parent[generation][column]-1;
        no_cells[column*2][column]=parent[generation][column]+1;

}

/*------------------------------------------------------------------------*/
/* CALC_EFFICIENCY                          RETURN MOST EFFICIENT CHILD   */
/*------------------------------------------------------------------------*/
```

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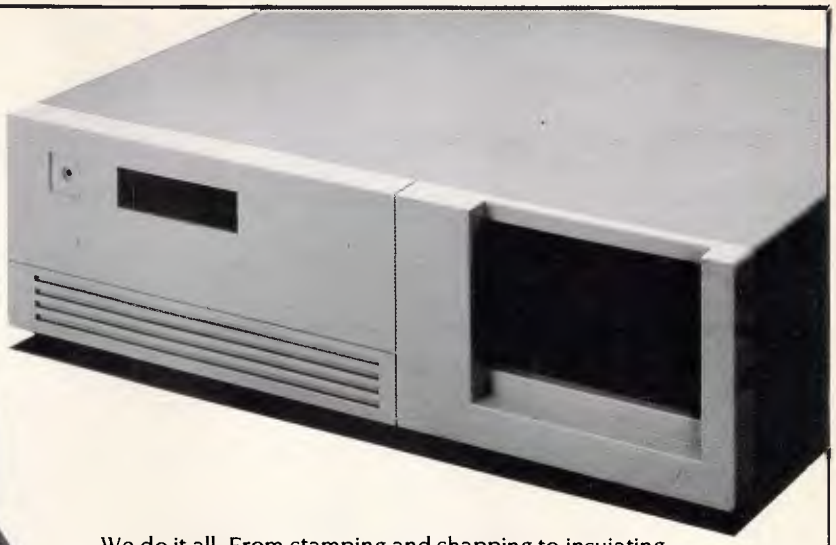

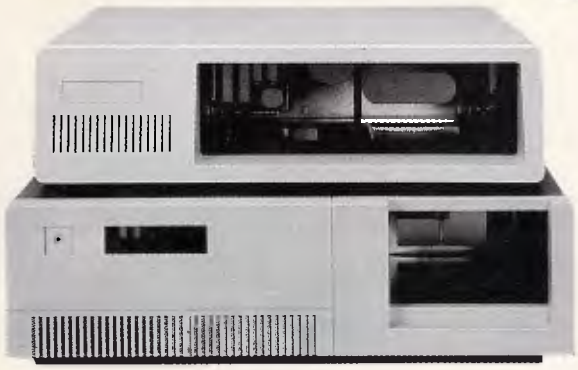

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```
calc_efficiency(generation,focal_length,tot_offsets)
                        /* calculate optical efficiency of each child */
int generation,focal_length;
double tot_offsets;

(
int child,ray,best_child;
double theta1,theta2,theta3,length,dh,dv,R;
double ray_percent,true_offset,maxeff;

        for ( child=1 ; child<=NO_CHILDREN ; child++ ) {
              child_eff[child]=0.0;
        for ( ray=1 ; ray<=NO_COLUMNS-1 ; ray++ ) {
              dh=(no_cells[child][ray]-no_cells[child][ray+1])*CELLD;
              theta1=atan(dh/CELLW);
              theta2=asin(sin(theta1)/RI);
              theta3=theta1-theta2;
              length=focal_length+no_cells[child][ray+1]*CELLD+0.5*dh;
              dv=length*tan(theta3);
              R=ray*CELLW-dv;
              child_offset[ray]=R;
              if ( R<0 )
                    R=-R;
              true_offset=R*cos(theta3);/* true offset of ray from cell */
              child_eff[child]+=true_offset;
              }

       child_eff[child]=100-100*(child_eff[child]/tot_offsets);

       if ( child_eff[child]>maxeff ) {             /* select best child */
              maxeff=child_eff[child];
              best_child=child;
              for ( i=1 ; i<=NO_COLUMNS-1 ; i++ )
                    offset[generation+1][i]=child_offset[i];
              }
       }

       efficiency[generation]=child_eff[best_child];
       return(best_child);
}


/*-------------------------------------------------------------------------*/
/* PRINT_FOCAL_LENGTH                              NO RETURNS              */
/*-------------------------------------------------------------------------*/

print_focal_length(focal_len2)                  /* show next focal length */

int focal_len2;

{
int pxy[4],x1,y1,x2,y2,tx,ty;
                                                        /* erase last line */
       vst_height(handle,4,&dummy,&dummy,&dummy,&dummy);
       x1=120;y1=340;x2=x1+MAX_FOCAL_LENGTH;y2=y1-20;
       pxy[0]=x1+1;pxy[1]=y1;
       pxy[2]=x2;pxy[3]=y2;
       vsf_color(handle,0);
       v_bar(handle,pxy);

       vsl_ends(handle,1,1);                            /* draw arrow */
       pxy[2]=x1+focal_len2;
       pxy[1]=pxy[3]=(y1+y2)/2;
       v_pline(handle,2,pxy);

       sprintf(temp,"Next focal length = %d",focal_len2);   /* show text */
       tx=x1+.5*focal_len2-3*strlen(temp);
       ty=y1-12;
       v_gtext(handle,tx,ty,temp);
       vsl_ends(handle,0,0);

}

/*-------------------------------------------------------------------------*/
/* START_REPLAY                                    NO RETURNS              */
/*-------------------------------------------------------------------------*/

start_replay(focal_length)                      /* display 1st generation */

int focal_length;

{
       draw_screen(1,focal_length,0);
       function[6]=function[7]=ENABLED;
       menu_text();

}

/*-------------------------------------------------------------------------*/
/* AUTO_REPLAY                                     NO RETURNS              */
/*-------------------------------------------------------------------------*/

auto_replay(total_generations,focal_length)                 /* film show */

int total_generations,focal_length;

{
int key,generation;

       for ( key=1 ; key<=10 ; key++ )          /* set function key text */
             function[key]=DISABLED;
       function[8]=ENABLED;
       menu_text();

       for ( generation=1 ; generation<=total_generations ; generation++)
             draw_screen(generation,focal_length,0);

       for ( key=1 ; key<=10 ; key++ )          /* set function key text */
             function[key]=ENABLED;
       function[4]=function[9]=DISABLED;
       menu_text();

}

/*-------------------------------------------------------------------------*/
/* EXIT_PROGRAMME                                  NO RETURNS              */
/*-------------------------------------------------------------------------*/

exit_programme()                                    /* return to desktop */

{
       v_clsvwk(handle);
       graf_mouse(257,&dummy);
       appl_exit();
}

/*-------------------------------------------------------------------------*/
/* INSTRUCTIONS                                    NO RETURNS              */
/*-------------------------------------------------------------------------*/

instructions()                              /* print page of instructions */

{
             /* type each line pair as single line to fit on screen */
       v_enter_cur(handle);
       puts("                                  DARWIN'S LENS ");
       puts("                                  ------------- ");
       puts("   This programme uses the theory of natural selection
             to evolve the shape of a");
       puts(" lens from a flat section of skin. It achieves this
             by breeding 14 children    ");
       puts(" from the starting skin configuration. Each child
             differs from its parent      ");
       puts(" configuration by the addition or removal of one cell
             from one of seven columns");
       puts(" of cells (hence 2x7=14 children).    ");
       puts(" ");
       puts("   The laws of physics are then applied to each of the
             children to discover    ");
       puts(" which one is the most efficient at bending rays of
             light towards a light      ");
       puts(" sensitive cell. This cell is at a depth of
             'focal length' beneath the skin    ");
       puts(" surface. As the cells are 1 unit of length deep,
             this depth is also the no. of");
       puts(" cells between the light sensitive cell and the skin
             surface.                                    ");
       puts(" ");
       puts("   This best child then becomes the parent configuration
             for the next          ");
       puts(" generation of children. This is equivalent to the
```

```
            genetic code of the parent  ");
        puts(" being passed onto the next generation.           ");
        puts(" ");
        puts("   The process repeats until the computer can no
             longer breed a more efficient ");
        puts(" lens shape.");
        vs_curaddress(handle,24,28);
        puts("Press any key to continue");
        evnt_keybd();
        v_curhome(handle);
        v_eeos(handle);
        puts("                                    DARWIN'S LENS  ");
        puts("                                    ------------   ");
        puts("   To start the evolution you should first adjust
             the focal length using keys  ");
        puts(" F2 and F3. Pressing  key F1 will then start the
             evolutionary process.        ");
        puts(" ");
        puts("   Time taken varies from 25 minutes for focal
             length of 450 to 90 minutes for ");
        puts(" focal length of 180. ");
        puts(" ");
        puts("   At each generation a cross-section through the
             lens is shown. The size of   ");
        puts(" each column of cells is shown below the centre line
             with a + or - to indicate ");
        puts(" which column was changed for this generation. ");
        puts(" ");
        puts("   Above the centre line the smoothed shape of the
             skin surface is shown along ");
        puts(" with the diffracted paths of the light rays as they
             pass through the lens.    ");
        puts(" ");
        puts("   Once you have evolved a lens shape you can study
             it generation by generation");
        puts(" using buttons F5, F6 and F7. Key F5 shows the first
             generation and F6 and F7  ");
        puts(" can be used to go forward or back by one generation.");
        puts(" ");
        puts("   F8 shows an animated film of the skin as it
             evolves from a flat surface to  ");
        puts(" the final complex lens shape.");
        vs_curaddress(handle,24,28);
        puts("Press any key to continue");
        evnt_keybd();
        v_exit_cur(handle);
}

/*------------------------------END-----------------------------------------*/
```

Multi-machine Basic MULTREK

by Paul Beadle

MICROTEX 666

This program is available electronically through Microtex 666's software downloading service. It is accessed through Viatel page *66637#

This program is a version of old the Star Trek game — with a difference. It is intended for multi-player use, each player using his own computer. The program has been used on a set-up consisting of a BBC Micro, and two Apple IIs, as well as on a set-up of three BBCs.

There are two mistakes in the listing. Lines 3310 and 4020 contain REM statements which have not appeared. A REM should be inserted before the text that appears at the end of these two lines.

A facility provided on many computers is a serial interface. The idea of linking a group of computers with a serial interface is fine in theory, but in practice it tends to be complicated. This program uses some ideas generated in local area networks to provide data transfer between one micro and a number of others. Perhaps your computer club could share program entry and make the connecting cables?

The micros are wired in a 'serial ring': that is, the serial output of one computer is connected to the input of the next, the final computer in the ring being connected to the first (Fig 1). A message sent by one computer in the ring is tagged with a standard header which details its type, length, origin and the computer(s) it is to be read by. The message makes its way around the ring, each computer reading it in, taking action if necessary, and sending it on. When the message reaches the origin computer, it stops. In order to limit the amount of information travelling around the ring, each computer is limited to one message of one type at a time. There are 15 message types covering ship movement through to space station destruction. All characters sent in the messages are restricted to ASCII values 32 to 127 to avoid problems with control characters and stop bits.

Each message is a sequence of bytes; the first four bytes are the same for all messages (see box).

Byte1: Msg type
Byte2: Total length
Byte3: Origin
Byte 4: Dest (0 for all ships)

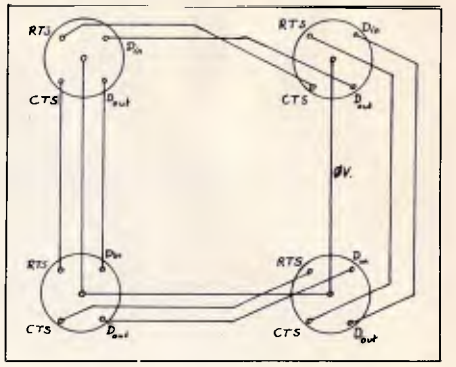

Fig 1 Serial ring arrangement

It is essential that each computer has an input buffer in its serial system, and RTS-CTS protocols for input and output handshaking. Also, your micro must be able to check for the existence of characters in the keyboard and serial input buffers. The program has been running on two and three micro rings but the maximum is four (due to screen size, but with an 80-column screen this could be improved). The listing given here is in BBC Basic, but it is very easy to convert to virtually any kind of Basic.

Type	Explanation	Extra bytes
1	Ship moved	Two 2-byte numbers for location X and Y. A number can be from 0 to 9000
2	Phasor	
3	Torpedo	
4	Space mine	None
5	Text message	Sequence of characters
6	Dock request	Two 2-byte numbers, X and Y
7	Dock accept	None
8	Dock reject	None
9	Undocking	None
10	Energy transfer	Sign byte, 2-byte number
11	Ship inactive	None
12	Ship destroyed	None
13	Improbability drive	None
14	Station position	Two 2-byte numbers, X and Y
15	Station destroyed	None

The problem areas are likely to be differences in serial interfaces. Machine and language-specific program lines are 160-180, 230, 320, 380-440, 610, 6020-6100, 8060, 8100-8170 and 10120-10160. There may, of course, be other details such as string manipulation, zeroth elements of arrays and integer FOR . . . NEXT variables. The program can be tested with only one micro by connecting the serial input to serial output and RTS to CTS.

The game is an extended Star Trek game — the object being to destroy other players' ships and ultimately their space stations. You possess four ships and one space station each.

A brief description of the game and commands is given in the help screens on lines 13000 to 13510. Here are a few additional details:

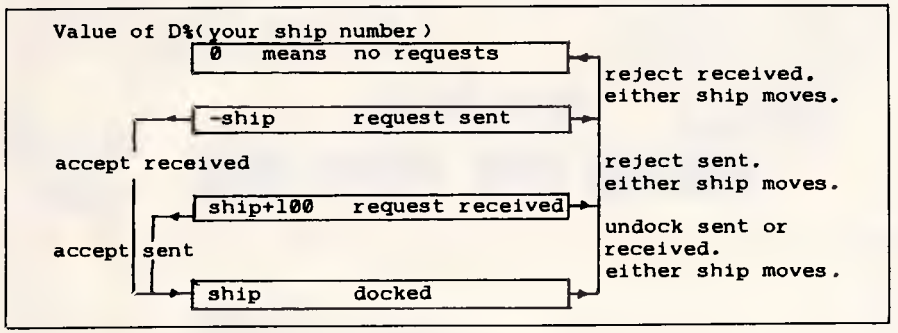

Fig 2 Docking sequence

```
SHP.CO-ORDS  DOCK.ENER.    DEST.   SPD HIT   This player
 1 1234,5678 D10 <9999> 5678,1234 W9 PH    has ships 1-4.
 2 8765,3987 R9                      TO    No energy left
 3 8765,4765      <7665>
 4*5476,4876      <  94> 2386,3764 W2 SM    Current ship=*
 5 DESTROYED     STATION:3464,3456          Ship 5 is Dead
 6 4654,4876
 7)5667,3554                                Inactive=)
 8
 9               STATION:4575,4552          Stn. for ships
10 1234,5678 D1  (PRIVATE MSG FROM SHP)     9 to 12.
11 8765,3987 R2  (NUMBER TEN.          )
12
13               STATION:2344,2345
14 3522,2644      'PUBLIC MSG RECEIVED '
15                'BY ALL SHIPS.       '
16 3856,2435
SPACE MINES         TORPEDOES
1234,7654 7676,2727            7474,3443
8282,7272 7437,4747            3464,4355
4747,4747           STATION:2354,2347      This micro's
                    ERROR MSG LINE.        station posn.

4>=-'THIS IS THE COMMAND LINE
```

Fig 3 Sample screen

Moving: After setting the destination for one of your four ships with an M command, a W command will define warp speed. The warp speed will increase in steps of one to the desired speed. This means that in order to hyperspace to anywhere in the galaxy, you will have to wait until warp nine is reached before using a H command. As soon as a ship is moved, its position is known by the other players.

Improbability drive: This moves the currently selected ship to a random destination and hides its position from other players. This is fairly expensive in terms of energy, and if you try it with less than 500 units, all of your energy will be drained (so that you cannot move) and the other players will 'see' where you have gone — in other words, you will be a sitting duck. If this happens, the best thing to do is get another of your ships on the same spot, drop a space mine and pick it up with the disabled ship.

Weaponry: *Photon torpedoes*: Cost=100, destroying energy=400, effective against other space stations and ships, you may have only one torpedo from one ship flying at one time, range=200. *Phasors*: Cost=50, destroying energy=200, effective against *all* ships, range =100. *Space mines*: Cost=selected, destroying energy=selected × 4, recoverable energy=selected-25, effective against other ships.

Docking: You may dock a ship with another player's ship but only if both are stationary. This must follow a strict sequence. Fig 2 shows the commands and conditions required for docking.

Screen information: A 40-column screen has been tightly packed with all the information a player will need. The screen does not scroll but tabbing is used to direct characters to the right places. A sample screen is shown in Fig 3.

Entering commands: Most commands need to know which ship to affect. To set your current ship (marked by an '*'), enter the number of the ship and press Return. You may enter a command directly after the number and then press Return; the program will treat the command as if it were typed on a line by itself.

```
   10 REM MULTREK MULTI-USER GAME
   20 REM VERSION 3.3  (BBC)
   30 REM WRITTEN BY PAUL BEADLE. MAY'86
   40 REM
   50 REM THIS VERSION WORKS FOR UP TO
   60 REM FOUR COMPUTERS IN THE RING
   70 REM
   80 REM MANY THANKS TO STEPHEN BEADLE (APPLE IIC, APPLESOFT COMPILED BASIC VERS
ION)
   90 REM
  100 REM FOR HELP IN THE CONSTRUCTION
  110 REM OF THIS SOFTWARE.
  120 REM
  130 ST%=1:REM OFFSET FOR SHIP NUMBER. CAN BE 1,5,9 OR 13. 1 IS THE MASTER
  140 REM THERE MUST BE ONE MASTER IN THE RING (WHICH SETS UP SPACE STATIONS)
  150 REM THE NEXT 2 CMDS SET THE BBC SCREEN TO 40 COLUMN BY 25 LINES.
  160 *TV 255,1
  170 MODE 7
  180 VDU23,1,0;0;0;0;:REM TURN CURSOR OFF
  190 GOSUB 13000:REM HELP SCREEN
  200 GOTO 250:REM MAKE ROOM FOR OFTEN USED ROUTINES (SPEED)
  210 REM ROUTINE TO MOVE CURSOR TO H%(0-39),U%(0-24).   0,0 IS TOP LEFT.
  220 REM FOR 24 LINE SCREENS, PUT CURSOR ON THE BOTTOM LINE FOR H%=23 AND 24
  230 PRINT TAB(H%,U%);
  240 RETURN
```

```
  250 REM INITIALISE SCREEN
  260 CLS
  270 U%=0:H%=0:GOSUB 210:PRINT"SHP.CO-ORDS  DOCK.ENER.   DEST.  SPD HIT";
  280 FOR I%=1 TO 16:H%=0:U%=I%:GOSUB 210:PRINTFNP(I%,2):NEXT I%:REM SHIP NUMBER
S
  290 REM INITIALISE SHIP VARS
  300 N%=3:REM NUM SHIPS MINUS ONE
  310 REM REMEMBER BBC BASIC CLEARS DIM'D ARRAYS
  320 DIM os% 256:REM FX CALL WORKSPC FOR BBC BASIC I
  330 DIM X%(N%),Y%(N%),D%(N%),W%(N%),E%(N%),SX%(10),SY%(10),SE%(10),TX%(N%),TY%
(N%),TU%(N%),TV%(N%),TM%(N%),MX%(N%),MY%(N%),WD%(N%),AX%(4),AY%(4)
  340 DIM F%(15,N%):REM MSG CIRCULATING FLAGS
  350 SM%=0:QT%=0:P$=" ":REM NO MINES, NO QUIT AND NO PREVIOUS COMMAND.
  360 CS%=0:REM CURRENT SHIP (INTERNAL NUM 0-3, ADD TO ST% FOR EXTERNAL NUM).
  370 REM SET UP I/O @ 9600 BD
  380 *FX 7,7
  390 *FX 8,7
  400 *FX2,2
  410 REM CLEAR BUFFERS
  420 *FX21,0
  430 *FX21,1
  440 *FX21,2
  450 FOR I%=0 TO N% :REM SCATTER SHIPS
  460 X%(I%)=FNR(6000)+2000
  470 MX%(I%)=X%(I%):REM MX%( AND MY%( ARE DESTINATION CO-ORDS.
  480 Y%(I%)=FNR(6000)+2000
  490 MY%(I%)=Y%(I%)
  500 E%(I%)=9999:REM MAX ENERGY.
  510 NEXT I%
  520 IF ST%=1 THEN GOSUB 12600:REM THE FIRST MICRO SENDS THE STATION POSNS
  530 AE%=20000:REM SPACE STATION DEFENCE ENERGY.
  540 H%=0:U%=17:GOSUB 210:PRINT"SPACE MINES";SPC(9);"TORPEDOES";
  550 FOR I%=ST% TO ST%+N%:H%=3:U%=I%:GOSUB 210:PRINTFNP(X%(I%-ST%),4);",";FNP(Y
%(I%-ST%),4);SPC(5);"<";FNP(E%(I%-ST%),4);">";:NEXT I%
  560 GOSUB 12300:CS="":REM CMD STRING & INDICATE CURRENT SHIP WITH A *.
  570 H%=0:U%=24:GOSUB 210:PRINTSPC(39);:REM CLR CMD LINE
  580 H%=0:U%=24:GOSUB 210:PRINT;CS%+ST%;">=-";CS;CHR$(255);:REM PUT CURRENT CMD
 AT BTM OF SCRN
  590 GOSUB 5000:REM SEND ONGOING MSGS ( MOVING SHIPS & TORPEDOES.)
  600 GOSUB 3000:REM SERIAL I/P CHK
  610 X%=ADVAL(-1):REM KEYBOARD BUFFER CHECK. X%=0 IF EMPTY, -1 IF IT CONTAINS
A CHARACTER.
  620 IF X%=0 THEN 590
  630 B$=GET$:CS=CS+B$:REM ADD CHR TO CMD STRING.
  640 IF B$=CHR$(18) THEN CS=PS:B$=CHR$(13):H%=0:U%=24:GOSUB 210:PRINT;CS%+ST%;"
>=-";LEFT$(CS,LEN(CS)-1);:REM FORCE THE PREVIOUS CMD AGAIN WITH ^R
  650 IF B$=CHR$(13) THEN GOSUB 2000:PS=CS:GOTO 560: REM DO A COMMAND & REMEMBER
 IT
  660 IF B$=CHR$(127) THEN CS=LEFT$(CS,LEN(CS)-1-ABS(LEN(CS)<>1)):GOTO 570:REM D
ELETE A CHARACTER
  670 IF B$=CHR$(24) THEN 560:REM ^X CLEARS CMD LINE.
  680 IF LEN(CS)>34 THEN PRINTCHR$(7);:CS=LEFT$(CS,34):REM MAX NUM CHARS ON CMD
LINE IS 34.
  690 IF B$=CHR$(9) THEN GOSUB 12400:REM TIDY SCREEN IF TAB (^I) PRESSED.
  700 IF B$<" " THEN CS=LEFT$(CS,LEN(CS)-1):REM REMOVE CTRL CHRS
  710 GOTO 580:REM LOOP AROUND MAIN BIT.
 1000 REM GET NUMBER FROM C$ TO V%, CURRENT POSITION PO%
 1010 G%=0
 1020 IF PO%=LEN(C$) THEN V%=0:G%=1:RETURN:REM NO PARAM SO RETURN WITH 0 AND G%
 1030 B$=MID$(C$,PO%,1):PO%=PO%+1
 1040 IF B$<"0" OR B$>"9" THEN 1020
 1050 A$=B$
 1060 IF PO%=LEN(C$) THEN V%=VAL(A$):GOTO 1100: REM LAST PARAM IN STRING.
 1070 B$=MID$(C$,PO%,1):PO%=PO%+1
 1080 IF B$<"0" OR B$>"9" THEN V%=VAL(A$): GOTO 1100 :REM NON DIGIT DELIMITER
 1090 A$=A$+B$:GOTO 1060
 1100 IF V%>9000 THEN V%=9000:REM MAX NUMBER.
 1110 RETURN
 2000 REM EXECUTE CMD IN C$
 2010 IF QT% THEN RETURN:REM IGNORE CMD IF USER HAS NO SHIPS LEFT
 2020 PO%=1:REM POSN IN C$
 2030 IF C$=CHR$(13) THEN H%=20:U%=21:GOSUB 210:PRINTSPC(20);:RETURN
 2040 REM SPACESHIP CHANGE
 2050 IF ASC(C$)<48 OR ASC(C$)>57 THEN 2110:REM NOT A DIGIT
 2060 GOSUB 1000:IF V%<ST% OR V%>ST%+N% THEN H%=20:U%=21:GOSUB 210:PRINT"BAD SHI
P NUMBER.....";:RETURN
 2070 IF E%(V%-ST%)<0 THEN H%=20:U%=21:GOSUB 210:PRINT"SHIP NO LONGER ALIVE";:GO
TO 2090
 2080 CS%=V%-ST%
 2090 FOR I%=PO%-1 TO LEN(C$):IF MID$(C$,I%,1)<"A" THEN NEXT I%:RETURN:REM NO MO
RE COMMANDS
 2100 PO%=I%:I%=LEN(C$):NEXT I%:C$=MID$(C$,PO%):GOTO 2020:REM MORE COMMAND
 2110 REM QUIT CMD
 2120 IF LEFT$(C$,4)="QUIT" THEN FOR I%=0 TO N%:GOSUB 9060:NEXT I%:REM THIS HAND
LES DEAD SHIPS, SETS QT%. ROUTINE BREAKS OUT & GOES TO MAIN LOOP.
 2130 REM HYPERSPACE
 2140 IF LEFT$(C$,1)="H" THEN GOTO 11600
 2150 REM SEND MESSAGE
 2160 IF LEFT$(C$,1)="'" THEN C$="C0 "+MID$(C$,2):REM "'" IS SHORTHAND FOR 'C 0
MSG."
 2170 IF LEFT$(C$,1)="C" THEN GOTO 10600
 2180 REM DOCKING COMMANDS
 2190 IF LEFT$(C$,1)="D" THEN GOTO 10700
 2200 REM LAY SPACE MINE
 2210 IF LEFT$(C$,1)="S" THEN GOTO 11100
 2220 REM ENERGY TRANSFER
 2230 IF LEFT$(C$,1)="E" THEN GOTO 11300
 2240 REM UNLAY MINE
 2250 IF LEFT$(C$,1)="U" THEN GOTO 11400
 2260 REM FIRE PHASOR
 2270 IF LEFT$(C$,1)="P" THEN GOTO 11700
 2280 REM SET WARP SPEED
 2290 IF LEFT$(C$,1)="W" THEN GOTO 11800
 2300 REM SET DESTINATION
 2310 IF LEFT$(C$,1)="M" THEN GOTO 11900
 2320 REM FIRE A TORPEDO
 2330 IF LEFT$(C$,1)="T" THEN GOTO 12000
 2340 REM IMPROB DRIVE
 2350 IF LEFT$(C$,1)="I" THEN GOTO 12100
 2360 H%=20:U%=21:GOSUB 210:PRINT"UNKNOWN COMMAND ERR."
 2370 RETURN
 3000 REM INTERPRET AND TAKE ACTION ON THE INPUT STRING
 3010 GOSUB 6000:REM READ BUFFER
 3020 IF S%=0 THEN RETURN:REM NO CHARS IN BUFFER.
 3030 B1%=ASC(A$)-32:REM MSG NUMBER
 3040 B2%=ASC(MID$(A$,2))-32:REM MSG LENGTH
 3050 B3%=ASC(MID$(A$,3))-32:REM SOURCE OF MSG
 3060 B4%=ASC(MID$(A$,4))-32:REM DESTINATION OF MSG
 3070 REM NOW CHECK IF THIS MICRO SENT THE MESSAGE
 3080 IF B3%>=ST% AND B3%<=ST%+N% THEN F%(B1%,B3%-ST%)=0:RETURN:REM ENABLE NXT M
SG OF THIS TYPE AND IGNORE IT
 3090 GOSUB 8000 :REM SEND ON MSG.
 3100 ON B1% GOTO 3110,3230,3290,3440,3470,3530,3590,3660,3720,3780,3840,3870,39
30,3990,4040
 3110 REM SOMEONE HAS MOVED
 3120 NX%=FNN(5):NY%=FNN(7)
 3130 H%=2:U%=B3%:GOSUB 210:PRINT" ";FNP(NX%,4);",";FNP(NY%,4);
 3140 REM CHECK IF THE MOVED SHIP HAD ANY DOCK INFO. IF SO THEN CLEAR IT
 3150 FOR I%=0 TON%:IF D%(I%)=B3% OR D%(I%)=-B3% OR D%(I%)=100+B3% THEN D%(I%)=0
:H%=13:U%=I%+ST%:GOSUB 210:PRINTSPC(3);:U%=B3%:GOSUB 210:PRINTSPC(3);
 3160 NEXT I%
 3170 IF SM%=0 THEN RETURN:REM NO MINES SET
 3180 I%=1
 3190 IF SX%(I%)=NX% AND SY%(I%)=NY% THEN ED%=-SE%(I%)*4:SH%=B3%:GOSUB 10200:GOS
UB 11470:GOTO 3210:REM ENERGY TRANSFER,REMOVE MINE FROM ARRAYS
 3200 I%=I%+1
 3210 IF I%<=SM% THEN 3190
 3220 RETURN
 3230 REM PHASOR CHECK
 3240 NX%=FNN(5):NY%=FNN(7)
 3250 FOR I%=0 TO N%
 3260 IF E%(I%)>=0 AND NX%-X%(I%) AND NY%-Y%(I%) THEN H%=37:U%=I%+ST%:GOSUB 210:
PRINT"PH";CHR$(7);:EL%=200:GOSUB 10000:REM LOSE ENERGY
 3270 NEXT I%
 3280 RETURN
 3290 REM TORP CHECK
 3300 NX%=FNN(5):NY%=FNN(7)
 3310 H%=20:IF (B3%-1)/8<>INT((B3%-1)/8) THEN H%=30:SORT OUT SPACE ON SCREEN FOR
 CO-ORDS.
 3320 U%=18+(B3%-1)/8:GOSUB 210:PRINTFNP(NX%,4);",";FNP(NY%,4);
 3330 FOR I%=0 TO N%
 3340 IF E%(I%)<0 THEN 3360:REM SHIP DEAD SO TRY NEXT ONE.
 3350 IF ABS(NX%-X%(I%))<6 AND ABS(NY%-Y%(I%))<6 THEN H%=37:U%=I%+ST%:GOSUB 210:
PRINT"TO";CHR$(7);:EL%=400:GOSUB 10000:REM LOSE ENERGY
 3360 NEXT I%
 3370 IF NX%<>AX%((ST%-1)/4+1) OR NY%<>AY%((ST%-1)/4+1) THEN RETURN:REM CHECK FO
R SPC STN DAMAGE
 3380 AE%=AE%-400:H%=20:U%=21:GOSUB 210:PRINT"STATION HIT....";FNP(AE%,5);CHR$(7
);
 3390 IF AE%>=0 THEN RETURN:REM CHECK REMAINING DEFENCE ENERGY.
 3400 H%=20:U%=21:GOSUB 210:PRINT"STATION DESTROYED...";
 3410 FOR I%=0 TO N%:IF E%(I%)>0 THEN E%(I%)=0:GOSUB 9000:REM DRAIN ENERGY IN RE
MAINING SHIPS.
 3420 NEXT I%
 3430 RETURN
 3440 REM SPACE MINE MSG
 3450 H%=20:U%=21:GOSUB 210:PRINT"SHIP ";FNP(B3%,2);" DROPPED MINE";
 3460 RETURN
 3470 REM TXT MSG
 3480 IF B4%<>0 AND (B4%>ST%+N% OR B4%<ST%) THEN RETURN:REM PRIVATE MSG FOR ANOT
HER SHIP.
 3490 D$="(":B$=")":IF B4%=0 THEN D$="'":B$="'":REM PARENTHESIS FOR PRIVATE MSG,
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"*" FOR PUBLIC.
 3500 A$=MID$(A$,5):H%=17:U%=INT((B3%-1)/4)*4+2:GOSUB 210
 3510 A$=LEFT$(A$+"                                        ",40):PRINTD$;LEFT$(A
$,20);B$;:U%=U%+1:GOSUB 210:PRINTD$;RIGHT$(A$,20);B$;:REM THAT WAS 40 SPACES.
 3520 RETURN
 3530 REM DOCK REQUEST
 3540 IF B4%<ST% OR B4%>ST%+N% THEN RETURN
 3550 IF E%(B4%-ST%)<0 OR D%(B4%-ST%)<>0 OR FNN(5)<>X%(B4%-ST%) OR FNN(7)<>Y%(B4
%-ST%) THEN A$=CHR$(40)+CHR$(36)+CHR$(32+B4%)+CHR$(32+B3%):GOSUB 8000:RETURN:REM
 DOCK REFUSAL IF REQUESTED SHIP IS DEAD, BUSY OR WRONGLY PLACED.
 3560 H%=13:U%=B3%:GOSUB 210:PRINT"R";B4%;
 3570 D%(B4%-ST%)=B3%+100
 3580 RETURN
 3590 REM DOCKING ACCEPT MESSAGE
 3600 IF B4%<ST% OR B4%>ST%+N% THEN RETURN
 3610 IF E%(B4%-ST%)<0 OR D%(B4%-ST%)<>-B3% THEN RETURN:REM DEAD OR NOT REQUESTE
D.
 3620 H%=13:U%=B3%:GOSUB 210:PRINT"D";B4%;
 3630 U%=B4%:GOSUB 210:PRINT"D";B3%;
 3640 D%(B4%-ST%)=B3%
 3650 RETURN
 3660 REM DOCK REJECT
 3670 IF B4%<ST% OR B4%>ST%+N% THEN RETURN
 3680 IF D%(B4%-ST%)<>-B3% THEN RETURN:REM NOT REQUESTED.
 3690 D%(B4%-ST%)=0
 3700 H%=13:U%=B4%:GOSUB 210:PRINTSPC(3);
 3710 RETURN
 3720 REM UNDOCKING MESSAGE
 3730 IF B4%<ST% OR B4%>ST%+N% THEN RETURN
 3740 IF D%(B4%-ST%)<>B3% THEN RETURN:REM NOT DOCKED.
 3750 D%(B4%-ST%)=0
 3760 H%=13:U%=B4%:GOSUB 210:PRINTSPC(3);:U%=B3%:GOSUB 210:PRINTSPC(3);
 3770 RETURN
 3780 REM ENERGY TRANSFER
 3790 IF B4%<ST% OR B4%>ST%+N% THEN RETURN
 3800 IF E%(B4%-ST%)<0 THEN RETURN
 3810 EL%=-FNN(6)*(ASC(MID$(A$,5))-33):REM SIGN OF ENERGY IS IN THE 5TH BYTE.
 3820 I%=B4%-ST%:GOSUB 10000
 3830 RETURN
 3840 REM SHIP INACTIVE MSG
 3850 H%=2:U%=B3%:GOSUB 210:PRINT")";:REM INDICATE WITH PARENTHESIS KNOWN SHIP N
UM.
 3860 RETURN
 3870 REM SHIP DESTROYED MSG
 3880 H%=3:U%=B3%:GOSUB 210:PRINT"DESTROYED";
 3890 REM CLEAN UP DOCK STATUS
 3900 FORI%=0TON%:IF D%(I%)=B3% OR D%(I%)=-B3% OR D%(I%)=100+B3% THEN D%(I%)=0:H
%=13:U%=B3%:GOSUB 210:PRINTSPC(3);:U%=B4%:GOSUB 210:PRINTSPC(3);
 3910 NEXT I%
 3920 RETURN
 3930 REM IMPROBABILITY MSG
 3940 H%=3:U%=B3%:GOSUB 210:PRINTSPC(9);:REM POSITION NO LONGER KNOWN.
 3950 REM CLEAR DOCK STATUS IF ANY
 3960 FOR I%=0 TON%:IF D%(I%)=B3% OR D%(I%)=-B3% OR D%(I%)=100+B3% THEN D%(I%)=0
:H%=13:U%=I%+ST%:GOSUB 210:PRINTSPC(3);:U%=B3%:GOSUB 210:PRINTSPC(3);
 3970 NEXT I%
 3980 RETURN
 3990 REM POS OF STN RECEIVED
 4000 I%=(B4%-1)/4+1
 4010 AX%(I%)=FNN(5):AY%(I%)=FNN(7)
 4020 GOSUB 12700:PRINT IT ON SCREEN.
 4030 RETURN
 4040 REM STATION DESTROYED MSG
 4050 I%=(B4%-1)/4+1
 4060 H%=17:U%=(I%-1)*4+1
 4070 GOSUB 210:PRINT"STATION DESTROYED";CHR$(7);CHR$(7);
 4080 RETURN
 5000 REM SEND REPEATING MSGS
 5010 REM SHIP MOVE MSGS
 5020 FOR I%=0 TO N%
 5030 IF E%(I%)<=W%(I%) OR W%(I%)=0 OR F%(1,I%)<>0 THEN GOTO 5140:REM SKIP IF NO
 ENERGY, SPEED OR PREVIOUS MSG HAS NOT RETURNED.
 5040 H%=34:U%=I%+ST%:GOSUB 210:PRINT"W";W%(I%);
 5050 IF D%(I%)<>0 THEN GOSUB 7000:REM CLEAR DOCK STATUS
 5060 NX%=MX%(I%)-X%(I%):NY%=MY%(I%)-Y%(I%)
 5070 X%(I%)=X%(I%)+SGN(NX%)*W%(I%):Y%(I%)=Y%(I%)+SGN(NY%)*W%(I%)
 5080 IF ABS(NX%)<W%(I%) THEN X%(I%)=MX%(I%)
 5090 IF ABS(NY%)<W%(I%) THEN Y%(I%)=MY%(I%)
 5100 IF Y%(I%)=MY%(I%) AND X%(I%)=MX%(I%) THEN W%(I%)=0:WD%(I%)=0:H%=24:U%=I%+S
T%:GOSUB 210:PRINTSPC(12);:REM DESTINATION REACHED
 5110 SH%=I%+ST%:GOSUB 10240:REM SEND MOVE MSG
 5120 EL%=W%(I%):GOSUB 10000:REM TAKE AWAY ENERGY
 5130 IF W%(I%)<WD%(I%) THEN W%(I%)=W%(I%)+1:REM SPEED UP TO WARP DESTINATION.
 5140 NEXT I%
 5150 REM TORPEDO MOVE MSGS
 5160 FOR I%=0 TO N%
 5170 IF TM%(I%)=0 OR F%(3,I%)<>0 THEN 5260
 5180 NX%=TU%(I%)-TX%(I%):NY%=TV%(I%)-TY%(I%)
 5190 TX%(I%)=TX%(I%)+SGN(NX%)*15:TY%(I%)=TY%(I%)+SGN(NY%)*15
 5200 IF ABS(NX%)<15 THEN TX%(I%)=TU%(I%)
 5210 IF ABS(NY%)<15 THEN TY%(I%)=TV%(I%)
 5220 IF TY%(I%)<>TV%(I%) OR TX%(I%)<>TU%(I%) THEN 5250
 5230 TM%(I%)=0:H%=20:IF(CS%+ST%-1)/8<>INT((CS%+ST%-1)/8) THEN H%=30
 5240 U%=18+(CS%+ST%-1)/8:GOSUB 210:PRINTSPC(9);
 5250 SH%=I%+ST%:X%=TX%(I%):Y%=TY%(I%):GOSUB 10450:REM SEND T.MOVE MSG
 5260 NEXT I%
 5270 RETURN
 6000 REM READ BUFFER
 6010 REM SETS S% TO 1 AND RETURNS A$
 6020 X%=ADVAL(-2):REM X%=0 IF NO CHARS IN BUFFER
 6030 IF X%=0 THEN S%=0:RETURN
 6040 S%=1
 6050 REM SERIAL I/P ON
 6060 *FX2,1
 6070 Y%=GET AND 127:Z%=GET AND 127:A$=CHR$(Y%)+CHR$(Z%)
 6080 REM READ IN REST OF MSG
 6090 FOR Q%=1 TO Z%-34:Y%=GET AND 127:A$=A$+CHR$(Y%)
 6100 NEXT Q%:*FX2,2
 6110 REM SWITCH SERIAL OFF
 6120 RETURN
 7000 REM CLEAR DOCK STATUS
 7010 IF D%(I%)>100 THEN H%=13:U%=D%(I%)-100:GOSUB 210:PRINTSPC(3);:D%(I%)=0
 7020 IF D%(I%)<0 THEN H%=13:U%=I%+ST%:GOSUB 210:PRINTSPC(3);:D%(I%)=0
 7030 IF D%(I%)>0 THEN H%=13:U%=I%+ST%:GOSUB 210:PRINTSPC(3);:U%=D%(I%):GOSUB 21
0:PRINTSPC(3);:D%(I%)=0
 7040 RETURN
 8000 REM SEND THE MSG IN A$
 8010 IF ASC(MID$(A$,3))>=ST%+32 AND ASC(MID$(A$,3))<=ST%+N%+32 THEN F%(ASC(A$)-
32,ASC(MID$(A$,3))-32-ST%)=-1:REM DISALLOW >1 MSGS OF 1 TYPE SENT BY ONE SHIP AT
 ONE TIME
 8020 FOR Q%=1 TO LEN(A$)
 8030 YY%=ASC(MID$(A$,Q%))
 8040 IF YY%<32 THEN YY%=YY%+32:REM CONV CTRL CHRS TO NORM
 8050 REM SEND A CHAR TO SERIAL
 8060 PROCoscli(" FX138,2,"+STR$(YY%))
 8070 NEXT Q%
 8080 RETURN
 8090 REM OSCLI FIX FOR BBC BASIC I ONLY.
 8100 DEF PROCoscli(fx$)
 8110 LOCAL X%,Y%
 8120 X%=os% MOD 256
 8130 Y%=os% DIV 256
 8140 fx$=fx$+CHR$(13)
 8150 $os%=fx$
 8160 CALL(&FFF7)
 8170 ENDPROC
 9000 REM SEND SHIP INACTIVE MSG
 9010 H%=18:U%=I%+ST%:GOSUB 210:PRINTSPC(4);
 9020 W%(I%)=0
 9030 A$=CHR$(43)+CHR$(36)+CHR$(I%+ST%+32)+CHR$(32)
 9040 GOSUB 8000
 9050 RETURN
 9060 REM SEND SHIP DESTROYED MSG
 9070 H%=3:U%=I%+ST%:GOSUB 210:PRINT"DESTROYED";SPC(27);
 9080 E%(I%)=-1:W%(I%)=0
 9090 A$=CHR$(44)+CHR$(36)+CHR$(I%+ST%+32)+CHR$(32)
 9100 GOSUB 8000
 9110 REM SEARCH FOR A LIVE SHIP AND MAKE THAT THE CURRENT SHIP.
 9120 FOR Z%=0 TO N%:IF E%(Z%)<0 THEN NEXT Z%
 9130 IF Z%=N%+1 THEN H%=20:U%=21:GOSUB 210:PRINT"WITHDRAWN FROM GAME.";:QT%=1:G
OTO 600: REM SET IT TO IGNORE COMMANDS
 9140 CS%=Z%:Z%=N%:NEXT Z%:GOSUB 12300:REM PUT * WITH CURRENT SHIP
 9150 RETURN
10000 REM LOSE ENERGY EL% OH SHIP I%(INTERNAL)
10010 E%(I%)=E%(I%)-EL%:H%=18:U%=I%+ST%:GOSUB 210:PRINTFNP(E%(I%),4);
10020 IF E%(I%)=0 THEN GOSUB 9000:REM SEND SHIP INACTIVE MSG
10030 IF E%(I%)<0 THEN GOSUB 9060:REM SEND SHIP DESTROYED MSG
10040 RETURN
10100 REM OPTIONAL INITIALISE
10110 REM CALL THIS IF YOUR BASIC NEEDS IT.
10120 DEFFNN(P%)=ASC(MID$(A$,P%))-32+95*(ASC(MID$(A$,P%+1))-32):REM EXTRACT NUM
FROM MSG.
10130 DEFFNH(P%)=32+ABS(P%) DIV 95:REM CONVERT NUM TO HIGH BYTE READY FOR TRANSM
ISSION.
10140 DEFFNL(P%)=32+ABS(P%) MOD 95:REM DITTO LOW ORDER BYTE.
10150 DEFFNR(P%)=RND(P%):REM RETURN A RANDOM NUMBER FROM 0 TO P%-1
10160 DEFFNP(P$,Q%)=RIGHT$("      "+STR$(P$),Q%):REM RIGHT JUSTIFY P% IN Q% CHARS
. MAY NEED MODIFICATION IF YOUR BASIC DOESN'T DO FN'S OF STRINGS & 2 PARAMETERS.
10170 RETURN
10200 REM ENERGY TRANSFER ED% TO SH%
10210 A$=CHR$(42)+CHR$(39)+CHR$(ST%+32)+CHR$(SH%+32)+CHR$(33+SGN(ED%))+CHR$(FNL(
ED%))+CHR$(FNH(ED%))
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10220 GOSUB 8000
10230 RETURN
10240 REM TX MOVE SH%,X%(,Y%(
10250 HS%=SH%-ST%:REM HS% IS INTERNAL NUM
10260 AS=CHR$(33)+CHR$(40)+CHR$(SH%+32)+CHR$(32)+CHR$(FNL(X%(HS%)))+CHR$(FNH(X%(
HS%)))+CHR$(FNL(Y%(HS%)))+CHR$(FNH(Y%(HS%)))
10270 GOSUB 8000
10300 REM PRINT SHIP POS
10310 H%=3:U%=SH%:GOSUB 210:PRINTFNP(X%(HS%),4);",";FNP(Y%(HS%),4);
10320 FOR J%=1 TO 4:REM SPACE STN CHECK.
10330 IF X%(HS%)<>AX%(J%) OR Y%(HS%)<>AY%(J%) THEN NEXT J%:RETURN
10340 IF J%=INT((ST%-1)/4+1) AND AE%>1001 THEN AE%=AE%-1000:E%(HS%)=9999:H%=18:U
%=HS%+ST%:GOSUB 210:PRINT FNP(E%(HS%),4);:NEXT J%:RETURN:REM REPLENISH ENERGY IF
 SHIP AT SPC STH.
10350 I%=HS%:GOSUB 9060:NEXT J%:RETURN:REM DESTROY SHIP IF IT WAS ON ANOTHER SPC
 STN.
10400 REM TX PHASOR SH%,X%,Y%
10410 M%=2
10420 AS=CHR$(M%+32)+CHR$(40)+CHR$(SH%+32)+CHR$(32)+CHR$(FNL(X%))+CHR$(FNH(X%))+
CHR$(FNL(Y%))+CHR$(FNH(Y%))
10430 GOSUB 8000
10440 RETURN
10450 REM TX TORPEDO SH%,X%,Y%
10460 H%=20:IF (SH%-1)/8<>INT((SH%-1)/8) THEN H%=30
10470 U%=18+(SH%-1)/8:GOSUB 210:PRINTFNP(X%,4);",";FNP(Y%,4);
10480 M%=3: GOTO 10420:REM USE 2ND HALF OF PHASOR ROUTINE.
10490 REM TX SPACE MINE WARNING SH%
10500 AS=CHR$(36)+CHR$(36)+CHR$(CS%+ST%+32)+CHR$(32)
10510 GOSUB 8000
10520 RETURN
10600 REM SEND A TEXT MESSAGE.
10610 GOSUB 1000:REM GET NUMBER
10620 IF G%=1 THEN H%=20:U%=21:GOSUB 210:PRINT"NO SHIP NUMBER GIVEN";:RETURN
10630 IF FO%+1>LEN(CS) THEN H%=20:U%=21:GOSUB 210:PRINT"NO MESSAGE TXT GIVEN";:R
ETURN
10640 AS=CHR$(37)+CHR$(36+LEN(MID$(CS,PO%,LEN(CS)-PO%)))+CHR$(CS%+ST%+32)+CHR$(V
%+32)+MID$(CS,PO%,LEN(CS)-PO%)
10650 GOSUB 8000
10660 RETURN
10700 REM DOCKING COMMANDS
10710 DS=MID$(CS,2,1)
10720 GOSUB 1000:REM GET PARAM.
10730 IF V%=0 OR (V%>=ST% AND V%<=ST%+N%) THEN H%=20:U%=21:GOSUB 210:PRINT"INVAL
ID SHIP NUMBER.":RETURN
10740 IF DS="R" THEN GOTO 10800 :REM REQUEST
10750 IF DS="A" THEN GOTO 10860 :REM ACCEPT
10760 IF DS="N" THEN GOTO 10920 :REM REFUSE
10770 IF DS="U" THEN GOTO 10980 :REM UNDOCK
10780 H%=20:U%=21:GOSUB 210:PRINT"INVALID DOCKING CMD.";
10790 RETURN
10800 IF D%(CS%)<>0 THEN H%=20:U%=21:GOSUB 210:FRINT"THIS SHIP NOT FREE..":RETUR
N
10810 H%=13:U%=CS%+ST%:GOSUB 210:PRINT"P";V%;
10820 AS=CHR$(38)+CHR$(40)+CHR$(32+ST%+CS%)+CHR$(32+V%)+CHR$(FNL(X%(CS%)))+CHR$(
FNH(X%(CS%)))+CHR$(FNL(Y%(CS%)))+CHR$(FNH(Y%(CS%)))
10830 GOSUB 8000
10840 D%(CS%)=-V%
10850 RETURN
10860 IF D%(CS%)<>V%+100 THEN H%=20:U%=21:GOSUB 210:PRINT"ACCEPT WHAT REQUEST.";
:RETURN
10870 H%=13:U%=CS%+ST%:GOSUB 210:PRINT"D";V%:U%=V%:GOSUB 210:PRINT"D";CS%+ST%;
10880 AS=CHR$(39)+CHR$(36)+CHR$(32+ST%+CS%)+CHR$(32+V%)
10890 GOSUB 8000
10900 D%(CS%)=V%
10910 RETURN
10920 IF D%(CS%)<>V%+100 THEN H%=20:U%=21:GOSUB 210:PRINT"REFUSE WHAT REQUEST?";
:RETURN
10930 H%=13:U%=V%:GOSUB 210:PRINTSPC(3);
10940 AS=CHR$(40)+CHR$(36)+CHR$(32+ST%+CS%)+CHR$(32+V%)
10950 D%(CS%)=0
10960 GOSUB 8000
10970 RETURN
10980 IF D%(CS%)<=0 OR D%(CS%)>100 THEN H%=20:U%=21:GOSUB 210:PRINT"UNDOCK WHAT
SHIP ?..";:RETURN
10990 H%=13:U%=ST%+CS%:GOSUB 210:PRINTSPC(3);:U%=V%:GOSUB 210:PRINTSPC(3);
11000 AS=CHR$(41)+CHR$(36)+CHR$(32+ST%+CS%)+CHR$(32+V%)
11010 D%(CS%)=0
11020 GOSUB 8000
11030 RETURN
11100 REM SPACE MINE
11110 GOSUB 1000:REM GET ENERGY OF MINE TO BE LAID.
11120 IF V%<26 OR V%>2000 THEN H%=20:U%=21:GOSUB 210:FRINT"MIN 25,MAX 2000UNITS"
;:RETURN
11130 IP SM%=10 THEN H%=20:U%=21:GOSUB 210:PRINT"NOT ENOUGH CANISTERS";:RETURN
11140 IP E%(CS%)<V%+1 THEN H%=20:U%=21:GOSUB 210:PRINT"NOT ENOUGH ENERGY...";:RE
TURN
11150 EL%=V%:I%=CS%:GOSUB 10000
11160 GOSUB 10500:REM SEND WARNING
11170 SM%=SM%+1:SX%(SM%)=X%(CS%):SY%(SM%)=Y%(CS%):SE%(SM%)=V%-25:GOSUB 11190
11180 RETURN
11190 REM PRINT SPACE MINE LIST
11200 FOR U%=18 TO 22:H%=0:GOSUB 210:PRINTSPC(19);:NEXT U%
11210 IF SM%=0 THEN RETURN
11220 FOR K%=1 TO SM%
11230 H%=0:IF K%/2=INT(K%/2) THEN H%=10
11240 U%=(1+K%)/2+17:GOSUB 210:PRINTFNP(SX%(K%),4);",";FNP(SY%(K%),4);
11250 NEXT K%
11260 RETURN
11300 REM ENERGY TRANSFER
11310 GOSUB 1000
11320 IF D%(CS%)<=0 OR D%(CS%)>100 THEN H%=20:U%=21:GOSUB 210:PRINT"SHIPS ARE NO
T DOCKED";:RETURN
11330 IF E%(CS%)-V%<=0 THEN H%=20:U%=21:GOSUB 210:PRINT"NOT ENOUGH ENERGY...";:R
ETURN
11340 IF V%=0 THEN RETURN
11350 ED%=V%:SH%=D%(CS%):GOSUB 10200:REM TX ENERGY
11360 EL%=V%:I%=CS%:GOSUB 10000
11370 RETURN
11400 REM UHLAY SPACE MINE
11410 IF SM%=0 THEN H%=20:U%=21:GOSUB 210:PRINT"NO MINES LAID HERE..";:RETURN
11420 I%=1
11430 IF SX%(I%)=X%(CS%) AND SY%(I%)=Y%(CS%) THEN EL%=-SE%(I%):II%=I%:I%=CS%:GOS
UB 10000:I%=II%:GOSUB 11470:GOTO11450:REM DELETE HINE FROM LIST
11440 I%=I%+1
11450 IF I%<=SM% THEN 11430
11460 RETURN
11470 REM REMOVE HINE FROM ARRAYS AND HOVE OTHERS DOWN
11480 IF SM%=I% THEN 11520:REM HINE WAS AT TOP OF LIST
11490 FOR J%=I% TO SM%-1
11500 SX%(J%)=SX%(J%+1):SY%(J%)=SY%(J%+1):SE%(J%)=SE%(J%+1)
11510 NEXT J%
11520 SM%=SM%-1
11530 GOSUB 11190:REM PRIHT LIST
11540 RETURN
11600 REM HYPERSPACE COMMAND
11610 IF E%(CS%)<201 THEN H%=20:U%=21:GOSUB 210:PRINT"NOT ENOUGH ENERGY...";:RET
URN
11620 IF W%(CS%)<>9 THEN H%=20:U%=21:GOSUB 210:PRINT"WARP 9 TO HYPERSPACE";:RETU
RN
11630 X%(CS%)=MX%(CS%):Y%(CS%)=MY%(CS%)
11640 W%(CS%)=0:H%=24:U%=CS%+ST%:GOSUB 210:PRINTSPC(12);
11650 SH%=CS%+ST%:GOSUB 10240:I%=CS%:EL%=200:GOSUB 10000
11660 RETURN
11700 REM PHASOR CMD
11710 IF B%(CS%)<51 THEN H%=20:U%=21:GOSUB 210:PRINT"NOT ENOUGH ENERGY...";:RETU
RN
11720 GOSUB 1000:X%=V%:GOSUB 1000:Y%=V%
11730 IF ABS(X%-X%(CS%))>100 OR ABS(Y%-Y%(CS%))>100 THEN H%=20:U%=21:GOSUB 210:P
RINT"RANGE TOO LARGE.....";:RETURN
11740 SH%=ST%+CS%:GOSUB 10400:REM TX MSG.
11750 EL%=50:I%=CS%:GOSUB 10000:REM DEDUCT ENERGY.
11760 NX%=X%:NY%=Y%:GOTO3250:REM USE IHCOMING CHECKER IH CASE YOU FIRED AT YOURS
ELF!
11800 REM SET WARP SPEED CMD
11810 IF B%(CS%)<=0 THEN H%=20:U%=21:GOSUB 210:PRINT"NOT ENOUGH ENERGY...";:RETU
RN
11820 IF X%(CS%)=MX%(CS%) AND Y%(CS%)=MY%(CS%) THEN H%=20:U%=21:GOSUB 210:PRINT"
NO DESTINATION SET..";:RETURN
11830 GOSUB 1000:REM GET VALUE
11840 IF V%>9 THEN H%=20:U%=21:GOSUB 210:PRINT"MAXIMUM SPEED WARP 9";:V%=9
11850 IF V%>0 AND W%(CS%)=0 THEN W%(CS%)=1
11860 IF V%>W%(CS%) THEN WD%(CS%)=V%:RETURN:REM THE MOVE ROUTINE WILL SPEED UP S
HIP FROM W% TO WD%
11870 IF V%=0 THEN H%=34:U%=CS%+ST%:GOSUB 210:PRINT SPC(3);:W%(CS%)=0:RETURN
11880 W%(CS%)=V%:WD%(CS%)=V%
11890 RETURN
11900 REM SET DESTINATION
11910 IF E%(CS%)<=0 THEN H%=20:U%=21:GOSUB 210:PRINT"NOT ENOUGH ENERGY...";:RETU
RN
11920 GOSUB 1000:MX%(CS%)=V%:GOSUB 1000:MY%(CS%)=V%
11930 H%=24:U%=ST%+CS%:GOSUB 210:PRINTFNP(MX%(CS%),4);",";FNP(MY%(CS%),4);
11940 IF MX%(CS%)=X%(CS%) AND MY%(CS%)=Y%(CS%) THEN W%(CS%)=0:H%=24:U%=CS%+ST%:G
OSUB 210:PRINTSPC(12);
11950 RETURN
12000 REM PHOTON TORP. CHD
12010 GOSUB 1000:X%=V%:GOSUB 1000:Y%=V%
12020 IF E%(CS%)<101 THEN H%=20:U%=21:GOSUB 210:PRINT"NOT ENOUGH ENERGY...":RET
URN
12030 IF TM%(CS%)<>0 THEN RETURN
12040 IF ABS(X%-X%(CS%))>200 OR ABS(V%-Y%(CS%))>200 THEN H%=28:U%=21:GOSUB 210:P
RINT"RANGE TOO LARGE.....";:RETURN
12050 TU%(CS%)=X%:TV%(CS%)=Y%:TX%(CS%)=X%(CS%):TY%(CS%)=Y%(CS%):TM%(CS%)=1
12060 EL%=100:I%=CS%:GOSUB 10000
12070 RETURN
```

```
12100 REM IMPROBABILITY DRIVE
12110 IF E%(CS%)<100 THEN H%=20:U%=21:GOSUB 210:PRINT"NOT ENOUGH ENERGY...";:RET
URN
12120 IF E%(CS%)<500 THEN GOTO 12190:REM NOT ENOUGH ENERGY FOR FULL IMPROB
12130 I%=CS%:EL%=500:GOSUB 10000
12140 X%(CS%)=FNR(9000):Y%(CS%)=FNR(9000)
12150 GOSUB 7000:REM CLEAR DOCK STATUS IF ANY
12160 A$=CHR$(45)+CHR$(36)+CHR$(32+CS%+ST%)+CHR$(32)
12170 GOSUB 8000
12180 SH%=CS%+ST%:HS%=CS%:GOTO 10310:REM PRINT POS ON SCRN
12190 REM PSEUDO IMPROB.
12200 EL%=E%(CS%):I%=CS%:GOSUB 10000:REM DRAIN REMAINING ENERGY
12210 X%(CS%)=FNR(9000):Y%(CS%)=FNR(9000)
12220 GOSUB 7000:REM CLEAR DOCK STATUS IF ANY.
12230 SH%=CS%+ST%:GOSUB 10240:REM SEND MOVE MSG
12240 RETURN
12300 REM INDICATE CURRENT SHIP WITH *
12310 FOR U%=ST% TO ST%+N%
12320 H%=2:GOSUB 210:PRINTSPC(1);
12330 NEXT U%
12340 U%=ST%+CS%:GOSUB 210:PRINT"*";
12350 RETURN
12400 REM CLEAR PARTS OF SCREEN (IF TAB OR ^I PRESSED).
12410 H%=20:U%=21:GOSUB 210:PRINTSPC(20);
12420 FOR I%=0 TO 3
12430 H%=37:U%=I%+ST%:GOSUB 210:PRINTSPC(2);
12440 NEXT I%
12450 FOR I%=0 TO 3
12460 IF I%+1=ST% THEN 12490
12470 H%=17:U%=I%+2:GOSUB 210:PRINTSPC(22);
12480 U%=U%+1:GOSUB 210:PRINTSPC(22);
12490 NEXT I%
12500 FOR U%=18 TO 19
12510 H%=20:GOSUB 210:PRINTSPC(19);:NEXT U%
12520 RETURN
12600 REM SEND SPACE STATION POSNS
12610 FOR I%=1 TO 4
12620 AX%(I%)=FNR(9000)
12630 AY%(I%)=FNR(9000)
12640 A$=CHR$(46)+CHR$(40)+CHR$(CS%+ST%+32)+CHR$(32+(I%-1)*4+1)+CHR$(FNL(AX%(I%)
))+CHR$(FNH(AX%(I%)))+CHR$(FNL(AY%(I%)))+CHR$(FNH(AY%(I%)))
12650 GOSUB 8000
12660 GOSUB 12700:REM PRINT IT ON SCREEN
12670 NEXT I%
12680 RETURN
12700 REM PRINT SPACE STN ON SCREEN
12710 H%=17:U%=(I%-1)*4+1
12720 IF I%=(ST%-1)/4+1 THEN H%=20:U%=20:REM THIS MICRO'S STN
12730 GOSUB 210:PRINT"STATION:";AX%(I%);",";AY%(I%);
12740 RETURN
13000 REM HELP SCREENS
13010 CLS
13020 PRINT"MULTREK MULTI USER STAR TREK GAME"
13030 PRINT"You control ships ";ST%;" to ";ST%+3;"."
13040 PRINT"Ensure that these are unique in your"
13050 PRINT"group.  You can move your four ships in"
13060 PRINT"the galaxy which has co-ordinate"
13070 PRINT"ranges (0 to 9000,0 to 9000).  Commands"
13080 PRINT"consist of one or two letters followed"
13090 PRINT"by numbers or other information."
13100 PRINT"The next page shows the available"
13110 PRINT"commands."
13120 PRINT"The object of the game is to destroy"
13130 PRINT"the other player's space stations by"
13140 PRINT"firing photon torpedoes which weaken"
13150 PRINT"their defences.  You may use torpedoes,"
13160 PRINT"phasors or space mines to destroy"
13170 PRINT"another player's ships."
13180 PRINT"If your space station is destroyed,"
13190 PRINT"your ships will be drained of their"
13200 PRINT"energy.  You may then join with another"
13210 PRINT"player who may give your ships energy"
13220 PRINT"in return for co-operation."
13230 PRINT"Beware of players who double cross you!"
13240 PRINT:PRINT"**** PRESS SPACE TO CONTINUE ****";:A$=GET$
13250 CLS
13260 PRINT"To change the ship you are commanding,"
13270 PRINT"enter the number followed either by a"
13280 PRINT"command or <ret>."
13290 PRINT"M <x><y> Sets destination co-ords."
13300 PRINT"         Any non digit can be used as"
13310 PRINT"         the separator."
13320 PRINT"W <0-9>  Sets warp speed"
13330 PRINT"H  Hyperspace to dest., only at warp 9."
13340 PRINT"I  Improbability drive to random dest."
13350 PRINT"T <x><y> Sends photon torpedo (one per"
13360 PRINT"         ship at any time.)"
13370 PRINT"P <x><y> Fire phasor, instantaneous."
13380 PRINT"S <e>    Set mine of certain energy"
13390 PRINT"U  Unlay mines at this ship's position."
13400 PRINT"DR <n> Request a dock with ship <n>."
13410 PRINT"DA <n> Accept dock request from ship."
13420 PRINT"DN <n> Refuse dock request from ship."
13430 PRINT"DU <n> Undock from ship <n>."
13440 PRINT"E <e>  Transfer energy to docked ship."
13450 PRINT"' <txt> Send text message to all ships."
13460 PRINT"C <n>   Send text message to ship <n>."
13470 PRINT"QUIT   Withdraw from the game."
13480 PRINT"^I=Tidy scrn,^R=Repeat cmd,^X=Clear cmd"
13490 IF ST%=1 THEN PRINT"Now press space after the others have.";
13500 IF ST%<>1 THEN PRINT"Press space to start.";
13510 A$=GET$:RETURN
```

Atari GTIA+

by Paul Lay

The 8-bit Atari micros have very sophisticated graphics capabilities thanks to a couple of custom chips, ANTIC and GTIA. Much of their power is derived from the fact that a 256-colour palette is provided. However, at best only 16 of these colours can be displayed at once. Display list interrupts can be used to alter colours, but these are restrictive.

This program provides a custom display list which allows all 256 colours to be freely displayed with a resolution of 80 by 96. The principle behind this display is that every scan line alternates between 16 luminance and 16 hue modes (GTIA modes 9 and 11), so that the overall effect is of a single scan line with all 256 models.

Graphics routines

To support this custom graphics mode, a full set of graphics routines have been provided (something which the Atari ROM has always lacked). They interface to Basic via USR calls and are described below. In the program, lines 10 to 1360 set up the routines, and lines 1370 onwards provide a demonstration program, showing how the routines are used.

Graphics

<var> = USR(GRAPHICS, <option>) where <option> is one of FULLCLR, SPLITCLR, FULLNOCLR or SPLITNOCLR.

This routine opens the custom graphics mode with all the standard screen configurations provided for. Note that in order to switch between GTIA modes 9 and 11 every scan line, a display list interrupt is used which alters PRIOR ($D01B). Particularly interesting about this DLI is that the glitch problem associated with keyboard input has been resolved. This was performed by synchronising to the vertical line counter VCOUNT ($D40B).

Colour

COLOR c

Note that colour is still specified by the Basic COLOR statement. The only difference is that the colour is specified by a value in the range 0 to 255, which represents 16*hue+luminance.

Plot

<var> = USR (PLOT x,y)

This routine plots the pixel at position x,y in the current colour.

Drawto

<var> = USR (DRAWTO x,y)

This routine draws a line from the current graphics cursor position to position x,y in the current colour. Note that the generalised integer Bresenham's algorithm is used, working with byte arithmetic.

Mode

<var> = USR (MODE, <option>) where <option> is one of NORMAL, ANDMODE, ORMODE or XOR.
This routine allows special plotting modes to be used (normal, and, or, and exclusive or plotting modes). These modes are commonly used for special effects such as animation, colour blending and masking.

Move

<var> = USR (MOVE, x,y)
This routine moves the graphics cursor to position x,y

Locate

<var> = USR (LOCATE, x,y)
This routine returns to the calling variable the colour of the pixel specified at position x,y

Fill

<var> = USR (FILL x,y)
This routine performs an area fill in the current colour at position x,y (an area fill fills the area identified by the colour under the specified position, and is capable of filling any shape). Note that a scan line seed fill algorithm is used which specifically minimises stack use.

Circle

<var> = USR (CIRCLE, x,y,r)
This routine draws a circle in the current colour with centre x,y and radius r. Bresenham's incremental circle algorithm is used.

Disc

<var> = USR (DISC, x,y,r)
This routine draws a disc (filled circle) in the current colour with centre x,y and radius r.
Clipping off the screen is provided but suffers from the fact that the Basic USR command can only accept positive parameter values. Also, as byte arithmetic is extensively used (for efficiency), any value exceeding 255 will be truncated accordingly.

When normally using any of the GTIA modes, SETCOLOR 4, hue, lum is used to alter colours. Obviously, this is now no longer needed as all 256 colours are readily available. However, by experimenting with SETCOLOR 4, hue, lum, filter effects can be generated (effectively giving an enormous colour palette).

Finally, note that the routines reside in memory between locations $782B and $7ECO. When the routines have been set up, users with a disk drive could always enter DOS and save a binary file between these addresses, removing the need for lines 90 to 1190 by loading the binary file instead.

```
100 REM **********************
110 REM *      GTIA+ GRAPHICS      *
120 REM *       By Paul Lay        *
130 REM **********************
140 REM
150 REM --- M/C CODE DATA ---
160 DATA 533A9B0[illegible]AD2D0[illegible]68C901D05F68682903AABD2E789D0A78BD32788D2
978[illegible]D07968C9[illegible]D1178
170 DATA 9D27[illegible]D1278BD28784C9679AD27[illegible]D1378AD28788D147868C902D02268688D157
88D[illegible]7868688D167[illegible]D28784C5A7A
180 DATA 68C901D[illegible]A686829038D0B784C587BAAF0056868CAD0FB6068C902D0F268688D2778686
8[illegible]D28786068C902D0E268668D1178
190 DATA 6868[illegible]D12782065[illegible]7B85D4A90085D56068C902D0C968688D117868688D12784CE27BA9008
DC07868C903D0B268688D24786868
200 DATA 8D257868688D23784C0F7DA9018D00784CE778A260A90C9D42032056E4A260A9039D420
3A9289D4403A9789D4503AD0A789D
```

```
210 DATA 4A03A9089D4B032056E4A9578D0002A9798D0102AD300285CBAD310285CCA001A9F091C
BA9F08D0ED4A9008D13788D147860
220 DATA 488A48AD6F02293F8D0C78AD0BD4C90FD0F9AE2978AD0C788D0AD409C08D0AD48D1BD0A
D0C7809408D0AD48D1BD0A0C78CA
230 DATA D0E78D0AD48D1BD068AA684060AD117830FAC950B0F6AD127830F1C960B0ED85CBA9008
5CC05CB26CC06CB26CC06CB26CC06
240 DATA CB26CCA5CB85CDA5CC85CE06CB26CC06CB26CCA5CB1865CD85CBA5CC65CE85CCA5CB186
55885CBA5CC655985CCAD11784AA8
250 DATA 801FA9F08D0D78A90F8D0E78A5C829F08D0F78A5C8290F0A0A0A0A8D10784C2A7AA90F8
D0D78A9F08D0E78A5C829F04A4A4A
260 DATA 4A8D0F78A5C8290F8D1078B1CB2D0D78AD0F788D0F78B1CB2D0E780D0F7891CB9818692
8A8B1CB2D0D78AD10788D1078B1CB
270 DATA 2D0E780D107891CB60A9008D2A788D1E78AD13788D1178AD14788D1278AD157838ED137
8F00BB00D49FF186901A2FF3006A2
280 DATA 001002A2018D17788E1B78AD167838ED1478F00BB00D49FF186901A2FF3006A2001002A
2018D18788E1C78AD1878CD177890
290 DATA 0E48AD17788D18786B8D1778EE2A78AD17780A8D1978AD1878DA8D1A78AD1A7838ED177
88D1D78B003CE1E78AD17788D1F78
300 DATA 209679AD1E783037D005AD1D78F030AD2A78F00EAD1178186D1B788D1178100C300AAD1
278186D1C788D1278AD1D7838ED19
310 DATA 788D1D78B003CE1E7810C630C4AD2A78F00EAD1278186D1C788D1278100C300AAD11781
86D1B788D1178AD1D78186D1A788D
320 DATA 1D789003EE1E78CE1F78109060AE0B78BD36788D2F7A8D497A60AD127885CBA90085CC0
5CB26CC05CB26CC06CB26CC06CB26
330 DATA CCA5CB85CDA5CC85CED6CB26CC06CB26CCA5CB1865CD85CBA5CC65CE85CCA5CB1865588
5CBA5CC655985CCAD11784AA8B019
340 DATA B1CB29F08D0D7898186928A8B1CB29F04A4A4A4A186D0D7860B1CB290F0A0A0A0A8D0D7
89318692 8A8B1CB290F186D0D7860
350 DATA 60AD117830FAC950B0F6AD127830F1C960B0EDAD11788DC17EAD12788D117FA9018D097
920657BBD2678CE097810O160AE09
360 DATA 78BDC17E8D1178BD117F8D127820967 9AD11788D2078EE1178AD1178C950100E20A87BC
D2678D00620E8794C297CAE1178CA
370 DATA 8E2878AD20788D1178CE1178300E20A87BCD2678D00620E8794C4E7CAE1178E88E2178C
E12783049AD02788D117820657BAD
380 DATA 1178CD2178303820A87BCD2678D02ACE1178AD1178CD2178300820A87BCD2678F0EDAE0
978AC1178C8989DC17EAD12789D11
390 DATA 7FEF09784C767CCE11784C767CEF1278EE1278AD1278C960F049AD22788D117820657BA
D1178CD2178C03820A87BCD2678D0
400 DATA 2ACE1178AD1178CD2178300820657BCD2678F0EDAE0978AC1178C8989DC17EAD12789D1
17FEE09784C767CCE11784CCC7C4C
410 DATA 0B7CA9008D01788D037 8AD23788D0278A90138ED23788D0578A900E9008D06780E05782
E0678AD078D0D620387E4C417D20
420 DATA 777EAD0278CDD3783011F00FAD0678300BD043AD0578D03E4CDD760AD05780A9D0778A
D06782A8D0878AD02780A186D0778
430 DATA 8D07789003EE0878AD077838E9018D0778B003CE0878AD0878303BD04FAD0778F034D04
8AD05780A8D0778AD06782A8D0878
440 DATA AD01780A8D0478AD077818ED04788D0778B003CE0878AD0878301FD054AD0778F018D04
DFE0178AD01780A386D05788D0578
450 DATA 9003EE06784C337DEE0178CE0278AD01780A386D05788D05789003EE0678AD02780A8D0
478AD057838ED04788D0578B003CE
460 DATA 0678EF0578D003EE06784C337DCE0278AD02780A8D0478AD057838ED0478 D0578B003C
E0678EE0578D003EE06784C337DAD
470 DATA 2478186D01788D1178AD2578136D02788D1278209679AD257839ED02788D1278209679A
D247838ED01788D1178209679AD25
480 DATA 78186D02788D127820957960AD01780A8D1F78AD2578439ED02783D1278 D147869136
D02788D1678AD247838ED01788D11
490 DATA 78209679AD1F78F01AEE1178AD14788D1278209679AD15788D1278209679CE1F78D0E6
0000000000000000000000000000
500 REM --- READ M/C DATA ---
510 TRAP 620
520 ? :? "INSTALLING GTIA+ GRAPHICS ROUTINES"
530 DATA 0,1,2,3,4,5,6,7,8,9,0,0,0,0,0,0,0,10,11,12,13,14,15
540 DIM HEX(22),CODE$(100)
550 RESTORE 530:FOR I=0 TO 22:READ J:HEX(I)=J:NEXT I
560 CHKSM=0:ADDR=30763:RESTORE 160
570 FOR I=1 TO 34:READ CODE$
580 FOR J=0 TO 49:BYTE=16*HEX(ASC(CODE$(2*J+1))-48)+HEX(ASC(CODE$(2*J+2))-48)
590 CHKSM=CHKSM+BYTE:POKE ADDR+J,BYTE
600 NEXT J:ADDR=ADDR+50:NEXT I
610 IF CHKSM=177693 THEN 630
620 ? :? "ERROR IN DATA STATEMENTS":STOP
630 TRAP 65535
640 REM --- ROUTINE LABELS ---
```

```
650 LET GRAPHICS=30778
660 LET PLOT=30803
670 LET DRAWTO=30827
680 MODE=30863
690 MOVE=30887
700 LET LOCATE=30903
710 FILL=30928
720 CIRCLE=30946
730 DISC=30974
740 REM --- PARAMETER LABELS ---
750 REM --- GRAPHICS OPTIONS ---
760 FULLCLR=0:SPLITCLR=1
770 FULLNOCLR=2:SPLITNOCLR=3
780 REM --- MODE OPTIONS ---
790 NORMAL=0:ANDMODE=1
800 ORMODE=2:XOR=3
810 REM --- DEMO PROGRAM ---
820 DIM T$(40)
830 FOR DEMO=1 TO 7
840 ON DEMO GOSUB 860,960,1020,1080,1250,1370,1500
850 NEXT DEMO:GOTO 830
860 T$="GTIA+ GRAPHICS":GOSUB 1540
870 CALL=USR(GRAPHICS,FULLCLR)
880 FOR X=0 TO 79
890 COLOR X
900 CALL=USR(MOVE,0,0)
910 CALL=USR(DRAWTO,X,95)
920 COLOR 80+X
930 CALL=USR(MOVE,79,95)
940 CALL=USR(DRAWTO,79-X,0)
950 NEXT X:GOSUB 1600:RETURN
960 T$="CIRCLES":GOSUB 1540
970 CALL=USR(GRAPHICS,FULLCLR)
980 FOR X=0 TO 63
990 COLOR 32+X
1000 CALL=USR(CIRCLE,X,X,X)
1010 NEXT X:GOSUB 1600:RETURN
1020 T$="DISCS":GOSUB 1540
1030 CALL=USR(GRAPHICS,FULLCLR)
1040 FOR X=0 TO 5
1050 COLOR 42+14*X
1060 CALL=USR(DISC,39+4*X,47,30-5*X)
1070 NEXT X:GOSUB 1600:RETURN
1080 T$="AREA FILLS":GOSUB 1540
1090 CALL=USR(GRAPHICS,FULLCLR)
1100 COLOR 15
1110 X=5:Y=8:SIZE=69
1120 CALL=USR(MOVE,X,Y)
1130 FOR I=1 TO 7
1140 CALL=USR(DRAWTO,X,Y+SIZE)
1150 CALL=USR(DRAWTO,X+SIZE,Y+SIZE)
1160 CALL=USR(DRAWTO,X+SIZE,Y+5)
1170 CALL=USR(DRAWTO,X+5,Y+5)
1180 X=X+5:Y=Y+5:SIZE=SIZE-10:NEXT I
1190 COLOR 136
1200 CALL=USR(FILL,39,95)
1210 COLOR 0
```

Screen Mover

by Kevin Riordan

MICROTEX 666

This program is available electronically through Microtex 666's software downloading service. It is accessed through Viatel page *66637#.

This Commodore 64 utility uses a Basic loader program to instal a machine language screen handler. It copies data from a designated memory location onto the default 64 screen. Full instructions are included in the listing.

```
1000 REM ************************************************************
1001 REM *                                                          *
1002 REM *                      SCREEN MOVER                        *
1003 REM *                                                          *
1004 REM *              A COMMODORE 64 BASIC UTILITY                *
1005 REM *                                                          *
1006 REM *                    (KEVIN RIORDAN 1986)                  *
1007 REM *                                                          *
1008 REM ************************************************************
1009 :
1010 REM  THIS PROGRAM ADDS A COMMAND - 'PUTSCR' - TO BASIC IN ORDER TO ENABLE
1011 REM   YOU TO COPY INFORMATION IN A FLASH FROM A DESIGNATED MEMORY AREA TO
1012 REM   THE DEFAULT TEXT SCREEN.  ENTER LINES 2000-2053  BELOW AND RUN THEM
1013 REM   WITH YOUR DISK DRIVE (DEVICE 8) ENGAGED; THEY WILL CREATE A MACHINE
1014 REM   CODE FILE CALLED 'PUTSCR' ON YOUR DISK,  WHICH YOU MAY LOAD AT ANY
1015 REM   TIME WITH THE USUAL ',8,1' EXTENSION.
1016 :
1017 REM  THE  'PUTSCR'  COMMAND IS ENGAGED  BY A 'SYS 828' STATEMENT  IN YOUR
1018 REM   HOST PROGRAM.  THIS STATEMENT CAN ALSO BE ENTERED IN DIRECT MODE IF
1019 REM   YOU WISH.  HOWEVER, BEFORE YOU ISSUE THE 'PUTSCR' COMMAND, YOU MUST
1020 REM   FIRST  DECLARE  THE VARIABLE  SC  TO POINT TO THE FIRST SYTE OF THE
1021 REM   DATA BLOCK YOU WISH TO TRANSFER TO THE SCREEN.
1022 :
1023 REM  NOTE THAT  THE VARIABLE SC MUST BE REAL (I.E. NOT AN INTEGER) AND IT
1024 REM   MUST BE DECLARED  BEFORE 'PUTSCR' IS USED.   FAILURE TO COMPLY WITH
1025 REM   THIS SYNTAX WILL CRASH YOUR MACHINE.
1026 :
1027 REM  NOTE ALSO  THAT THE DATA WHICH IS TO BE TRANSFERRED TO THE SCREEN IS
1028 REM   NOT  ORDINARY  ASCII  INFORMATION  BUT RATHER  SHOULD BE ENCODED AS
1029 REM   SCREEN 'POKE' CODES  (SEE THE APPENDICES  TO THE  C64  PROGRAMMERS'
1030 REM   REFERENCE  GUIDE FOR  THE APPROPRIATE  TABLE OF CODES).   SINCE THE
1031 REM   ROUTINE IS A STRAIGHT DATA TRANSFER AND DOES NOT EMPLOY ANY PART OF
1032 REM   THE COMMODORE'S PRINT HANDLERS, IT HAS NO EFFECT ON THE POSITION OF
1033 REM   THE CURSOR.
1034 :
1035 REM  LINES  3000-3005  BELOW PROVIDE  A SAMPLE PROGRAM  TO ILLUSTRATE HOW
1036 REM   THE ROUTINE CAN BE UTILISED.  IF YOU RUN THIS SECTION, YOU WILL SEE
1037 REM   THE SCREEN FILLED WITH THE CHARACTER 'B' AFTER A SHORT HIATUS WHILE
1038 REM   THE AREA 49152-50151 IS BEING LOADED WITH THE TRANSFERABLE DATA.
1039 :
2000 OPEN2,8,2,"-PUTSCR,P,W"
2001 PRINT#2,CHR$(50)CHR$(3)
2002 FORX=828TO924:D=0:READ#
2003 FORY=1TO5:A=ASC(MID$(#$,Y,1))-48
2004 D=16*D+A+7*(A>9):NEXT:PRINT#2,CHR$(D);:NEXT
2005 CLOSE2:END
2006 :
2007 DATA9,4D    :REM       LDA #$4D        ;INSTALL PUTSCR COMMAND
2008 DATA8D,08,03:REM       STA $0308
2009 DATA9,03    :REM       LDA #$03
2010 DATA8D,09,03:REM       STA $0309
2011 DATA60      :REM       RTS
2012 :
2013 DATA50,55,54:REM       .BYT 'PUTSCR'   ;COMMAND TEXT
2014 DATA53,43,52:REM
2015 :
2016 DATA20,73,00:REM       JSR $0073       ;FETCH NEXT BASIC CHARACTER
2017 DATA00,05   :REM       LDY #$05        ;COUNT FOR 6 CHARACTERS
2018 DATA81,7A   :REM TEST  CMP ($7A),Y     ;TEST FOR PRESENCE OF PUTSCR IN
2019 DATA09,47,03:REM       CMP $0347,Y     ;COMMAND LINE
2020 DATAF0,06   :REM       BEQ TEST2
2021 DATA20,79,00:REM       JSR $0079       ;IF NOT FOUND, EXIT TO BASIC
2022 DATA4C,E7,A7:REM       JMP $A7E7
2023 DATA88      :REM TEST2 DEY
2024 DATA10,F0   :REM       BPL TEST        ;IF THIS FAILS, WE'VE FOUND IT!
2025 DATA20,F6,A8:REM       JSR $A8F6       ;GET BASIC FIND NEXT STATEMENT
2026 DATAA9,00   :REM       LDA #$00        ;POINT $F6,FC AT DEFAULT TEXT SCREEN
2027 DATA85,FB   :REM       STA $FB
2028 DATAAD,88,02:REM       LDA $0288
2029 DATA85,FC   :REM       STA $FC
2030 DATAA9,53   :REM       LDA 'S'         ;MAKE A NOTE THAT THE VARIABLE WE'RE
2031 DATA85,45   :REM       STA $45         ;LOOKING FOR IS CALLED 'SC'
2032 DATAA9,43   :REM       LDA 'C'
2033 DATA85,46   :REM       STA $46
2034 DATA20,E7,B0:REM       JSR $B0E7       ;FIND THE VARIABLE IN MEMORY
2035 DATA20,A2,B8:REM       JSR $B8A2       ;PASS ITS VALUE TO FP ACCUMULATOR
2036 DATA20,F7,B7:REM       JSR $B7F7       ;INTEGER 0-65535 -> $14,15
2038 DATAA2,03   :REM       LDX #$03        ;COUNT FOR 768 BYTES
```

```
2039 DATAA0,00   :REM        LDY #$00
2040 DATAB1,14   :REM TFER   LDA ($14),Y     ;TRANSFER A BYTE
2041 DATA91,FB   :REM        STA ($FB),Y
2042 DATAC8      :REM        INY              ;NEXT BYTE
2043 DATAD0,F9   :REM        BNE TFER
2044 DATAE6,15   :REM        INC $15          ;NEXT PAGE
2045 DATAE6,FC   :REM        INC $FC
2046 DATACA      :REM        DEX              ;ONE LESS PAGE
2047 DATAD0,F2   :REM        BNE TFER
2048 DATA91,FB   :REM        STA ($FB),Y
2050 DATAC8      :REM        INY
2051 DATAC0,E8   :REM        CPY #$E8
2052 DATA90,F7   :REM        BCC TFER2
2053 DATA4C,AE,A7:REM        JMP $A7AE        ;AND EXIT TO BASIC
2054 '
3000 REM  DEMONSTRATION PROGRAM
3001 IFA=0THENA=1:LOAD"PUTSCR",8,1
3002 SYS828:FORY=49152TO50151:POKEY,2:NEXT
3003 SC=49152:PUTSCR
3004 GETA$:IFA$=""THEN3004
3005 END
READY.
```


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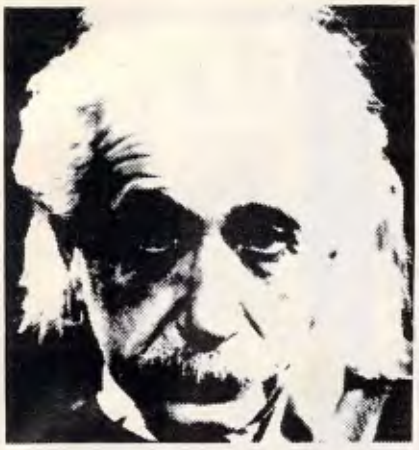

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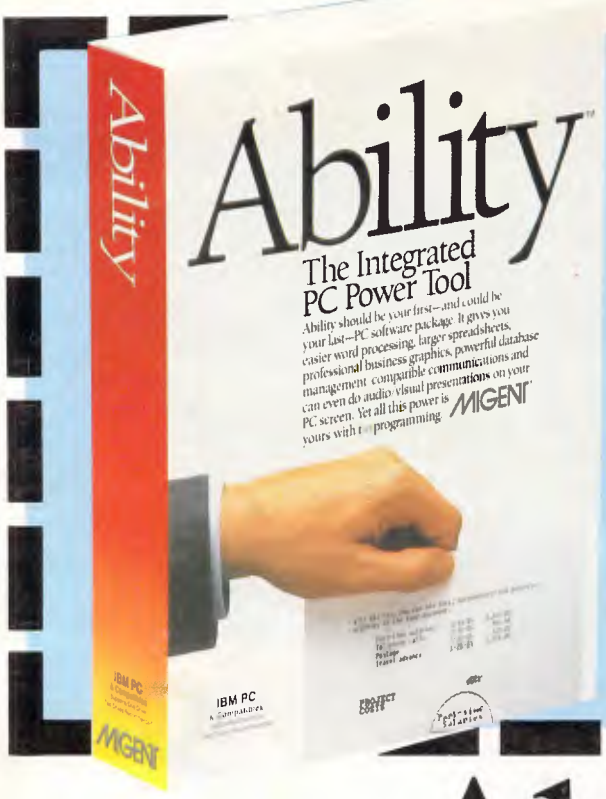

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