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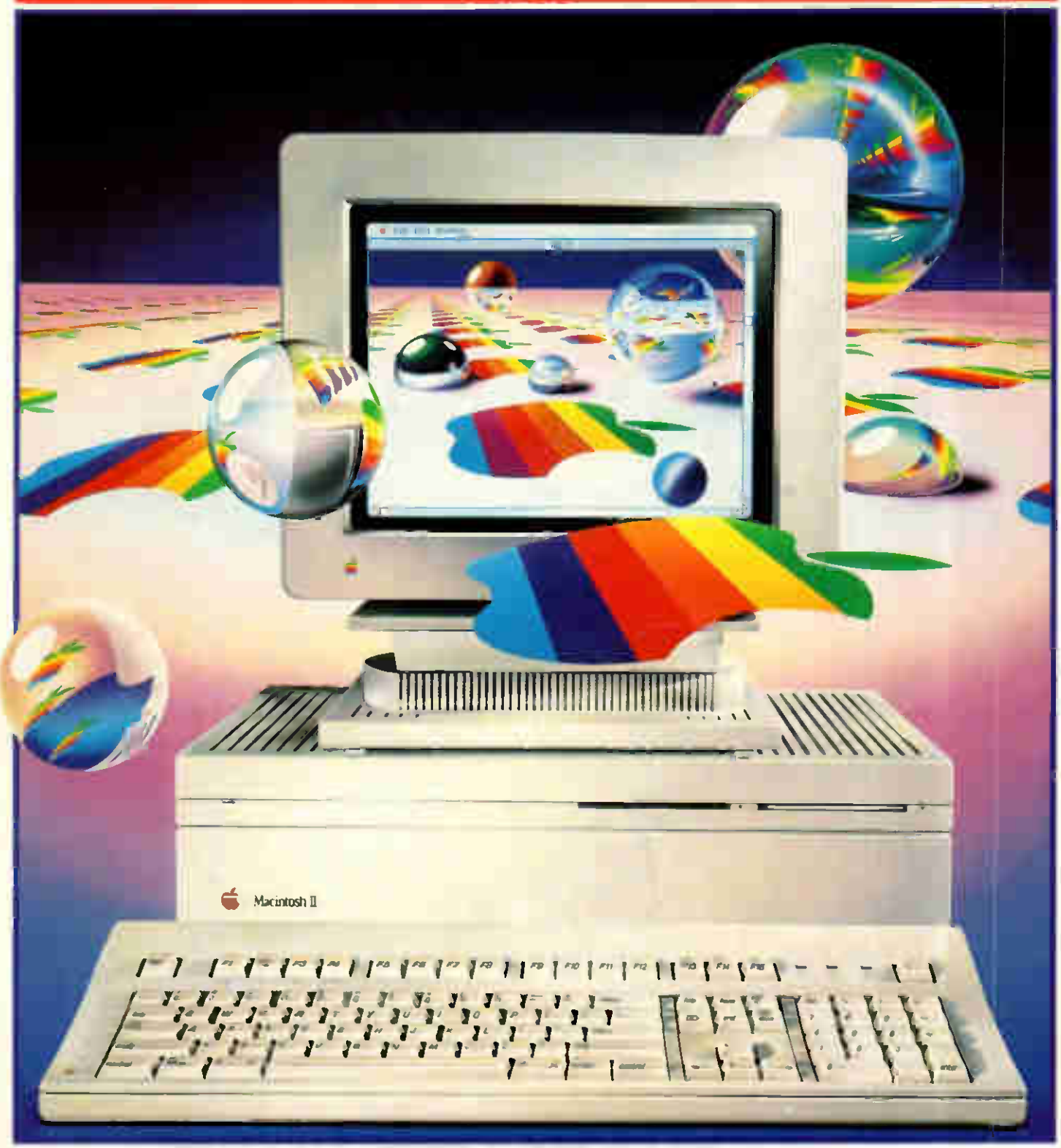

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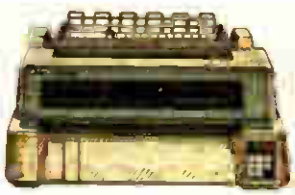

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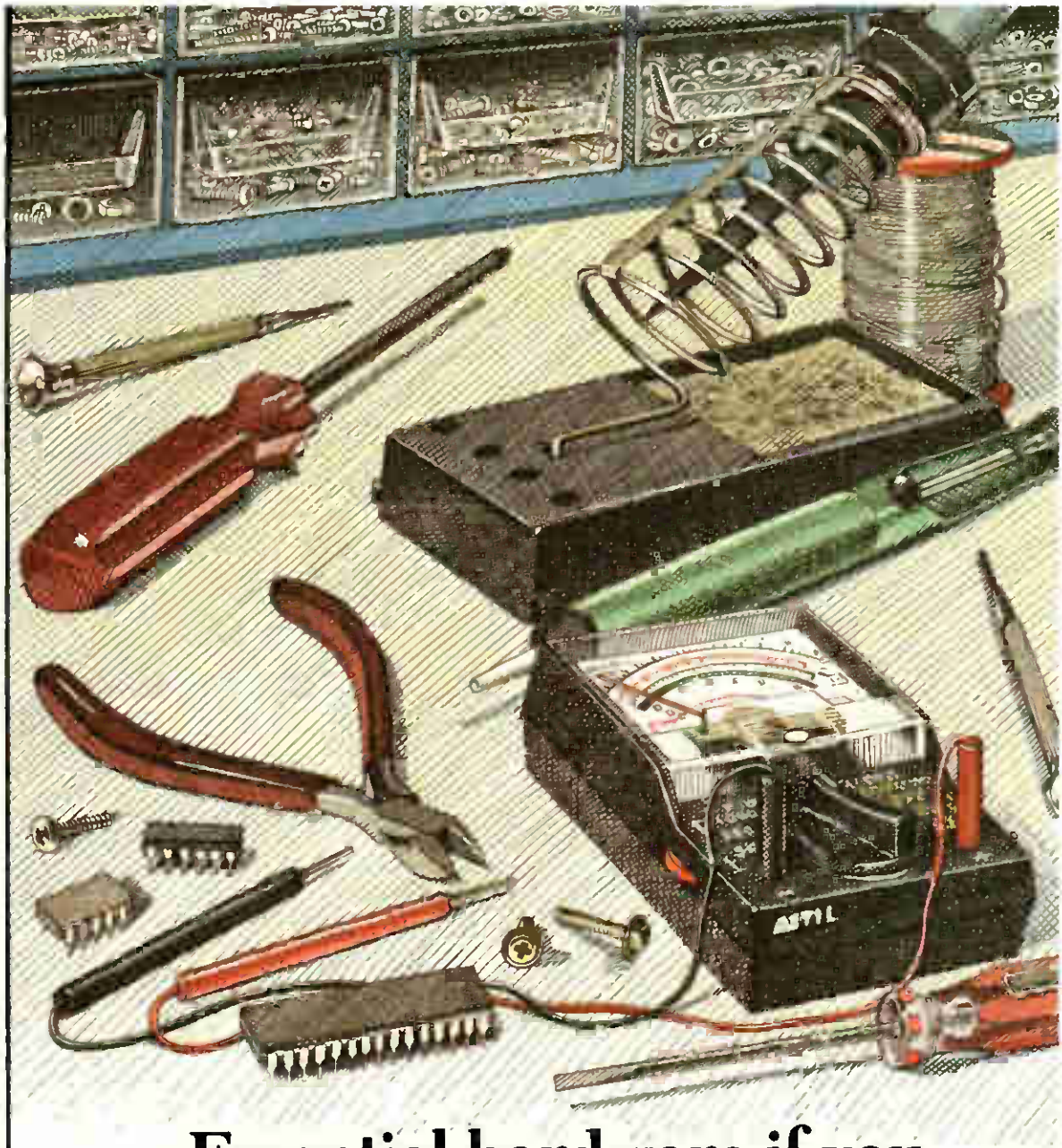

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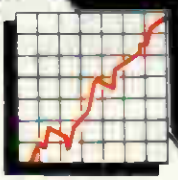

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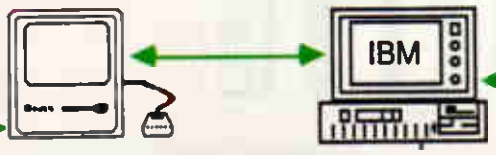

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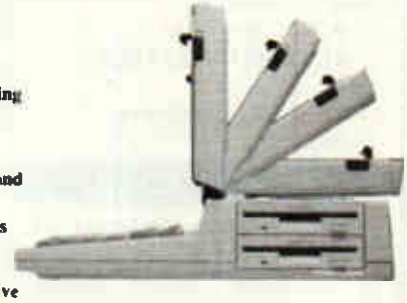

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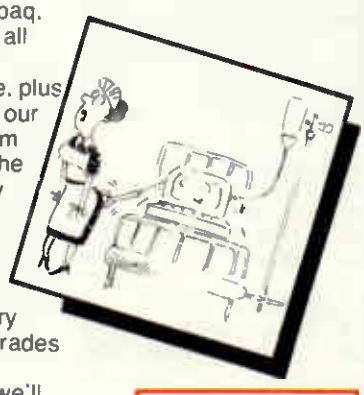

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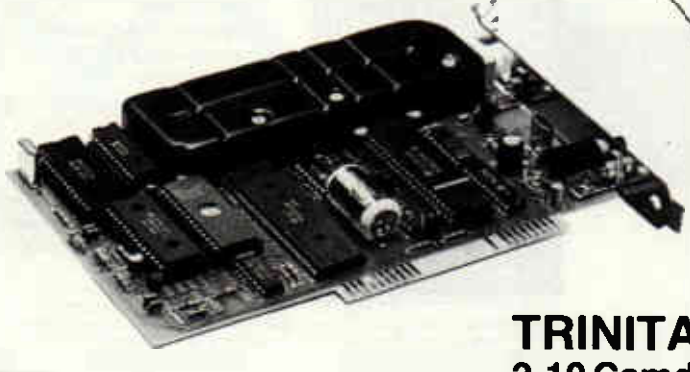

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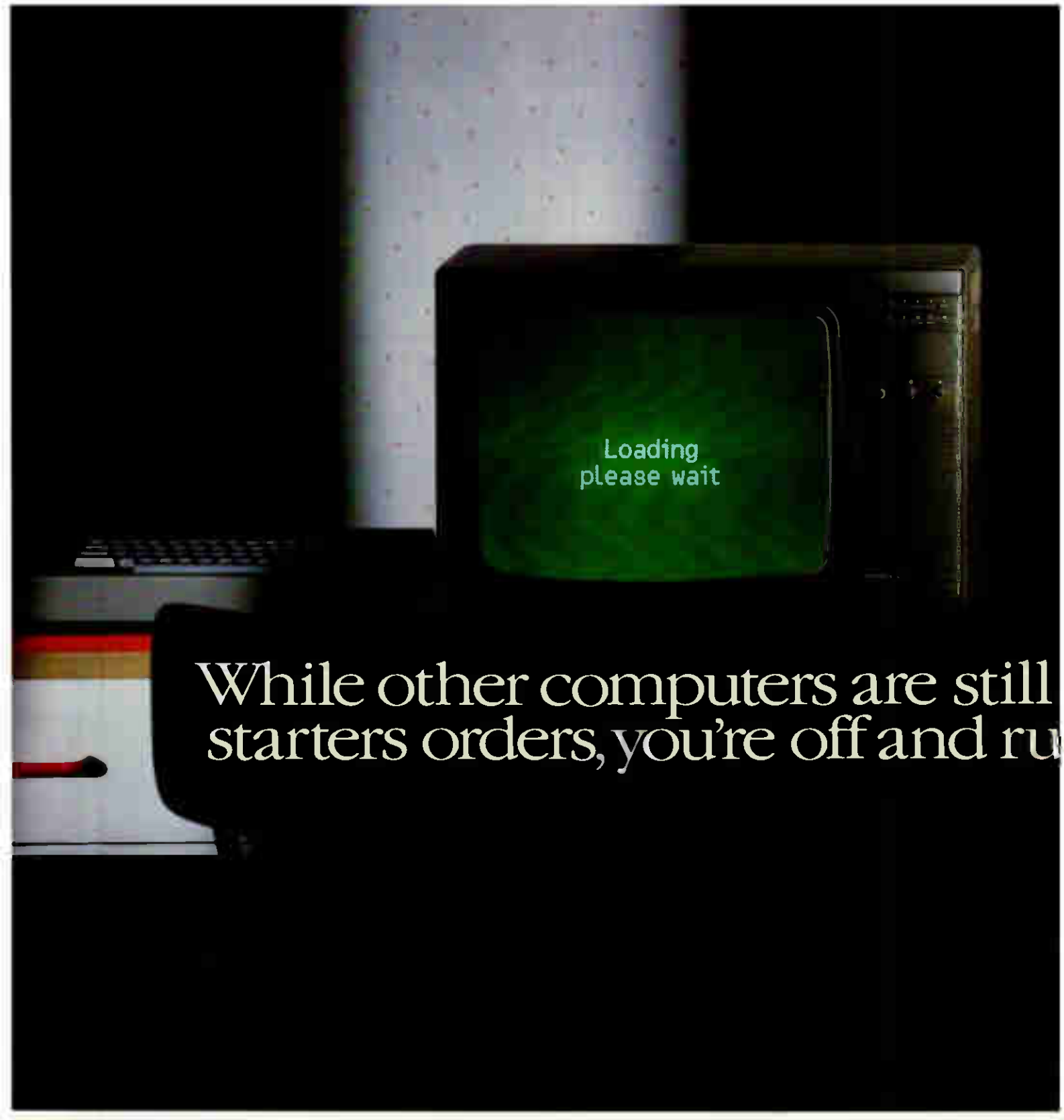

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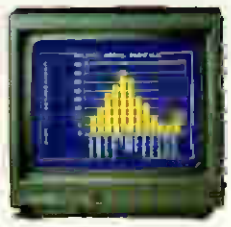

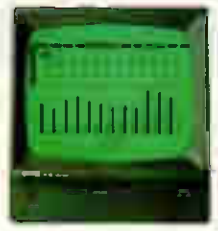

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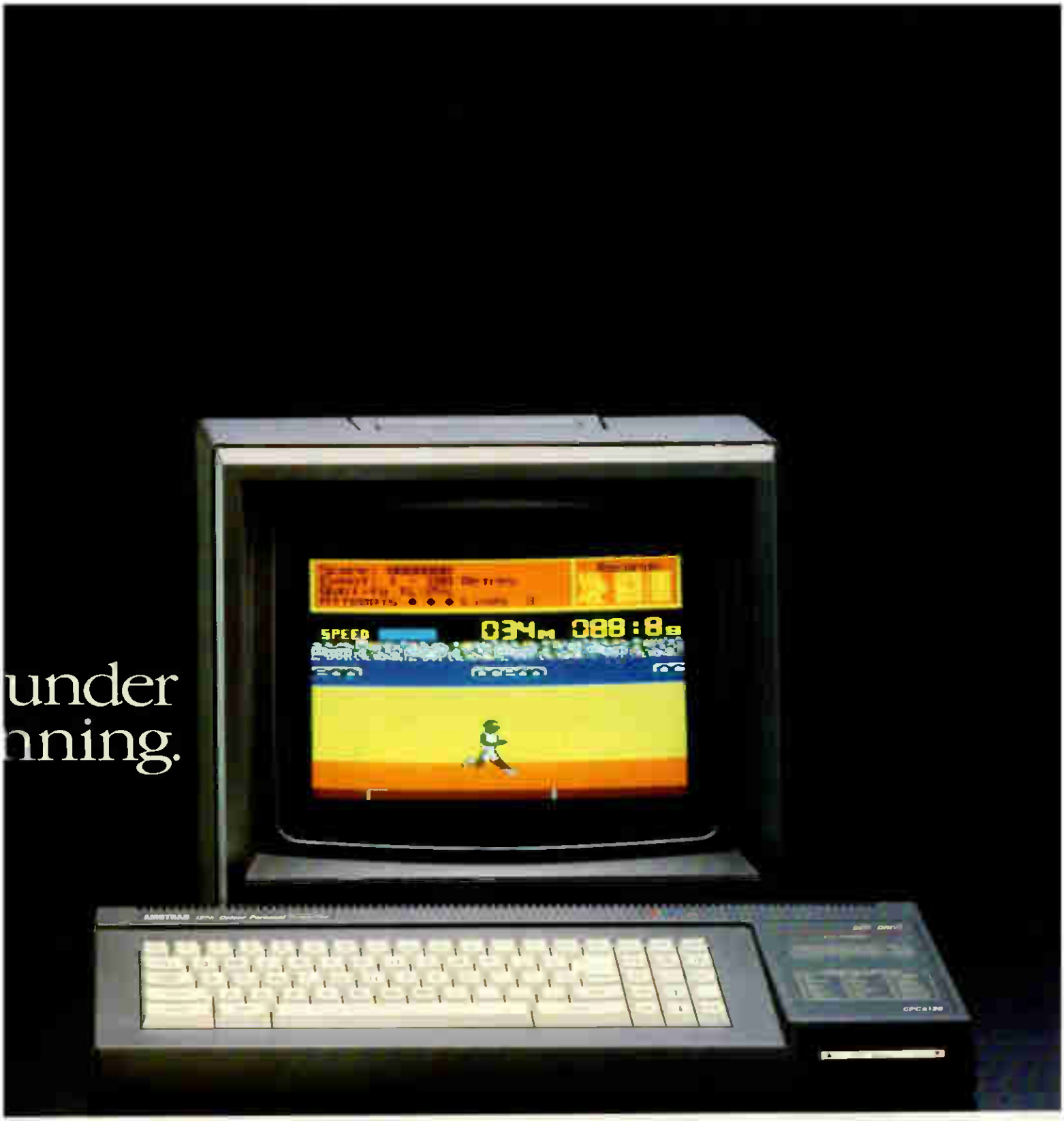

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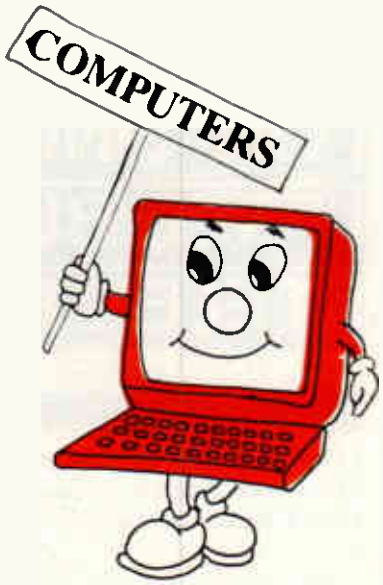

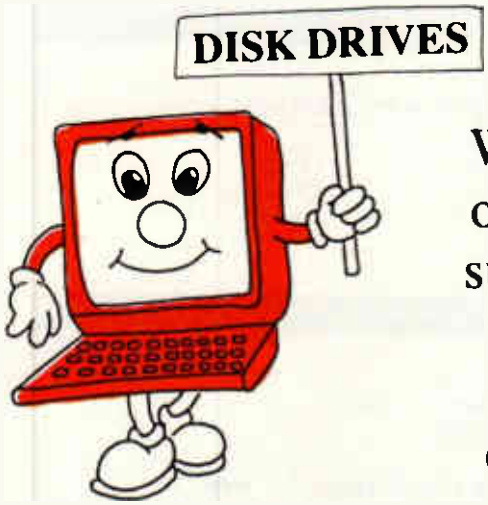

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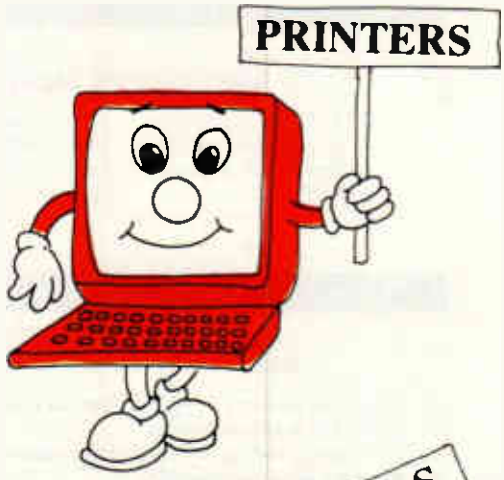

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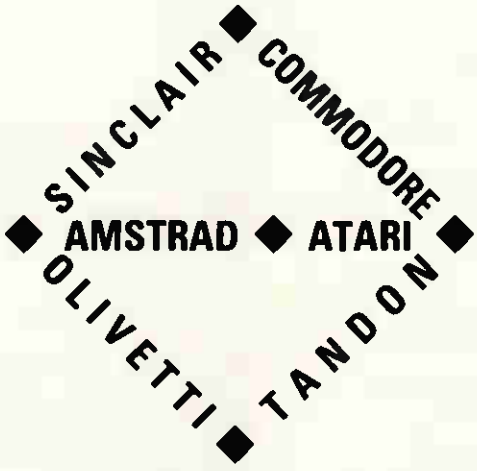

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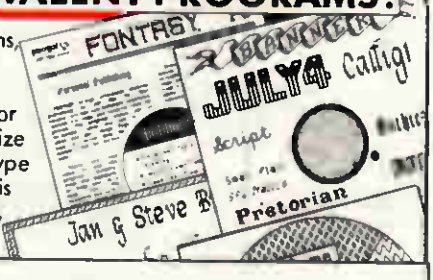

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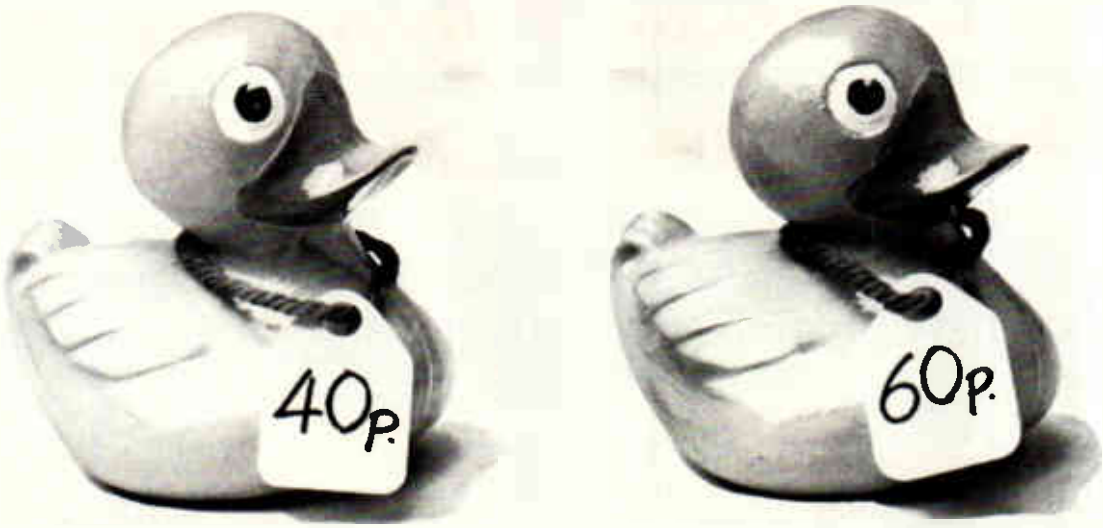

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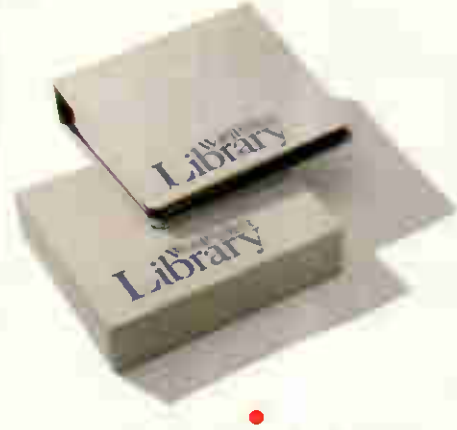

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PCW SHOW FOCUS

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The 1987 PCW Show celebrates its tenth anniversary this year and the product line-up is already beginning to look impressive. Here's a preview of some of the attractions and special events.

Record demand for space

Independently audited attendance figures for last year's PCW Show put the total number of visitors at 66,070, with a massive 47,528 from business, the professions and the trade.

The only other event bearing serious comparison on the business side is the Which Computer? Show with its 1986 figure of 42,870 visitors.

'With events like the PC User Show and Compec reporting audiences of around 18,000 and 24,000 respectively, it's not surprising that demand for space at this September's PCW Show is way ahead of last year,' said Mike Blackman, PCW Show project manager.

In both the business only Olympia 2 hall and the general area, the show's organisers have added more display areas for exhibitors at the event's tenth anniversary edition. 'What's particularly influencing companies at the moment is not just the size and quality of our business user audience. It's the fact that they can't get to them anywhere else,' said Mike Blackman.

According to last year's attendance audit, over 90 per cent of PCW Show business visitors did not visit Which Computer? Even in London, the competing PC User Show and Compec events could only attract 15 per cent and 10 per cent of PCW Show visitors respectively. Of the entire PCW Show audience, 80 per cent did not attend any other major computing event.

PCW Show '87 is again sponsored by *Personal Computer World*. An additional first-time sponsor is *PC Week*.

This year marks the tenth anniversary of the PCW Show. Shown here is the National Hall which provides general coverage across all sections of personal computing leisure, business and education

Look-out: Atari's back!

Spurred on by the success of last year's 'World of Atari' shared with software and hardware suppliers, Atari plans to repeat the exercise. This year, the company plans to field the entire range of products, from video consoles up to STs and Mega STs — plus the first public viewing of a new PC to be announced in April. Despite having its own dedicated exhibition in the Atari Computer Show, Atari still finds it worthwhile coming to the PCW Show.

'The PCW Show attracts a different type of visitor because it is much more geared to business. The Atari Computer Show is mainly for enthusiasts,' explained a spokesman for Atari.

Few of the suppliers who took satellite stands last year within the World of Atari would disagree with that, and about 30 have already signed up for 1987. They include Systematics, Red Rat Software, Computer Concepts and Robtek.

Red Rat Software, a Manchester company specialising in entertainment packages, was particularly successful at last year's Show.

Red Rat plans to use this year's Show as a showcase for winter products, including some for the Atari ST. Among the packages on display will be the Big Nose Software range, which was launched to advance orders last year but never reached customers because the original distributor went into liquidation.

Emphasis on business for 1987

Unlike most microcomputer shows, PCW attracts a heavyweight business audience, from corporate users down to small, one-man operations. Over 19 per cent of them were on the board within their organisations and 25 per cent within DP management, indicating the type of decision-makers the PCW Show attracts.

The importance of the show is reflected by the big names of the industry who come back every year, such as Olivetti, Victor, Research Machines, Psion, Philips, Comart and the Spectrum Group. In true competitive spirit, few are prepared to talk about their plans in advance, although Spectrum Group and Olivetti are expected to be unveiling at least one new product each.

A newcomer to the Business Hall this year is Sagesoft, which has moved across from the general area to be better aligned with its current target audience. A company spokesman said that market research has shown that there are over one million small businesses on the borderline between home and business in the UK and only about 30 per cent are computerised, so Sagesoft is after the remaining 700,000.

'Last year was our first time at PCW and it was very successful — there was immense interest in the Businesswise range for the Amstrad PC1512 that we launched at the show,' said David Goldman, managing director of Sagesoft. 'This year, we're aiming for the multi-user market. In fact one of the things that took us into it was the Comart Quad which was also launched at PCW. We shall be introducing new products for the Quad and for other multi-user systems this year.'

Sagesoft's move is well-timed because research shows that 76 per cent of last year's visitors came especially to see software and 20 per cent to evaluate complete business systems. The next highest percentage, 51 per cent, were especially interested in PCs, so this year's visitors should find plenty to interest them in the new generation of 386 machines due to make their entry in 1987.

No time to relax

Leisure will be all around at this year's show, for those with the time to enjoy it. The UK's top 20 names in entertainment software have earmarked their space, but their employees will have little time to relax — except with a foreigner. They will probably be on the look-out for overseas distributors, who regard PCW as a showcase.

Games software house, Elite, is returning in search of more overseas contacts. The company is setting up a US operation later this year.

Inside Information

For details of PCW Show '87, contact Mike Blackman and the PCW Show team on (01) 486 1951 or (01) 487 5831 or write to PCW Show, 11 Manchester Square, London W1M 5AB. END

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PC-lookalike prices fall as IBM waits to strike with new machines, and Sir Clive Sinclair's old habits die hard. Guy Kewney's news reveals all.

Prices drop as IBM lurks — new hardware possible

Zenith and Olivetti have cut the prices of their PC lookalikes. In the case of Olivetti, the drop is the second in a month.

The drops aren't terrifying in themselves. What makes them interesting is the motivation — which is not just the arrival of cheap Amstrads, but also the imminent announcement of lots and lots of new hardware, possibly even by IBM.

There isn't much question that IBM will announce something: what people are putting bets on is what, and when.

If Zenith and Olivetti are betting on an 80386 machine, however, they may be disappointed. Out of the confusion which is IBM today, quite conceivably an 80386 machine could appear, with the other two models due. But if the folks at IBM have their heads straight, they'll wait.

At press time, the smart money was shifting to 2 April (some said the 7th) for a big IBM launch, in the States at least, of two machines. And some were arguing that the third machine would appear, based on this super-chip 80386.

I say 'smart money', but in fact only a fool bets money on what IBM will do in the future. It can change its mind the day before a scheduled announcement.

Well, some of the details have already been printed in this column before. The low-end machine, known as 'Entry' over here, is the machine which IBM hopes to sell to students, at $1500.

This is a ridiculously high price unless the company plans to give an automatic 50 per cent discount.

The other machine will be based on the 80286, and is a replacement for the strange XT286 which appeared 'quite by coincidence, I can assure you, Guy' on the same day that Amstrad announced its PC1512 in September.

I have no real details of this machine except that it will use DOS 5 and have Microsoft Windows as an option. It will also mark the burial mound of the standard PC XT, based on the 8088 chip. And, say my sources, it will be prettier than existing IBMs, smaller, more ergonomic, and more like a Macintosh.

People who have seen it say that it has an enhanced EGA display, the details of which are known to competitors with one exception — where it sits in memory.

With Zenith and Olivetti dropping prices, the assumption must be that they expect to have to ship extra machines before IBM launches.

Zenith has been dropping more and more hints about its machines, suggesting that it has an advanced DOS which will work with the 80386 for the machine which it will ship in May.

My information suggests that this is half right.

It seems more likely that Zenith will have DOS 5, not Advanced DOS 1.0. That works fine with an 80286, but doesn't take advantage of the amazing abilities of the 80386 for multiple program control.

DOS 6 is probably advanced DOS 1.0, and that needs an 80386 chip. But IBM has that system under contract, and no-one else can have it until IBM releases it.

The new prices, anyway: they take the lowest M24 machine with a single diskette and 640k, down to £1777. Not a big jump.

Amstrad's television advertisement, which apparently cost £20,000 to shoot, involved carefully measuring the right amount of an Olivetti M24 and cutting it off. Presumably the agency will press for a remake . . .

Compaq publicly launched its latest portable, the Compaq Portable III, on the first day of the Which Computer? Show. The launch was timed to occur simultaneously in twelve countries around the world, in keeping with Compaq's showmanship style. But despite all this organisation, the British journalists managed to mess up the launch by holding a work stoppage that afternoon in support of Duncan Campbell. This meant that we were all ushered inside a carefully guarded section of the Compaq stand for a preview half an hour before the worldwide launch.

The stand itself looked like a bandstand with sinister black shutters. Inside it felt like a garage, and the machines could only just be made out through the murk. Only close scrutiny revealed the following details.

The Portable III, previously rumoured to be an 80386-based portable, turned out to be Compaq's smallest, lightest and fastest to date but was not the lapheld many expected. The Portable III uses an 80286 at 12MHz, in line with the current trend for high-speed PC/XT compatibles. The machine looks a bit like a small sewing machine or a large toaster when packed up. The full-size keyboard unclips from the front to reveal a neat plasma display. This lifts up and swivels so that it can be placed in a good position for reading — very weird-looking but practical.

The standard model of the Portable III, the Model 20, comes with 640k of RAM, a high-performance 20Mbyte hard disk, a 1.2Mbyte 5¼in floppy, and serial, parallel and RGB interfaces. This model weighs a perfectly reasonable 20lbs and will cost £3950.

Two other models are available with slight variations. All machines can be expanded by adding a plug-on expansion unit with two slots for plug-in cards. The expansion box makes the whole machine look rather like it is carrying some sort of Compaq ultra-compact in a babysling.

Compaq admits that the new machine is aimed at restoring its 'sanctified' Number One spot in the portable market, which has recently been under pressure from several other manufacturers — notably Toshiba with the T1100 Plus and T3100, and Zenith with the recently introduced Z181.

Compaq is on (01) 940 8860.

Owen Linderholm

Interest in Sinclair

The Cambridge Computer Z88 duly arrived at its Which Computer? Show stand, and we were able to see the machine running very nearly as it was designed to run.

There will be changes, most insignificant, before it starts appearing on doormats around the country. Most of them arise because so much of the software was tested on a video screen, not the liquid crystal display.

On the video screen, for example, things flickered and distracted the eye.

The 'map' of the screen, showing one dot for every character typed, was updated a long time after you stopped typing because it was felt that it would be an irritation if it was constantly being changed.

In fact, on the LCD, the map is so unobtrusive that it might as well be updated every chance the system gets.

Also, the map shows the whole page. It turns out that, when you are typing and have just reached the bottom of page one, you don't suddenly want to see an empty page two. What you want is half of each.

What is going to attract most controversy, I suspect, is not the display but the keyboard.

Readers take note!

Twelve months ago we asked readers of *PCW* to tell us what they liked and disliked about the magazine's contents. The thousands of responses we received have helped us make *Personal Computer World* better reflect what you want out of Britain's biggest microcomputer magazine.

But a lot happens in a year in the fast-moving computer industry and once again we are offering you the chance to influence what appears on these pages.

As if the opportunity to give us a piece of your mind about *PCW* wasn't enough, we're offering you two extra incentives.

Last year we paid 10p to charity for every questionnaire filled in and returned. Five charities working to relieve the Ethiopian famine crisis received extra financial help, thanks to those readers who sent in their forms.

This year we are going one better. In addition to paying our 10ps to charity we are giving you the chance to win one of six valuable prizes.

We've made entering to win the prizes as easy as possible. Just turn to page 89, put your ticks in the relevant boxes (including answering the all-important questions about your favourite charity and the prize you'd like to win) and post the questionnaire back to us. We'll even pay the postage.

The prizes

From Psion there is an Organiser II. This miniature battery-powered computer comes with its own programming language, non-volatile storage, and is invaluable for any number of tasks from databases to electronic diary and phone book to portable comms terminal. If it's good enough for Marks & Spencer . . .

How would you like your pick of any four of the legendary Infocom adventure games? You could choose from the original Zork through to the latest salacious Leather Goddesses of Phobos, maybe stopping on the way for Suspended and Hitch-Hiker's Guide to the Galaxy. The choice will be yours. And, being text-based, Infocom games are available to run on a very wide range of machines.

Could 1987 be the year when you finally get into communications? To help you take the plunge we're offering as a prize a Miracle Technologies WS2000 modem. A manual modem that is very simple to use, the WS2000 operates at 300/300 and 1200/75 baud as well as 75/1200 for those wanting to set up their own bulletin boards. The unit will work with any computer with a standard serial port and comms software.

Borland's languages and utilities have become classics, with its Turbo Prolog even outselling Lotus 1-2-3. You could win any two Borland products. If you have a PC-compatible you could finally get round to owning a copy of SideKick or Reflex or the check-as-you-type spelling checker Turbo Lightning. Maybe you fancy following our Teach Yourself Prolog course. Then Turbo Prolog could be one of your choices. And there is also the best-selling Turbo Pascal which will run on CP/M machines such as the Amstrad PCW and CPC series, the BBC Master 512 as well as MS-DOS machines. [CP/M and MS-DOS]

Words and Figures is a new Lotus 1-2-3 compatible spreadsheet with integrated word processor from Lifetree. With it you can do your accounts, prepare budgets, or just play around with numbers. Spreadsheets can be viewed and scrolled through a window in the text document before incorporating them in documents. [MS-DOS only]

Also from Lifetree is Volkswriter 3 — a word processor with a long pedigree and features such as a large spelling checker, a maths facility to do calculations within a document, stylesheets, and support for over 400 printers.

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NEWSPRINT

If ever I heard someone making a virtue of necessity, it was the design team explaining that rubber keyboard. Someone who obviously didn't like it described it as 'Spectrum-like'. That's not a good description, but it does describe the feel of the rubber slab better than anything else I could think of.

Naturally, the rubber slab is there because it is the cheapest sort of keyboard Cambridge Computer could build.

But Sinclair himself has an answer: 'It's there because it is very important that it is quiet.'

Perhaps the most surprising (or not at all surprising) moment at the official launch of the Z88 was when Sir Clive was asked about his mail-order campaign. He was asked by one attendee with a long memory, what would happen to the cheques sent in between the start of the mail-order campaign in March and the claimed delivery date of machines in April.

'Oh, I'll put them in the bank,' announced Sir Clive with not a hint of embarrassment.

If you want to get an early position in the queue for a Z88, do send your money in. But don't complain about Clive amassing the interest and what will still be your money.

The soft advantage

What do traditional lapheld machines (Tandy 102, NEC, Olivetti M10) have over Sinclair's new beast?

Answer: software. Sardine, for example, just released by Traveling Software in the States, is a chip which plugs into those machines. It crams in a spelling checker, a word processor, and (if you have a diskette drive) a 33,000-word dictionary to check documents against.

Cost is a pitifully low $170. You do have to have Traveling Software's Ultimate ROM II, to make full use of it, but it will function with other word processors.

Traveling Software also has a disk operating system (launched late 1986) for 3.5in diskettes. This costs $90 on disk and $119 on ROM; the obvious advantage of the ROM is that you don't have to enter the boot code first.

Details on (206) 483 8088.

What's in a name?

I was quite impressed with Peter Reynolds' video, *An Introduction to your Amstrad PC*, because of its clever system of putting elapsed time in the top corner.

'If you are using a two-floppy system,' says Reynolds calmly onscreen, 'go fast forward to 14 minutes and 20 seconds.'

It was just unfortunate that, days after he released it, Amstrad won a court injunction against a wise guy by the name of John Hancox who had called his company Amstrad Computers Limited.

At the time Hancox pulled this stunt, Amstrad was called Amstrad Consumer Electronics. Alan Sugar wasn't amused, set his lawyers onto the problem, and registered the name Amstrad Computer himself.

Then his lawyers set out on a hunt of 'breach-of-trademark' examples, and scooped up Reynolds' video.

Reynolds will have to recall all sample editions, and send out a new package called something else.

Research Machines has long had a reputation as a sleepy computer manufacturer. The considered opinion is that the company started in the education market and that's where it should stay. After all, its main competitor there is Acorn, which also doesn't have a reputation for keeping up with the market.

In fact, Research Machines has merely been careful not to overreach itself as all too many UK computer firms have done. It has slowly edged its products into the mainstream computer market via graphics and networking. The RM Nimbus was one of the first machines to run fully working versions of Microsoft Windows and has also supported networking for several years, well in advance of the current fashion. Just before the Which Computer? Show, Research Machines launched its first full-scale attack on the mainstream PC-compatible market by announcing two new ranges, the AX-286 and VX-386 machines.

The VX-386 was the first 80386-based machine to be announced by a UK manufacturer (beating Apricot by one day). The machine itself looks very similar to the stylish Nimbus range. It has a 16MHz 80386 and 2Mbytes of RAM as standard, with support for the 80387 co-processor and cache memory as options. The machine is also IBM AT-compatible and RM Nimbus-compatible. It comes with an EGA plus graphics processor which allows it to support EGA, CGA, Hercules and RM Nimbus' 640 x 480 PEGA graphics modes. There are also five full-length IBM AT slots and one full-length PC slot. Very impressive specs indeed, especially from a UK manufacturer.

The machine can support 3½in floppy drives and has standard serial and parallel ports. Ultra-high resolution graphics modes are also available for use with high-powered CAD packages or desktop publishing. One system running at the launch had Aldus' Pagemaker running with two full A4 pages displayed legibly and with colour graphics supported. Unfortunately, colour laser printers aren't yet available, but Research Machines is ready for them when they come.

Research Machines has also launched the AX range with an 80286 processor. This has a 12MHz 80286, 1Mbyte of RAM, and similar other options to the VX range. Research Machines quoted Norton SI indexes for both machines (a common speed measurement). The VX range came in at 18.5 and the AX range at 13,

which means that the VX machines are measured at approximately 18.5 times as fast as an ordinary IBM PC and the AX at 13 times as fast. Even the Compaq 386 machine was only measured at 16. Who said UK technology was behind the Americans'?

An AX-286 with a 20Mbyte hard disk will cost £2695, including MS-DOS 3.2, PEGA graphics, a mouse, and so on. A VX-386 with 2Mbytes of RAM, a 40Mbyte hard disk and the usual bits will cost £4995. Research Machines says that full volume production will be under way by April. I certainly hope so, since it would be a pity to see yet another British manufacturer promise what it couldn't deliver.

Telephone (0865) 249866 for more details.

Owen Linderholm

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Introducing the perfect word processor

This Newsprint comes to you courtesy of Word Perfect, a word processor. The reason for using it isn't that it's new — it isn't (well, this is a new version, but that's all) — but because I have discovered that it is the ancestor of Sprint, Philippe Kahn's new word processor.

Just to whet your appetite for the next few paragraphs: I saw Kahn open a file and type (rapidly) a couple of paragraphs into the middle of it. He then, almost instantly, pulled the plug out.

On restarting the computer, all his new text was there.

Kahn is boss of Borland, the company which has given us SideKick, Turbo Pascal, Turbo Pascal toolkits and, most recently, Turbo Prolog.

The company is currently under something of a cloud because the City has decided to mark its shares down.

It's funny. Writers who know nothing at all about software are immediately suspicious about a company which is producing wonderful stuff, simply because a different bunch of people who know even less about software have decided to be nervous.

The stockbroker who made the decision to be nervous explained, later, that it was a simple book-keeping operation.

Software which was meant to be launched in this financial year was going to be delayed until next financial year. In the UK, explained the broker, you couldn't save the loss against the earnings you would eventually make. So the development costs had to come off this year's earnings.

You could argue that it all makes a weird kind of sense from the City's point of view. But how does it affect Borland's software? Not at all, in my opinion.

Sprint, the $199 word processor which Kahn will deliver in late summer, together with Sidekick II and Eureka (a problem solver) and Turbo C and Turbo Basic (language compilers) are still under development or at beta-test sites. Only a fool can pretend to be surprised when software is delivered late, and this will be delivered later than expected.

When Sprint comes, however, it will be worth the wait. About the only thing it can't do is create 'outlines' for planning purposes.

Kahn gave us a demonstration of the code in its beta-test form. It wasn't a pre-set demo: he put a projection screen up in a hotel room in London, and did what people told him to do.

The program is, already, the fastest piece of word processing technology I've ever seen.

On an ordinary Compaq, not a 286 version, it took perhaps just over one second to move the cursor from the top to the bottom of a document. Nothing fancy about that, you say; how long was the document? It was 500k long, that's how long.

Finding a unique word in the middle of it took perhaps three seconds, maybe less.

For the life of me I can't think of any feature I asked for, except vertical windows (it does horizontal windows) which it doesn't have.

It will work with script columns (scripts are typed with stage directions on the left, script on the right) and newspaper columns. It can do fancy scripts, foreign language characters, and even the menus can be in any language you like. If you don't like the phrase 'advanced' for one of the menus, change it. When that menu comes up, you will no longer have to type 'A' for 'Advanced', however, but 'P' for 'Perfect' or whatever.

Ah, says the sceptic — I don't want to learn a new word processor. I've become so good at WordStar/ Multimate/SamnaWord/ whatever, that I couldn't possibly adjust to a new one.

Borland has the answer: Sprint will emulate other word processors. It comes pre-supplied with most best-selling word processor commands, and others can be written — even by yourself, if you fancy tackling the job in the Sprint control language.

Kahn introduced his presentation by explaining that the product was about to go to beta-test and he didn't think he could keep it secret. So he'd decided to make it an official announcement.

Many at the conference were patently disbelieving. Perhaps they know something the rest of us don't, but I doubt it, or they wouldn't have been asking Kahn for the answers (would he be likely to say his company was struggling? In front of 40 journalists?).

Unfortunately, as with all exciting products, getting an early view of Sprint has just increased my thirst. And the earlier the view, the longer I'll have to put up with other word processors with half the features.

No-one knows exactly what graphics standard will evolve over the next year, but with a fair chance that IBM is planning to 'move the goal-posts' on compatibility, one company at least is doing pretty well — NEC.

The NEC Multisync monitor will automatically operate at the standard scan rate needed for IBM colour graphics. It will switch, when software asks it to, to the higher scan rate required by enhanced graphics (EGA) and it will also run at an even higher scan rate which, a lot of people think, might be needed for the next generation of PC-compatibles.

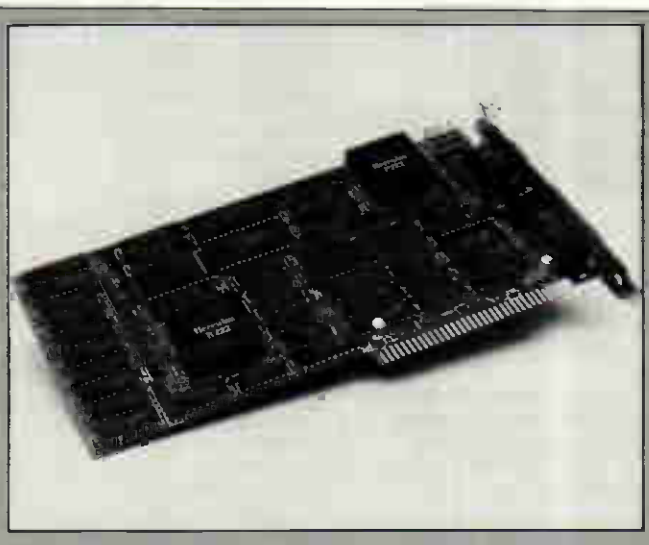
One alternative, however, is the Incolor card from Hercules. Hercules is the company which pioneered the idea of doing text and graphics together on the same screen — real, bit-mapped graphics; and proper, character-generated text.

The company has now extended this concept past the point of simple mixed displays. The Incolor card, due to be released for about $400 in the States in April/May, does in hardware what you would otherwise need a program like Fontasy to handle.

Admittedly, Fontasy costs a mere £70; but it doesn't really create letters onscreen. However pretty, the fonts generated by Fontasy are graphics characters.

From the Incolor card, however, you get an extra 3000-odd characters to play with. They are generated continuously onscreen by a character generator: you can move them, edit them, insert new characters, delete old ones, and change their colours. And because the card does it all in text mode — graphics and all — screen-handling is extremely fast.

The card was due to arrive on my desk somewhere between the time you read this and the time I wrote it.



Unanswered, at the time of writing, were questions like: will it work with Gem? Will desktop publishing packages like Ventura be able to use its amazingly small detail? How do you transfer its colours to colour printers?

I will certainly have more to say. In the meantime, First Software and Softsel will be looking for dealers and you can contact them to find out the nearest supplier.

Window on desktop publishing

It is commonly believed, in Silicon Valley, that IBM nearly offered to buy Digital Research, author and publisher of Concurrent DOS 386.

This operating system, just announced, is giving DR yet another chance to try and steal Microsoft's throne in the kingdom of the IBM user.

Digital Research has a new boss, now that John Rowley has been moved out. He is ex-IBM executive Dick Williams, working as the enterprise manager in partnership with Gary Kildall, founder, who will play the role of technical guru.

I asked Williams point blank whether IBM tried to buy the company, and he said, equally point blank, that it didn't.

He had a very, very senior position in the more mainframe side of IBM, based in San Jose, a couple of dozen miles away from Monterey. And he says if there had been a takeover of that sort, he damn well would have known.

'I think, partly, people heard that I was asking to meet Gary, looking for a job,' said Williams, 'and it was reported out of context.'

As to whether the company really has a chance of making the big time with Concurrent DOS 386, I'm not volunteering an opinion.

But one of the most difficult parts of multi-tasking software is the time taken to test it fully, and DR has been developing Concurrent for so long that there really must be a chance it has it right at last.

Microsoft has described its latest DOS, which is a less ambitious affair but with windowing built in, as 'as ready as any operating software is in its first release.' If there's much multi-tasking in that, then DR may just be able to do something because Microsoft is not notorious for over-fast delivery of operating software.

There is another point which is going to sound perverse when I make it, I know. That is, that Microsoft is sounding very, very positive about Windows. So jolly positive, in fact, that I smell a rat.

Sources on America's West Coast tell me definitely that IBM is *not* going to choose Windows as the front end for its 80386 machine.

The people at Microsoft I talk to, smile when I say that. 'Don't print that unless you want to look silly,' they say. They also say that desktop publishing is the big breakthrough for Windows in its fight against Gem, and I have a feeling that the cards are falling the other way.

Certainly, it isn't true that Venture, the Gem-based desktop publishing package, is 'just about to appear under Windows.'

What Xerox has said, under pressure, is that it does intend to produce a Windows version of Ventura. It hasn't said when.

Well, we'll see, won't we?

From its position as a back-runner fighting the tide of PC compatibility, Apricot has shot out front with the launch of very aggressively priced 386 versions of its Xen-i.

A basic Xen-i 386 with a 30Mbyte hard disk and 1Mbyte of RAM, will retail at £2999. That makes it cheaper than some ATs and at least £2000 cheaper than Compaq's 386 machine.

Clearly, Apricot managing director Roger Foster is aiming to create ripples in the market with both this and the VX range which, starting at £6750, will challenge traditional minicomputer markets.

The VXs start with a 70Mbyte hard disk, 2Mbytes of RAM and 125Mbyte tape back-up. The only catch is that you have to buy the special 'designer' furniture Apricot supplies to hold the kit.

The main question about these machines is not performance but delivery. Foster is insisting that the machines will be available during April, but sources within the industry say otherwise. Certainly if 386 machines at those prices start becoming available, Apricot will make a dent in sales of 286 machines as well as other 386 manufacturers.

Derek Cohen

Applied accessories

Macintosh software ranging from a desktop painter, through a car racing game to an appointment diary, has been announced by Applied Technology Marketing.

DeskScene, at £30, allows the user to customise the desktop so that instead of a regular pattern, you have a scanned image or a MacPaint picture. Smart Alarms and appointment diary is a pop-up accessory, but at £50 it's a bit pricey. Bodettes Square is a set of border fonts for LaserWriters, at £50. And Ferrari Grand Prix at £60 allows you to design your own race track, if you like. Details on (0642) 225854.

A future for the Transputer

Ignore all these IBM groupies who keep telling you about the Intel 80386 and the future of computing. Go and look at the Transputer.

I went to Wembley for the recent MDS show, where micro development systems are the theme, and found Transputers in barrel loads.

Ever seen a Mandelbrot diagram? Inmos was drawing them in colour, in incredible detail, in real time, a whole screen in less than a second. To do this, Inmos put together a system with faulty chips.

The Transputer can handle data going to and from other transputers, memory, and the rest of the world. These chips couldn't handle memory, except what they included in their own circuitry.

By putting six rows of seven chips on a board, and six boards in a crate, Inmos has produced a system with 252 Transputer chips. It would cost a lot to build out of fully functioning chips, but so what? — the point is made.

Now there is a new Transputer: the T800.

Software engineer Tim King of Perihelion Software has been playing with one. He's an expert on the Motorola 68000 family, having written AmigaDOS for the Commodore machine.

His assessment of the machine: after running a Benchmark on the Motorola 68020 with a maths co-processor (the 6818, I think) at 25MHz, it achieved a remarkable speed. It was able to process a Whetstone floating point test a million times a second.

A single T800, however, was able to do four mega-Whetstones, all on its own.

Don't be fooled by the fact that there are no Transputer-based machines in the shops: there are almost no 80386 machines in the shops either, despite the massive publicity generated about the chip.

Just remember that the Transputer, on its own, can eat the 68020 and the 80386 for lunch. And that where one 80386 won't do, you can't just plug another in parallel, as you can with the Transputer.

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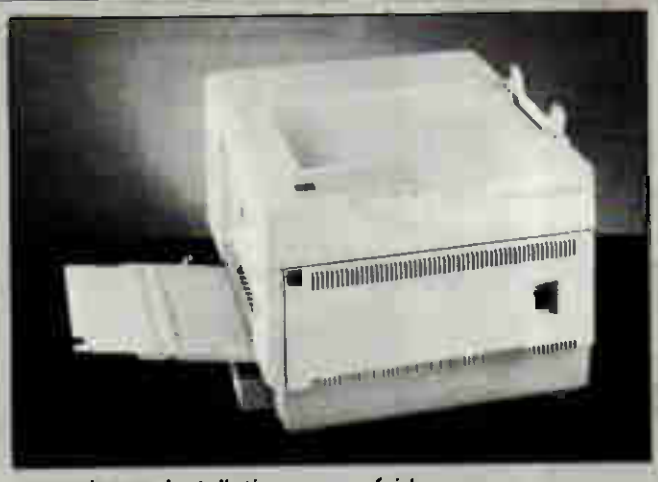

Epson tends to prefer setting standards rather than adopting other people's, so it's no surprise that its newly announced laser printer won't work with anyone's software yet.

The command set is an extended version of Epson's dot matrix language (ESP/P), though HP Emulation is available on a plug-in smartcard that holds 1Mbyte of font data.

The machine, to be known as the GQ-3500, will be available around May, and prices will be announced at the last minute. 'Under £1900' is the only guarantee that I could get. With Epson's top-of-the-range ink jet, the SQ-2500, retailing at £1345, the GQ is being marketed not as a piece of desktop publishing kit, but as a quiet replacement/upgrade for the office dot matrix.

As for software compatibility, most big software houses already have a GQ, so I'd expect it to start appearing on installation menus fairly soon.

Not to be outdone, Citizen has also entered the laser market with the Overture 110. The heart of the machine is a MITA engine (no, I haven't heard of it either) while Epson uses a Ricoh.

Print speed is billed at ten pages a minute, which beats Epson's official rating of six. There are six built-in fonts, and Epson (dot matrix), Diablo and IBM emulation is built in. The price has already been announced — you'll get five pounds change from two thousand.

The press release highlights the fact that, at 3.13 pence per page, the Overture has the cheapest running costs of printers in its class. Personally, I never realised it cost so much to use the beasts; next time I start using a new WP package, I'll use the FX80 to get the page length right.

Robert Schifreen

FAST justice for pirates

Another major pirate was caught in January, when Clive Pimlott confessed to duplicating 14,000 Ocean, US Gold, Software Projects and Gremlin Graphics games and was fined £500 plus £45 costs. Also that month, David Aldrich of Strong Computer Systems admitted selling 50 illegal copies of a file, printing management and utility suite of programs. He was fined £350.

I have to add: I'm delighted with the way FAST, the Federation Against Software Theft, is moving hard against organised software thieves rather than individual users. That's not to say I approve of software 'borrowing' but I do see the re-seller as the real threat to programmers' livings.

FAST has one grumble, of course: it doesn't regard these fines as being high enough. It's a good point.

Jerry Tresman, the utilities supplier whose goods were being duplicated, expects to take the copyist to court to recover lost revenue.

Bob Hay, of FAST, can be contacted on (01) 430 2408.

Takeover mystery

A mean trick of Alfrid Milgrom's — to say that he hopes Melbourne House will be Software House of the Year again in 1987. He's the man who started rival games software house Mastertronic, and he is perfectly sincere because he has just taken over Melbourne House.

Exactly what this means for people who consistently argue that the industry is under threat from collapse, with price-cutting, low-margin box shifters undermining respectable, overpricing (sorry) high-value outfits, we will have to see. On the one hand it proves that the low-price business was a success. On the other hand, you have to ask: if it's such a success, why did Milgrom and his partner Alan Sharam want to buy a full-price games producer?

Watch this space.

Babytalk

It was Mike Healy's plan to revive the Osborne name with the £700 Baby AT Taiwanese clone. But unfortunately, before he could show it at the Which Computer? Show, he had to wind up his company, Future Management.

The same name was used by MCP when it launched the Euromicro range — but this was a different machine. It costs £1300, and includes a hard disk which Healy's machine didn't.

Not to worry: MCP is on (01) 902 6146, and the company will tell you why it's a better deal.

You might also contact Walters, the low-cost clone importer, and ask that company where it got its Baby AT at £1280 without hard disk and is Walters potty, on (0494) 32751.

Walters does, to be fair, provide a monochrome monitor worth every penny of £60 in the price . . .

New stars from the old

Having lost the right to sell NewWord, William Poel doesn't intend to watch MicroPro reap the benefit of all the publicity he has given the program (which used to be a rival to WordStar until MicroPro bought it).

Instead he's launched NewStar4, since MicroPro now calls New Word WordStar 4.0.

I saw a pre-beta version of NewStar4, and if it has turned out as nice as it looked like it would be, it will be OK. However, if it is bug-free, I will be unable to close my mouth with astonishment for several weeks. Please try it (at £70 it's not very expensive) by all means, but insist on getting free updates if you find errors.

The program is obedient to the old WordStar commands. Other features listed include: networks, windowed editing, passwords to encrypt files, macros, the ability to stuff a picture onto the printer between text sections, word count, column sort, table of contents, index creation, mail list, background printing, and a special offer for WordStar 1512 users.

The special offer: if you provide WordStar 1512 disks and a manual, you get NewStar4 for £25. And if you have another low-cost word processor, there's a different offer: buy Streaker, the text retrieval package, and get NewStar4 free.

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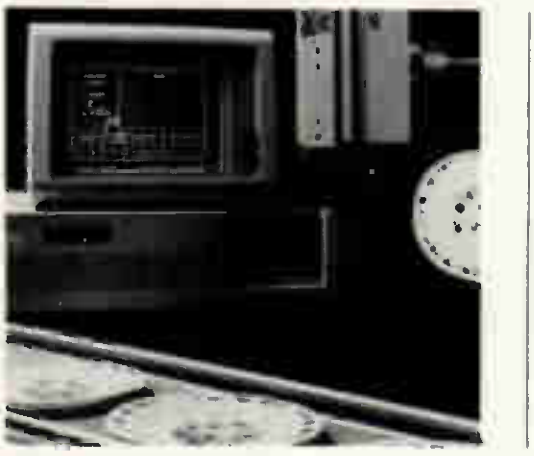

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THE WEST COAST CONNECTION

As the US market becomes saturated with PC clones, the scramble to attract customers gets frenzied but the search goes on to find the smallest computer. All the latest transatlantic news and gossip from our West Coast correspondent Tim Bajarin.

Tough battle ahead for PCclones

During 1986, prices of personal computers plummeted: PC configurations that sold for over $3000 less than two years ago are now selling for under $1000.

The American market is going through some very interesting changes at a time when clone manufacturers from Taiwan, Korea and the UK have decided to make their move on this lucrative market. At the last count, there were over 100 PC manufacturers with products in the US, all vying for the same 'customer'. But, the major change in market direction is being brought on by first-time users who are just now thinking of buying a personal computer.

The majority of buyers at the end of 1986 were already familiar with the PC due to its use in their own offices; these people are known as Fortune 3000 workers. But, this is a relatively small market compared to the one for those who have never used a computer and could conceivably want one in the very near future.

The problem is that DOS-based PCs are very difficult to use. Try explaining the 'A prompt: b drive command' to potential buyers and they think you are speaking Swahili.

If DOS-based PCs are going to flourish for first-time users, they *must* become easier to use. As a result, vendors such as Hyundai's Blue Chip Electronics and Amstrad with its model 1512 are going to find the market very difficult to penetrate without a gimmick or two up their sleeves. Both of these vendors are using Digital Research's GEM as a screen manager in an attempt to make their machines more Mac-like and easier to use. But, it is clear from the reaction they are getting from the new user market that it is going to take much more than this for them to be successful.

Hyundai's Blue Chip is fighting to secure its place

As a result, stores have been very slow to pick up the Blue Chip PC or the Amstrad, so both companies are being forced to look to mass merchandisers for distribution — and even these stores are sceptical of these IBM 'knock-offs'.

To say that these manufacturers have been successful so far would be exaggerating. Hyundai to date has had its machines in Target Stores and Federated electronic outlets. Amstrad has gone to a distributor in Arizona who has had only mild interest in its machines. Sources close to both Target and Federated say that even though the machines are priced around $699, the price is still too high for mass marketers to carry.

As a result, Hyundai specifically has not sold well in these stores and is beginning to seek out computer speciality stores to be its 'resellers'. Amstrad will be forced to go this route as well, but as you can imagine, speciality stores already have dozens of PCs to choose from and both Blue Chip and Amstrad will have to give cut-throat pricing to be accepted.

Muddying up these waters is Atari. Jack Tramiel and his cohorts have introduced a $499 PC clone that, if Atari can deliver, could really shake up the low end of the market and cause a ripple effect in every channel of distribution.

Since many industry observers feel that PC clones will have to be at the $499 level by next Christmas if they are going to sell to new users, it looks like 1987 will be a difficult year for anyone trying to make any money in the low end of the IBM PC clone market.

The incredible shrinking micro

Some of you may remember a movie a few years back called *The Incredible Shrinking Woman* starring Lily Tomlin. Its premise was based on a person who, through mysterious circumstances, became only 9ins tall, yet was just as much a complete person as anyone else, only smaller. The world of high technology has taken a cue from this story-line and continues to set out to 'shrink' the circuitry of a PC by taking the multitude of processors that are in the PCs of today, and putting them on two small chips.

Companies like Chips and Technology and Faraday Electronics, both from Silicon Valley, are doing what in many ways is just as mysterious as the events that caused Lily Tomlin to become a shrinking dynamo.

Both firms have taken these chips and, through the magic of computer-aided design, have developed actual silicon chips that become portable brains behind what will be the computers of tomorrow.

The cumbersome computers that sit on our desks today will be replaced by slim, sexy, smaller versions; yet they will have the same power and, in many cases, *more* power than the boxes we have now.

Faraday's newest design is known as the $25 DOS engine. This 'PC brain' is now on only two chips, instead of as many as 35, and will help to cut the cost of PCs dramatically. Chips and Technology have taken the EGA chips (normally 14) and cut the process down to only two chips as well.

This single/double chip design could someday give us a computer the size of a paperback novel, complete with CPU, keyboard and screen. Although it may not be here tomorrow, one day we may even see a fully-fledged computer the size of a credit card.

THE WEST COAST CONNECTION

Toy companies use interactive concept for products

In the CS Lewis novel *The Lion, the Witch and the Wardrobe*, children stumble into a world of fantasy by going into a closet and walking through its walls. Once they have passed through to this new world, they encounter all sorts of animals, forests and evil villains.

Another children's book, *The Tower of Geburah* by John White, takes this theme into the world of high technology by having the children literally pass through the television tube into their own world of make-believe.

Now, in 1987, toy manufacturers are giving us their own variation on this theme with a new concept called 'interactive' toys. Companies such as former toymaker Mattel, and the new kid on the block, Axlon (brainchild of Atari's original founder Nolan Bushnell) will soon be marketing ray guns, x-wing fighters and all sorts of toys that interact with specialised TV cartoon shows.

When kids shoot their power jets at the TV cartoon, the toy will record a hit. What's more, the villain on the screen can hit back and zap your pilot right out of his seat.

The toy business is a multi-billion dollar industry that operates on the basis that children get tired of their old toys quickly and continually demand new ones. With this in mind, toy manufacturers are constantly looking for gimmicks to grab childrens' attention.

This new 'gimmick' is made possible through the world of high technology and microprocessors.

The way these things work is to incorporate high-frequency sounds, low-frequency sounds, and in some cases a type of light. These trigger the mechanisms in the gun or fighter, which in turn makes either a simple crackling noise, or perhaps even causes your pilot to eject out of his cockpit.

No matter what technology is used, you can bet that this new fad will be the hottest thing since Cabbage Patch Dolls, and millions will be spent on getting Junior the newest thing in high-tech gadgets.

Big Blue Disk launches 'innovative' magazine

Almost since the invention of the printing press, we have had magazines that were designed for our personal interests, and they have come in all shapes and colours. We have, for example, *Readers Digest, People Magazine, Car and Driver*. Most of these magazines flourish and have one thing in common: they are all printed on paper. That is, until now. With the introduction of the personal computer, magazine delivery has taken a new turn. If the folks at Big Blue Disk have their way, the next major way to have a magazine delivered will be on disk.

Big Blue's magazine on a disk is a $9.95, two-disk package that is literally a magazine. But it is not like any ordinary magazine. It has news and commentary like *Time* and it also has features giving insights, advice and reviews like any ordinary computer magazine.

But this is where the similarities end. Big Blue goes on to offer you real-time games, utilities, educational programs and even an actual word processor so that you can use it to write the editors a message and send them your comments and feedback. The edition I have has three educational programs, five games, five application programs and four utility tools.

For $9.95, it is one of the best bargains in the computer world and is an idea that I hope really catches on. This inexpensive family computer magazine uses Big Blue Disk's unique interactive operating system and can be bought in most US computer stores.

Available for the IBM PC and compatibles and the Apple II, Big Blue Disk is at PO Box 30008, Shreveport, Louisiana, 71130-0008. Tel: (318) 868 7247.

Low cost method of storing and transferring data

Living in the valley of the shadow of the chip, I get a chance to peek into the future when visiting 'garages' of would-be entrepreneurs. One of the more interesting products I have had a chance to see involves a video recorder. This machine has been modified to take blips and bleeps from a PC, store it on a standard ½in tape, then send it over television signals to another video recorder. Using this method, a 350-page book can be sent from VCR to VCR in about five seconds. As you can imagine, this raises some interesting possibilities, as well as some difficult technical problems.

Since the air waves are public and anyone with the right equipment can also tap into such data transfer, an encryption-decryption scheme is mandatory. Such a scheme would have to have its own built-in error correction device so that it would guarantee that the data sent from one source to another would be perfect: even a small loss of data could drive the end user up a wall trying to figure out what it all means. Add to that the FCC's control of these air waves, and you see that these garage 'techies' have their work cut out for them if this product is ever to reach the market.

But Hewlett-Packard and Jobs and Wozniak were told they were crazy when products developed in their garage were shown to others. Lucky for us, and them, that they were not deterred by the sceptics. Although this system has a tough road ahead of it, it could be a very low-cost way to store and transfer computer data in the near future if the technology can be perfected.

An application for all tastes

To the person not familiar with what computers can do, they are often considered mechanical wonders for the folks that call themselves 'techies', Yet, if you take time to browse through a computer magazine, or stroll through a computer store, you may be amazed at some of the things you can do with a computer. In response to a question I often hear 'What can I do with a computer?', let me give you some ideas from software I have run across lately.

For the home and family interests, there is software written by Geneaology Software that lets you trace your family roots. You can track your baby's development, thanks to a program from Early Development Software. Want to improve relationships with your children? Try Mind over Minors from Human Edge Software. Want to design your own home? Get Architectural Design, Interior Design and Landscape Design from Hayden Software. Comedian Steven Wright says that he knows exactly when he is going to die because his 'birth certificate has an expiration date on it.' But, if your birth certificate does *not* have any of these tidings written on it and you would like to know how long you will live, try the 64 PAK program from Practicorp.

Flat too small to have pets of any kind? Get Fishies, a program that puts an animated fish tank on your screen, from Jersey Cow Software.

If your interest is education, how about Micro Speed Read. This program from CBS software teaches you to read 1000 words a minute. You can even learn how to mix drinks with a software program called Mr Boston Official Micro Bartender's Guide from Concept Development Associates.

Want to know if you have ESP? Find out with Jack Houck's Psychic?

As is obvious from this short list of application programs, if there is a need or interest in your life, you can be sure that there is a computer program out there that can fill it. END

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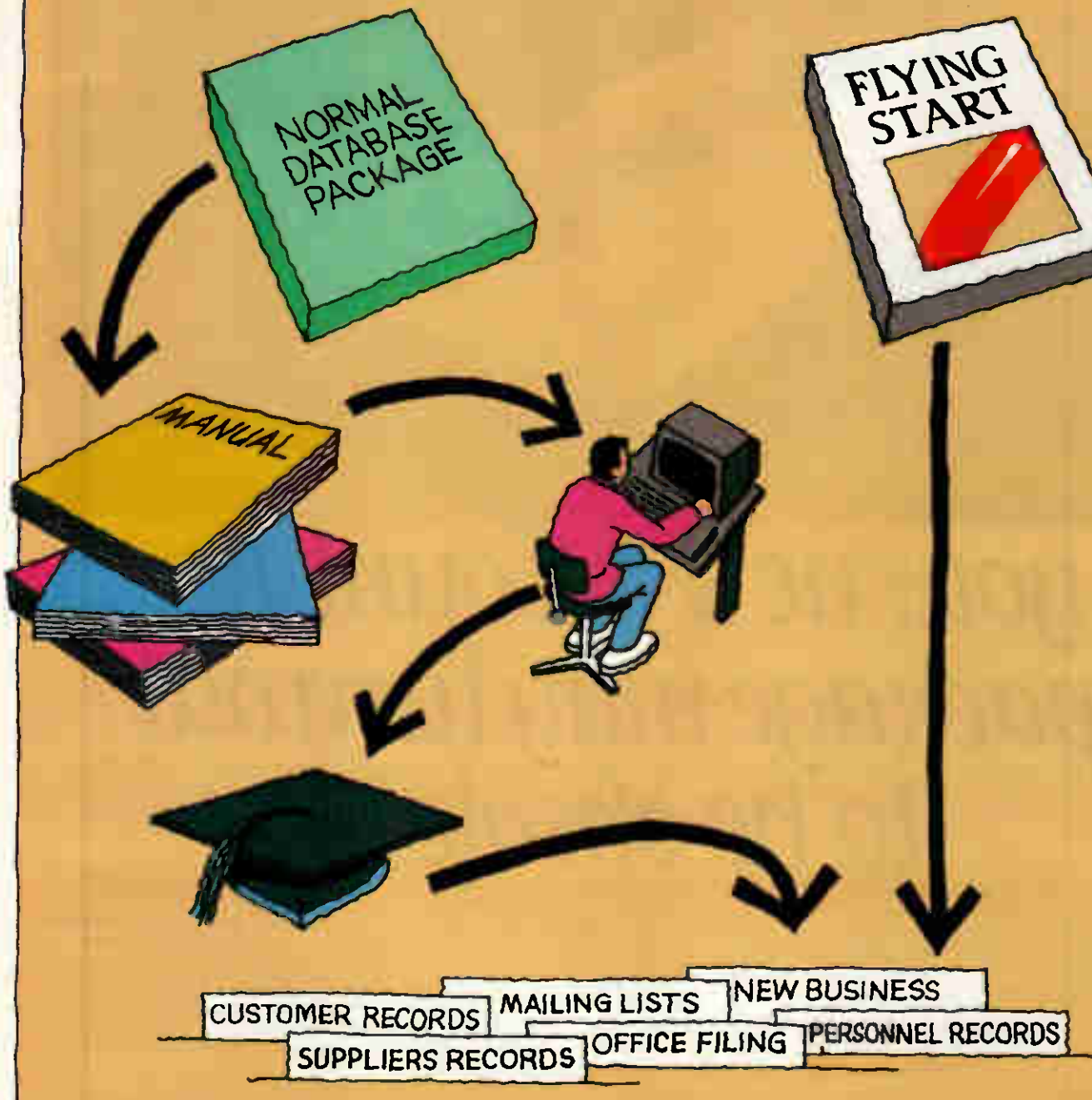

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READER SURVEY 1987

We at *Personal Computer World* would like your help to make the UK's biggest microcomputer magazine even better. The questions below will help you to tell us what you think of the magazine and in which direction you'd like to see us go in the future.

And to show our gratitude to you for taking the time to complete and return the form, we're appealing to both your baser and your more philanthropic instincts.

For our charitable gesture we will donate 10p to one of the organisations listed below (under Question 30) for every form returned. So please indicate at the end of the questionnaire where you'd like us to send our money.

To increase your own well-being, we will be holding a draw from all correctly completed questionnaires and six lucky readers will each win one of the prizes listed at the end of this form.

Please return your completed questionnaire to VNU Business Publications, Freepost 25, London W1E 6EZ by Tuesday 21 April. You don't even need a stamp. Thank you.

1 How often do you purchase *PCW*? (Please tick box)

A subscriber	01 ☐ Yes	02 ☐ No
Every month		03 ☐
Once every two months		04 ☐
Once every three months		05 ☐
Less often		06 ☐

2 Do you have any difficulty getting hold of copies of *PCW*?

Yes ☐ 01 No ☐ 02

3 How many other people read your copy of *PCW*?

None ☐ 01 1 ☐ 02 2 ☐ 03 3–5 ☐ 04
6–8 ☐ 05 9–11 ☐ 06 12–15 ☐ 07 15+ ☐ 08

4 Many *PCW* items appear every month — please show how often you read them:

	Always	Often	Sometimes	Never
Adverts	☐ 01	☐ 02	☐ 03	☐ 04
Banks' Statement	☐ 05	☐ 06	☐ 07	☐ 08
Bibliofile	☐ 09	☐ 10	☐ 11	☐ 12
Checkouts	☐ 13	☐ 14	☐ 15	☐ 16
ChipChat	☐ 17	☐ 18	☐ 19	☐ 20
Computer Answers	☐ 21	☐ 22	☐ 23	☐ 24
End Zone	☐ 25	☐ 26	☐ 27	☐ 28
Hardware Benchtests	☐ 29	☐ 30	☐ 31	☐ 32
Letters	☐ 33	☐ 34	☐ 35	☐ 36
Mailbox	☐ 37	☐ 38	☐ 39	☐ 40
Newsprint	☐ 41	☐ 42	☐ 43	☐ 44
Program File	☐ 45	☐ 46	☐ 47	☐ 48
Screenplay	☐ 49	☐ 50	☐ 51	☐ 52
Software Screentests	☐ 53	☐ 54	☐ 55	☐ 56
SubSet	☐ 57	☐ 58	☐ 59	☐ 60
West Coast Connection	☐ 61	☐ 62	☐ 63	☐ 64

5 How interested were you in articles we published under the following categories in the past year?

	Very	Quite	Mildly	Not
	interested			
Artificial Intelligence	☐ 01	☐ 02	☐ 03	☐ 04
CAD/CAM	☐ 05	☐ 06	☐ 07	☐ 08
Computers in action	☐ 09	☐ 10	☐ 11	☐ 12
Expert Systems	☐ 13	☐ 14	☐ 15	☐ 16
Hardware projects	☐ 17	☐ 18	☐ 19	☐ 20
Natural language understanding	☐ 21	☐ 22	☐ 23	☐ 24
Networking	☐ 25	☐ 26	☐ 27	☐ 28
New technologies	☐ 29	☐ 30	☐ 31	☐ 32
Online services	☐ 33	☐ 34	☐ 35	☐ 36
Operating systems	☐ 37	☐ 38	☐ 39	☐ 40
Over the horizon, speculation	☐ 41	☐ 42	☐ 43	☐ 44
Processors and chip design	☐ 45	☐ 46	☐ 47	☐ 48
Programming languages	☐ 49	☐ 50	☐ 51	☐ 52
Software projects	☐ 53	☐ 54	☐ 55	☐ 56

6 How interested would you be in our publishing articles under the following categories?

	Very	Quite	Mildly	Not
	interested			
Animation	☐ 01	☐ 02	☐ 03	☐ 04
Education	☐ 05	☐ 06	☐ 07	☐ 08
Engineering/scientific	☐ 09	☐ 10	☐ 11	☐ 12
Game-playing	☐ 13	☐ 14	☐ 15	☐ 16
Graphics	☐ 17	☐ 18	☐ 19	☐ 20
Hardware — how it works	☐ 21	☐ 22	☐ 23	☐ 24
High-powered computing	☐ 25	☐ 26	☐ 27	☐ 28
Software — how it works	☐ 29	☐ 30	☐ 31	☐ 32
Other (please specify)				

7 Do you like *PCW*'s covers?

Always ☐ 01 Often ☐ 02 Sometimes ☐ 03 Never ☐ 04

8 Do you ever buy *PCW* because of what is on the cover?

Yes ☐ 01 No ☐ 02

9 Which article that we published in the past twelve months did you like most?

10 Do you own a personal computer?

Yes ☐ 01 No ☐ 02

11 Do you use a personal computer?

Yes ☐ 01 No ☐ 02

12 If you replied yes to either of the above, which of the following categories apply?

	Use	Plan to buy
Sinclair Spectrum	☐ 01	☐ 02
Sinclair QL	☐ 03	☐ 04
Amstrad CPC	☐ 05	☐ 06
Amstrad PCW	☐ 07	☐ 08
Other CP/M	☐ 09	☐ 10
BBC	☐ 11	☐ 12
Commodore 64/128	☐ 13	☐ 14
Amiga	☐ 15	☐ 16
Apple Mac	☐ 17	☐ 18
Apple II	☐ 19	☐ 20
Atari ST	☐ 21	☐ 22
Atari 400/800/130	☐ 23	☐ 24
Amstrad 1512	☐ 25	☐ 26
Single/twin floppy PC compatible	☐ 27	☐ 28
Hard disk PC compatible	☐ 29	☐ 30
80286-based AT compatible	☐ 31	☐ 32
Apricot/Sirius/generic MS-DOS	☐ 33	☐ 34
Other (state which)	☐ 35	☐ 36

READER SURVEY 1987

13 If money were no object, which computer would you buy for yourself?

14 What peripherals do you own? And which are you planning to buy in the next 12 months?

	Own	Plan to buy
Mono monitor	☐ 01	☐ 02
Colour monitor	☐ 03	☐ 04
Dot-matrix printer	☐ 05	☐ 06
Daisywheel printer	☐ 07	☐ 08
Laser printer	☐ 09	☐ 10
Other printer	☐ 11	☐ 12
Plotter	☐ 13	☐ 14
Disk drive	☐ 15	☐ 16
Expansion/add-on boards	☐ 17	☐ 18
Graphics tablet	☐ 19	☐ 20
Joysticks	☐ 21	☐ 22
Lightpens	☐ 23	☐ 24
Modem	☐ 25	☐ 26
Mouse	☐ 27	☐ 28

15 How much do you expect to spend on hardware in the next twelve months?

	Personal use at home	To use at work
Up to £50	☐ 01	☐ 02
Up to £100	☐ 03	☐ 04
Up to £500	☐ 05	☐ 06
Up to £1000	☐ 07	☐ 08
Up to £2000	☐ 09	☐ 10
Up to £5000	☐ 11	☐ 12
£5000+	☐ 13	☐ 14

16 How much money do you expect to spend on software in the next twelve months?

	For personal use	For use at work
Up to £50	☐ 01	☐ 02
Up to £100	☐ 03	☐ 04
Up to £500	☐ 05	☐ 06
Up to £1000	☐ 07	☐ 08
Up to £2000	☐ 09	☐ 10
Up to £5000	☐ 11	☐ 12
£5000+	☐ 13	☐ 14

17 If you use an online service like Prestel, Easylink or Telecom Gold, how much do you spend on it each month?

Up to £10 ☐ 01 Up to £25 ☐ 02 Up to £100 ☐ 03
£100+ ☐ 04

18 How many computer books did you buy/read in the past twelve months?

19 Could you supply some details about yourself? These will be kept confidential.

Name

Address

Post Code

20 Age

Under 20 ☐ 01 20–25 ☐ 02 26–35 ☐ 03 36–45 ☐ 04
46–55 ☐ 05 56–65 ☐ 06 Over 65 ☐ 07

21 Sex

Female ☐ 01 Male ☐ 02

22 Are you in full-time education?

Yes ☐ 01 No ☐ 02
If yes go to question 28

23 Are you in full-time employment?

Yes ☐ 01 No ☐ 02
If no go to question 28

24 Which category does your job title fall into, and in which type of industry?

JOB TITLE

MD/owner/partner/chairman	☐ 01
Director level	☐ 02
DP management	☐ 03
Other systems/programming	☐ 04
Professional	☐ 05
Engineering	☐ 06
Education	☐ 07
Scientist/technologist/researcher	☐ 08
Other	☐ 09

PROFESSION

Insurance/banking/finance	☐ 10
Government/national/local	☐ 11
Transport/communications/utilities	☐ 12
Manufacturing (computer equipment)	☐ 13
Manufacturing (other)	☐ 14
Wholesale/retail/distribution	☐ 15
Mining/construction/oil/chemicals	☐ 16
Media/advertising/publishing	☐ 17
Education/health/law	☐ 18
Selling computer equipment	☐ 19
Computer services	☐ 20
Consultancy/programming	☐ 21
Other	☐ 22

25 Size of company

Up to 25 ☐ 01 26–50 ☐ 02 51–100 ☐ 03 101–150 ☐ 04
151–250 ☐ 05 251–500 ☐ 06 500–1000 ☐ 07 1000+ ☐ 08

26 Do you authorise expenditure on computer products and services for your department/company? Yes ☐ 01 No ☐ 02

27 Please indicate your income bracket

Up to £8000 ☐ 01 £8000–15,000 ☐ 02 £15,000–20,000 ☐ 03
£20,000+ ☐ 04

28 Which other computer publications do you regularly read?

29 What do you mainly use your computer for? (Tick up to three)

Accounting	☐ 01
CAD/scientific/engineering	☐ 02
Communications	☐ 03
Database	☐ 04
Education	☐ 05
Financial planning	☐ 06
Games	☐ 07
Graphics	☐ 08
Programming	☐ 09
Project management	☐ 10
Spreadsheet	☐ 11
Word processing	☐ 12
Other (please specify)	☐ 13

30 The charity I would like you to support on my behalf is:

Childline	☐ 01
Imperial Cancer Research	☐ 02
MenCap	☐ 03
Oxfam Ethiopian Fund	☐ 04
Terrence Higgins Trust (AIDS research)	☐ 05

31 I would like to win (indicate 1st and 2nd choices):

Four Infocom games	☐ 01
Miracle Technology WS2000 modem	☐ 02
Two Borland products	☐ 03
Volkswriter 3	☐ 04
Lifetree's Words & Figures	☐ 05
Psion Organiser II	☐ 06

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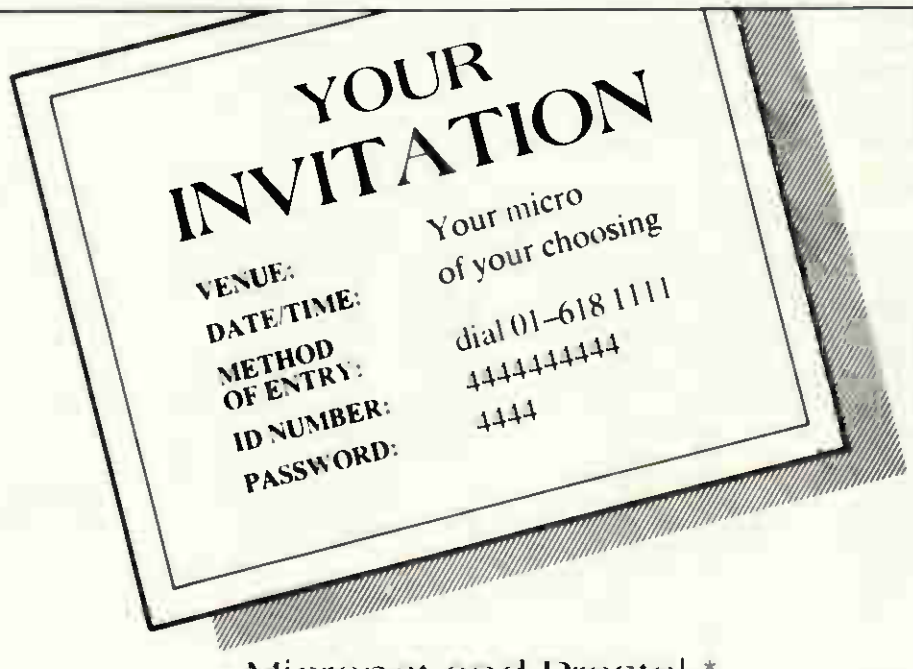

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LETTERS

This is the chance to air your views — send your letters or contact us on Telecom Gold 83: VNU200. The address to write to is: Letters, Personal Computer World, 32-34 Broadwick St, London W1A 2HG. Please be as brief as possible and add 'not for publication' if your letter is to be kept private.

Under the influence

Kaypro recently ran an advertising campaign claiming that its dealers had to satisfy quality control as vigorous as the company's machines. Unfortunately, the quality control itself seems to be out of control.

Last year, hoping to improve the intelligence of a wheelchair which a friend was developing, I bought a 768k RAM Kaypro 2000 portable from Kaypro's UK wholesale agent, Quest International Computers Ltd. The machine arrived with only 256k RAM and about a third of the bundled software it was supposed to have. I managed to squeeze most of the remaining software out of Quest. However, five months later I still jump whenever I hear the postman's knock, and search vainly but desperately for the extra chips which I said I would fit myself if Quest sent them. I gave Kaypro the benefit of the doubt about the free-floating battery isolation switch which had a mind of its own but was, alas, unintelligent.

In the meantime (and I mean *mean*) a half column of dead pixels began to mar an already barely legible LCD screen, and the machine's apparently irreplaceable 7.5V power supply all but disappeared in a puff of white smoke. The batteries went flat within eight hours, leaving me the proud owner of a useless but elegant chunk of black aluminium.

Quest doesn't answer my letters or return my calls. Apart from trying to stir the company up by writing to *PCW*, how would you go about debugging this defective bit of godly programming? Do I have any rights? Is anyone eligible for some kind of solid-state-buggery award?

Roc Sandford, Soft Computing, London W1

On receipt of a copy of this letter, Quest made a full apology and undertook to remedy the situation. Moral? Write to PCW.

If you want it doing properly

I refer to the letter titled 'Defending the Amstrad PC' in the February issue of *PCW* by R Elliott of Erskine, Scotland.

Mr Elliott is presumably correct when he states that Amstrad is being 'over-cautious' when insisting that the PC is returned to the dealer for the upgrade to 640k RAM. He is certainly correct in stating that all that is necessary to perform the upgrade is to fill the empty sockets, although there is a link on the PCB which needs relocating.

However, I would be *very* reluctant to return a machine to Dixons for upgrading. The gentleman in my local shop insisted that the 'bumph' supplied to the shop explained that the Amstrad machine was *totally user serviceable* as all the chips are on bases — even the colour modulator!

The 640k upgrade is simply something you 'open a flap at the back and plug in — without using any of the expansion slots.' To be fair, he did not say that Dixons would do it, but that Dixons would return it to Amstrad for the job.

However, upgrading the Amstrad PC *is* a simple job and can be carried out by anyone. A kit is available from my company which contains all the chips required along with complete instructions for the all-inclusive price of £25.95 (all-inclusive means VAT and P&P).

As an aside, the main branch of Dixons in Nottingham assures me that no Dixons branch anywhere will be selling software for the machine as 'with over a thousand titles, there isn't enough room'. It would appear that Dixons doesn't mind making its hefty profits (from Amstrad?) out of the machines, although the support Dixons offers appears to be nil.

Might I humbly suggest that anyone considering buying an Amstrad PC go to a computer shop, where at least *someone* should know what he's talking about. And if anyone wants to upgrade their machine, do it yourself.

Jon A Slack, proprietor, ACD Computer Services, Nottingham. Tel: (0602) 830884

Write and wrong

Yes, PC-Write is complex as well as flexible (review, *PCW* February). The more functions you have, the more you have to learn. I don't see any way around it. Word processors written to make things simple for naive users and computerphobes just don't have much to offer the able computer enthusiast. Luckily there is no rule that all products must be aimed at the lowest common denominator.

You did miss some nice beginners' features in your review. There is no function key overlay because none is needed. Press Shift/F1 and you get a two-line function key Help at the top of the screen. Normally this shows the effect of pressing the function keys on their own, but when you press Shift, Alt or Ctrl the display switches to show the effect of the function keys pressed with the Shift, Alt or Ctrl keys as appropriate. But there's more.

I use PC-Write with an Amstrad PC1512, and can use the mouse not only for skating around in the text, but also for selecting functions. You press the right button to bring up a two-line function menu at the top of the screen, then scroll the whole set of functions through the menu and highlight the one you want by moving the mouse. Each function has a one-line help that appears under the menu as each is highlighted. Press the left button to select. Some functions bring up a sub-menu which works in the same way. No need to mess with mouse drivers — the Amstrad MS-DOS start-up disk takes care of it.

Mr Schifreen complains of the visibility of the font control characters (little faces, and so on). If he doesn't like them, he can turn them off. Just press ALT and the spacebar to toggle them on/off. The great thing is that you can see them if you want to. As for the colours of the text and background combinations used to display enhanced text, there are 26 possible fonts or enhancements — do you want them all to be displayed the same? No WYSIWYG word processor that I have seen can support that many options, and the options they do support don't always show on the screen as they will on paper. Unless your PC screen has italics and superscripts?

Furthermore, PC-Write can print accented, Greek and graphic characters (on a printer that has them) and it shows such characters onscreen. Try that on NewWord! If your printer won't do the IBM character set, accents can be printed by a second pass or by backspace overprinting. The printer definition file that PC-Write constructs for your printer when you make your work disk will set this up as appropriate, so you don't really have to mess with the configuration file.

Iolo Davidson, Tetbury, Glos

Robert Schifreen replies: I quite agree with your opening statement — PC Write is both complex and flexible. My opinion on this situation is that, while trying to be flexible, the package provides facilities which are aimed fairly and squarely at experienced computer users like ourselves, and not at

someone in a non-computer industry who wants a word processor and not a program editor.

If you are someone who likes to use a mouse with a WP then fair enough, though personally I find it faster to keep my hands on the keyboard all the time.

The multiple-page help feature is far from complete. There are around 45 'pages' of help, each of which takes half a screen. How can a package as flexible and complex as this (your words) be summed up in such a short space?

While I am aware that the font characters can be turned off, the marker could be more understandable to the average human. Surely something like [Bld ON] says more than a red, smiling face?

Perhaps when the spelling checker can guess words correctly, a thesaurus has been added and the manual updated, I will look again at the program.

Incidentally, did you know that when you shell from PC-Write to DOS you can cut screens from any program and paste them into PC-Write? I'll leave you to read the manual to find out how.

In his review of PC-Write (*PCW*, February) Robert Schifreen was right to castigate Sage for the poorly edited and produced manuals, although he shouldn't have left the reader suspecting that Chapter 15 had gone missing — it seems to have turned into annex 1, where a list of WordStar codes is given. On the whole, although the manual is an editorial abomination, it seems to contain (somewhere, and often twice) everything you need in the way of documentation.

For me, the main pleasure of PC-Write is its speed. This is achieved by keeping the entire file in memory, imposing a 60k limit on a file. Is that so terrible? 60k is enough for a book chapter, a journal article — enough for any manageable unit of thought. With other word processors, not only is basic operation significantly slower, but it often slows down further when documents get too large. For other software, therefore, 60k is a pragmatic, if not compulsory, limit.

C Zielinski, Rome, Italy

These are just two of many letters from PC-Write users who are willing to sacrifice some features for others, such as speed, which they value more. Nonetheless, we wonder if anyone has yet found the perfect word processor.

Behind the glamour

Yes, Charlie Brown did win *The Times*/Hewlett-Packard Computer Press Awards, after his editor entered examples of his (brilliant) work (ChipChat, *PCW* February).

Yes, he did make a very worthy speech about *The Times* and the Wapping dispute, as he promised he would do should he ever win.

While he made this speech, many journalists (and not only those from the Wapping foundry of lies) jeered, booed and generally acted like the bunch of deaf/mute hypocrites they are.

No, he didn't refuse his prize which: a) he was very proud to win; and b) he wanted very much.

Fact: He then immediately donated the prize to the print unions fighting Rupert Murdoch.

Question: What on earth was Willy Rushton doing there?

I trust next time you run a story, you'll run the whole story (why didn't you ask Charlie?).

Mike Taylor, NUJ, NE Surrey and South London Branch

Making Smalltalk

Please forward our congratulations to Mike James on his series of articles about programming (*PCW*, July–December 1986). At the beginning of the series we thought it was going to be 'How to write tidy Basic', but it turned out to be an excellent brief introduction to real programming.

The last instalment included the best and least verbose explanation of the purpose and structure of Smalltalk that we have ever read in a UK magazine. Even up to six months ago we would not have thought it possible to have seen any mention of Smalltalk in *PCW*, so to have a review of Smalltalk and a programming article on the paradigm is very gratifying.

If any readers are interested in Smalltalk, please contact us. Although we would like to sell one of our Smalltalk implementations, we are always willing to chat about our favourite programming system. We wondered whether your readers were aware of the Smalltalk special interest group (which is part of the BCS) called OOPS. Details about membership can be obtained from: British Computer Society, OOPS, 13 Mansfield Street, London W1M 0BP.

John Ash, Smalltalk Express Ltd, Basingstoke, Hants

Heard this before?

'I don't think much of the express service these London dealers offer.'

With reference to Mr Everard's letter in the October 1986 issue of *PCW*, I can also substantiate the frustrations experienced in living overseas and trying to obtain replies to letters from UK companies.

I have written four times to Technomatic in London simply asking prices of computerware, with no response. I'm also in the middle of a one-way dialogue with Watford Electronics, which owes me a £100-plus credit on my Barclaycard.

I'm sure that the customers exist for the benefit of such companies. Each year I return to the UK on leave with a shopping list, in particular for BBC computer add-ons. During the last visit, I made the fatal mistake of ordering by phone a disk drive mechanism, volunteering my Barclaycard number and giving the address where I wanted the goods delivered. On validating my card, WE learned that my address was c/o Barclays Bank in Leeds who automatically pay my bills. This started the confusion, as eight days later WE advised me of the mismatch. I got back on the phone to explain (or rather confuse!) and reorder, but now the part was out of stock so WE wrote to me c/o my bank to tell me!

In total frustration and with the return flight only a week away, I decided that the only way I was ever going to get the drive was to go down to WE's shop and buy over the counter, where I tried unsuccessfully to cancel all traces of the original phone orders. This couldn't be done — I was told that it was all on computer. Having purchased a drive over the counter and being many times assured that it was completely compatible with my existing one . . . Yes, you've guessed — I find that on getting it back to Sarawak, it is totally incompatible! I've also been charged twice for the drive.

So you think you've got troubles, Mr Everard of Saudi Arabia?

For me, never again.

R Wylde, Sarawak, East Malaysia

Are any dealers able to provide a customer service geared specifically to the needs of overseas visitors — or is it a case of out of sight (and the country), out of mind?

Severing the connection

The review of Red Boxes in *PCW*, December 1986 clearly implies that their use entails the permanent connection of a micro: 'Dig out your old machine from a cupboard,' and so on.

References in other magazines, however, suggest that once the Red Box system has been set for any particular purpose, the micro need no longer be connected. Perhaps in fairness to General Information Systems (with whom I have no association) and your readers you could explain the position, as it clearly makes a great deal of difference to potential purchasers if they don't have to tie up several hundred pounds worth of machine to the product, whether or not that machine is currently in the cupboard.

DC Petter, Heathfield, East Sussex

Apologies if this was not clear. Have any readers found more imaginative uses for the Red Boxes than switching on lights, kettles and the ubiquitous burglar alarm? END

Illustration by Ron Mc Trusty

BANKS' STATEMENT

Passing the bug

It's little consolation to end users that their software boasts 'undocumented features' when all they want is a bug-free product that does the job it's supposed to. Martin Banks presents his version of events.

There is nothing like being doubly sure and well-protected: it must be true, because I read that once in a book. It is something I have often tried to keep in mind, sometimes successfully.

I was doing just that the other week. I'm off soon on a little trip to the States and, as I am scheduled to be landing at Boston, I have been taking some time out to practise circuits and bumps at Boston's Logan Field Airport with the game Flight Simulator.

Yes, I know an Olivetti M21 is not desperately like the flight deck of a 747, but there is nothing like being well-prepared, that's what I say. So round and round I went, and after a bit of practice I got quite confident and, therefore, more daring. Needless to say, I got caught out and found myself lined up nicely to ditch in the sea. To my surprise, instead of going 'splash', as per normal, the thing landed.

There is, I assume, a bug in my copy of Flight Simulator; actually, there are several, but then, what can one expect in a program that only costs some £30. That isn't meant to sound as snide as it seems, for there is every reason to believe that the bug-free program has never been written.

It is a sad fact that every useful program ever written has been issued to an unsuspecting public with all sorts of bugs in it. Given the nature of software this is inevitable, I suppose, for the human race is not terribly logical, especially when it is actually trying to be so.

Faced with this sad fact, what are the results? For example, it was my esteemed colleague, Guy Kewney, who pointed out some time ago that the US Strategic Defence Initiative, 'Star Wars', was really quite frightening given that there would probably only be the one chance to try out the software in its working environment, and that past history in software did not bode well.

He quoted MS-DOS as a prime example. Even with hundreds of thousands of users feeding in their observations to Microsoft, it still comes up with the occasional bug, even now. The biggest and the best in this business cannot create software that is bug-free. Indeed, it has been said about IBM that it has turned the 'bug' into a sales advantage. If enough users complain about a bug which proves difficult to cure, then it is said that the IBM marketing department labels it as a new 'feature'. An increasing number of software companies now talk in terms of 'undocumented features' in their software: you can guess what they mean.

But what does the user get from all this? For the mainframe user with a staff of programmers waiting to maintain as well as create applications, bugs are something that are planned and accounted for. But the average PC user doesn't always have such resources. Certainly, there will be a coterie of users who are aficionados, who like getting their hands dirty by diving into the code of their latest application acquisition.

But for the majority, all that they want is the apparently simple objective of a program that works in the way they expect it to, every time they use it. We all have personal experiences of bug-ridden software — or know someone who has. Many a journalist like myself will have sat in press conferences and sniggered as some over-hyped application program crashes ignominiously during its launch demonstration.

Most often, the cause is something simple, such as in one desktop publishing package I know that has a small bug in its pixel-handling routine. This causes the displayed horizontal image to gently and artistically turn vertical at the horizontal scroll command. Sometimes, however, the cause is more fundamentally stupid on the part of the authors.

I remember, for example, a story of an accounting package written by a software house specialising in scientific applications. They wrote it in the language they knew best, Fortran — just about the least suited language to accounting applications. The result was a package that produced the most amazing invoices, as it multiplied the quantity ordered by the line number, and then by the part number to give a value.

Whatever the cause of the bug, however, the end result to the user is normally the same — aggravation and inconvenience. It has been argued before that the PC software industry could and should do better in ensuring that its products reach the market in a satisfactory condition. While many companies do try, there are enough of the other sort to make users suspicious of all applications.

What is worse, many companies offer poor to non-existent levels of support to the user when a bug is discovered, even an old and well-charted one. You telephone to report the problem and, if the phone is ever answered, you can be met with enough tortuous ducking, weaving and buck-passing to rival the most complex set of nested subroutines.

Occasionally I hear of software companies that have offered users highly praised support and have been able to trace and cure bugs both quickly and efficiently. There seems to be a common theme in these operators; their products are in specialist, vertical markets, and they are expensive.

Now I know this is one of my favourite hobby horses, and that I am about to get on it again, *but*... you do get what you pay for and, given that bug-free software is a practical impossibility for now, paying for support by spending more on the purchase price is maybe an important step. While the economies of scale that PC sales volumes bring do affect product prices, you still can't get something for nothing.

Actually, in this case you do get something, though often it is just a can of worms. END


PHUT
PHUT
SSSSS
FIRING
BOINK
Ron McSmoty

Mac II and Mac SE

The Macintosh has been dismissed by serious programmers as no more than an executive toy, but the introduction of the Mac II and Mac SE to the family should dispel such criticism. Based on an open architecture, the field is now wide open to third-party suppliers. But will slots and colour really establish the Mac standard? Robin Webster puts the new machines through their paces.

Well, it has happened. About three years after the original 128k model was launched, Apple Computer has decided to take the chastity belt off its Macintosh technology with the introduction of the completely 'open' Macintosh II computer and the one-slot Macintosh SE (System Enhanced). The main part of this Benchtest is devoted to the Mac II, but there is also a section on the Mac SE. Before I go ahead, it might be useful to give the reader a quick run-down of what to expect from these two machines.

Clearly the most advanced system is the Motorola 68020-based Macintosh II; it not only supports a 13in colour monitor, but also earns the title of 'open Mac' in that it provides six internal slots for add-on cards. Many developers are said to be already working on specialised cards, including one company that intends to market Intel 8086 and 80286 co-processor boards that will enable the Mac II to run software designed for IBM PC systems (see below).

In appearance the machine is no longer Mac-like. Instead there are now separate units for the system, monitor and keyboard.

The second new machine, the 68000-based Macintosh SE is the next step up from the current Macintosh Plus computer and it retains much of the original Mac's design. The major external change is that there are now two disk drive slots in the front instead of one. In one configuration both slots are occupied by 800k floppies. In the other configuration there is one 800k floppy behind the lower slot and an internal 20Mbyte SCSI hard disk behind the top slot (the slot is blanked off by the front plate of the hard disk). By completely redesigning the inside of the Mac SE, Apple has managed to find space for one internal add-on card slot on the motherboard.

The route from the 'closed' to 'open' Macintosh has been a fairly long and rocky one for Macintosh users.

The breakthrough hardware design of the original 128k Macintosh — a one-piece system unit/disk drive/monitor with only the mouse and keyboard as separate components — was an important part of its appeal to those who were frightened by or fed up with the 'build-it-yourself' approach encouraged by most other major personal computer makers.

There were no boards to install, no switches to set, no bundles of cables with different end connectors to come to terms with: you just hauled the Mac out of the box, attached the keyboard, mouse, and power cable, and switched it on. To get going you then inserted the complimentary MacWrite/MacPaint disk and started work. But this all-in-one notion had its own set of drawbacks.

As more and more serious applications appeared, users quickly found themselves constantly frustrated by two major obstacles: the 128k internal (and essentially off-limits) memory and the single 400k disk drive. Which early Mac user does not remember those sessions spent copying large files with one drive, and the increasing tension as you were asked yet again to insert one of the disks? Or what about those other times when you tried to load the latest version of a document only to be told that the Mac didn't have enough memory to complete the task?

Solutions to these two problems first came not from Apple, but from third parties that disregarded the computer maker's dire warnings about what would happen if they, as unauthorised companies, opened up any Macintosh.

First of all there came memory upgrades that could boost the Mac's RAM to between 512k and 1Mbyte. These upgrades sold like hotcakes, and it even got to the point that some memory upgraders would go to people's homes and do the upgrade *instantly* for a very reasonable price.

Secondly, some of the more daring companies started installing internal hard disks (such as the Hyperdrive) that simply clipped onto the Macintosh system board.

With a decent amount of memory and hard disk storage available, business applications began to appear for the Mac at an ever increasing rate and the machine began to lose some of its 'plastic toy' image.

But it wasn't until the Macintosh Plus appeared last year that users began to see a real future for the machine in the business environment. The Mac Plus came with 1Mbyte of memory as standard, an internal 800k drive, and a new ROM that smoothed out some of the wrinkles of the machine's prior performance. The new SCSI (scuzzy) port with its parallel data transfer also allowed high-performance hard disks to be attached for the first time.

Despite all these considerable improvements, most Macintosh users have maintained a 'wish list' of features that they someday hoped to get from the Mac. Let's see what the Mac II strikes off your list.

Hardware

Unfortunately, the first thing that had to go when Apple decided to design an 'open Mac' was the concept of a one-piece system/monitor/disk drive unit that could be (fairly) easily toted from place to place. There clearly wasn't enough room inside a Mac box to put in all the pieces (see section on the new one-slot Macintosh SE).

As a result the Macintosh II has ended up similar in design (and even in its grey-white colour) to the recently announced Apple IIGS computer: it features a separate system unit, monitor, keyboard and mouse. The system unit measures 5.51ins high x 18.66ins wide x 14.37ins deep. Despite the fact that all the lines are straight and the corners square, the system unit is quite pleasing to the eye.

By itself the Mac II system unit weighs between 24 to 26lbs, depending upon the options installed. The colour display and the swivel mounting that it sits on account for about another 35lbs, so it is fairly *weighty* — the kind of system that will stay where you put it.

To the left of the front panel there is a small green LED that indicates when the power is on. To the right there are two 3.5in floppy disk drive slots set side by side (along with the small holes required to allow the insertion of a paper clip or other simi-

The Eastwood is one of two new Apple keyboards. It comprises 81 keys including a 10-key numeric pad. Note the large on/off switch to the top left

The Saratoga keyboard is larger and comprises 105 keys. These include 15 function keys — useful for IBM-style applications

lar probe in the event that a disk jams and has to be manually extracted). Apart from the name tag, that's all there is to see on the front.

Since the motherboard is placed low-down inside the system unit, all the input/output connectors appear along the bottom back edge. From left to right they are: the on/off switch; the stereo sound jack; two Apple Desktop Bus (ADB) connectors (4-pin); two serial ports (8-pin — still a non-standard version of S5/8); and one external SCSI disk connector (DB-25). To the right of the SCSI port are the six NuBus expansion card slots which are closed off with push-in plastic panels when not occupied. Finally, the right-most back edge has one main power inlet above which there is a monitor power cord socket.

Anyone who has had to worry about whether or not the country they are travelling to has a power supply compatible with their computer equipment can relax with the Mac II. Rather than having just one major design which is then later adapted for foreign markets, Apple has decided to provide the machine with a self-configuring power supply that can handle between 90 to 270 volts AC and input frequencies of between 48Hz to 62Hz. This is a nice touch that removes one of the major hassles of using computer equipment in different countries.

While Apple used a third-party (Insonic) music synthesiser chip in the IIGS, it opted to design a custom sound device for the Mac II called the ASC (Apple Sound Chip). While the original Mac speaker sounded a little bit like someone was holding a handkerchief over it, the standard Mac II sound output is really pretty good and has been enhanced by a sound 'baffle' underneath the system unit that is intended to project speaker output directly towards the user. Technically, the chip is capable of handling four individual voices in single channel mode or, by means of the special onboard stereo sampling generator, the ASC can drive external stereo equipment (speakers, headphones, and so on).

The ASC has a FIFO (First In First Out) as opposed to a LIFO (Last In First Out) architecture: that is, the first unit of data read into the chip

Macintosh SE review

Although the Macintosh SE still looks very much like a Macintosh Plus from the outside, the only main design features that the two machines have in common are the 68000 CPU and the 9in monochrome video tube. Everything else has undergone a major redesign.

At a glance, the most interesting features of the SE are that it is between 15–20 per cent faster than a Macintosh Plus, it has a 20Mbyte internal hard disk option, and it features a single internal expansion slot.

Although you can consider the Mac SE to be a 'bridge' between the Mac Plus and the new Mac II, you should be aware that you cannot upgrade your current machine to be an SE since the hardware differences are so extensive.

Hardware

The most noticeable changes to the original Macintosh casing are that it is now the same grey-white colour of the Mac II and that there are two drive slots in the front panel.

The slots are arranged one above the other rather than side by side as on the Mac II. They may be used for two 800k drives, or the top slot is blanked off when an optional 20Mbyte internal hard disk is installed.

The keyboard connector is no longer located at the front of the machine. Instead the keyboard is plugged into one of the two Apple Desktop Bus (ADB) connectors in the rear of the machine. The mouse is then plugged into the spare ADB connector on the keyboard itself (you can plug it in the other rear ADB connector if you really want to).

The screen brightness control remains in the old position to the left under the display screen.

On the back of the casing, the connectors are arranged in the usual fashion in a row across the bottom edge. From left to right they include: two Apple Desktop Bus connectors; a DB-19 floppy drive connector; a DB-25 SCSI port; two 8-pin serial ports; and an external sound jack. The power-in socket is placed above the sound jack.

This all seems familiar, but above all these connectors is a new feature — a cut-out in the casing to allow internal expansion card cables to reach the outside world! When the cut-out is not being used, it is closed off by means of a push-in plastic blank. When card cables need to come through, they will most likely terminate at some sort of specially designed connector that holds fast in the cut-out.

Despite being an 'almost-open' system, the Mac SE can only be officially opened (that is, the screws can be removed) by an Apple dealer, otherwise you will void your warran-

Externally the Mac SE is similar to the Mac Plus, but the drive slots are now stacked on top of one another rather than side by side (although the upper one here is blanked off). Inside is another story . . .

will be the first out. The combination of this FIFO architecture, a 1 kbyte onboard data buffer, a large amount of internal RAM, and the 68020 CPU means that music data can be fetched, processed and played very rapidly.

A good demonstation of how this arrangement can be useful to those who want to develop music with the Mac II came while I was using the original review machine (there were a number of machines made available). It was hooked up to a couple of Bose stereo speakers (used for Apple IIGS sound demos at launch time and in dealer showrooms) and these sounded marvellous when used to play back a selection of standard music demo files or even some real-time fooling around on an onscreen piano-style keyboard. It was only during one particularly long and complicated piece that I noticed the 'loading from disk' message regularly appearing in one of the music program dialogs.

At the rear two 8-pin serial ports, handled by a Zilog 8530 controller, provide synchronous and asynchronous support for the Appletalk system

The Mac II was actually loading a section of music, playing it and then immediately going back to the hard disk for the next section. There were no giveaway variations in the music output to indicate that this was happening. Impressive stuff.

If you really want the best sound possible, though, you will want to hook the Mac II up to external

ty. This could be a problem for you if the best deal on a multi-function card is to get it by mail-order — paying a dealer to have it installed could well wipe out any savings you manage to make on the card purchase. This does seem to be a potential area for unnecessary frustration, but given what's happened with other Macintosh models I'm sure that users will find a way around the situation.

Once you've popped the top off the SE, you can see that the motherboard has undergone quite a dramatic change. It is still located at the bottom of the machine but the chip count is markedly different. The reason for this is that Apple has put the circuitry of about 19 previously independent chips onto a single gate array unit (see the photo). This ensures that there is enough extra space on the board to include the single 96-pin expansion connector. Expansion cards will themselves have to pack all their features onto a 4in x 8in area to fit flat on the motherboard (see the main Benchtest about cards announced by AST Research).

The SE comes with 1Mbyte of RAM as standard; and this can be expanded up to 4Mbytes. RAM is in the form of surface-mounted 256kbit RAM modules supplied as standard. 1Mbit modules will be used for upgrades. A new 256k ROM chip has also been included, although the ROM code is said to be only just a little over 128k in size.

I mentioned above that the Mac SE is supposed to operate about 15–20 per cent faster than a Mac Plus. One way that the Apple designers achieved the increased performance was by changing the way in which the CPU handled data processing versus video display tasks. Whereas the 68000 spent an almost even amount of time taking care of data and video processing tasks on the Mac 512k and Mac Plus, the processing cycles on the Mac SE's 68000 are split differently: there are three for the CPU, and then two for the video, three for the CPU, and so on. It may seem a small change, but the performance increase (plus other go-faster tricks such as putting some o/s instructions into firmware and using data cacheing techniques) means that you can recalculate large spreadsheets about 20 per cent faster.

By providing the option of a hard disk and packing so much hardware inside the Mac case, Apple was forced to finally give in and install a small electric fan in the SE. It is of a 'squirrel cage' design and is quiet in operation. Also, the system clock is now powered by an onboard 7-year lithium battery.

Benchmarks

Note: These tests were carried out using compiled Microsoft Basic files (Microsoft Basic Compiler for the Macintosh)

Intmath	1.04 seconds
Realmath	0.60 seconds
Triglog	6.4 seconds
Textscrn	1 minute 40 seconds
Grafscrn	16.8 seconds
Store	4.8 seconds on SE 20Mbyte hard disk; 6.4 seconds on floppy

For a full explanation of the PCW Benchmarks, see the December 1986 issue, page 164

System software

The Mac SE will run virtually all existing software, according to Apple. I wasn't able to contradict this statement with the range of standard applications that I used for testing.

Price

No final prices were available at press time but the Macintosh SE price range is stated as being between £2495 for a dual floppy machine and £3195 for a 20Mbyte hard disk.

Conclusion

The Macintosh Plus was the first of the Macintosh family of computers that business people didn't feel too embarrassed to work with; the Mac SE should remove any lingering doubts in their minds. It demands attention as a powerful business computer that stacks up well against other PC competitors.

Technical specifications: Mac SE

Processor:	Motorola 68000 running at 8Mhz
RAM:	1Mbyte standard. Expandable up to 4Mbytes
Expansion:	One expansion slot on motherboard
ROM:	256k
Mass storage:	Two 800k, 3.5in floppy drives or one 800k and an internal 20Mbyte SCSI hard disk
Display:	Standard Macintosh 512 x 342 pixel screen
Keyboards:	Can use any Apple Desktop Bus compatible keyboard, including IIGS model
Standard interfaces:	Two ADB connectors; two serial ports; one SCSI hard disk interface; sound jack
Operating system:	Apple Macintosh

MIDI equipment and music synthesisers. The Mac II does not itself feature a MIDI interface that can be linked directly up to music synthesisers, but it can be made to send/receive MIDI interface compatible signals via one of the serial ports.

The two serial ports, handled by a Zilog 8530 controller, provide synchronous and asynchronous support for the Appletalk network system.

The SCSI connector is the standard 25-pin interface that supports 8-bit parallel data transfers at around 1.5 Mbits per second.

The Apple Desktop Bus (ADB) is a low-speed data bus which operates on the master/slave principle. The Mac II CPU acts as the master and all ADB connected devices — up to 16 devices, such as keyboards, mice and graphics tablets, may be daisychained — act as a slave to it.

Whenever there is an ID conflict among the various devices attached to the ADB circuit, the Mac II can resolve the situation by assigning new IDs to the relevant devices. The new IDs are only assigned and maintained during a single working session. The practical application of all this is that, for example, a teacher can control the main system while up to 15 students use keyboards on the same ADB circuit, or many people could simultaneously use mice to play a multi-user game.

Whereas the 128k Mac could only be opened by upgrade artists using an extra long screwdriver with a star bit to reach the recessed screws, the Mac II requires the use of only two fingers. Two small tabs protrude out of the top edge of the system unit on the back. By simultaneously pressing both in and lifting upwards, the lid comes free to reveal a neatly laid out interior. It's worth noting that, in keeping with the automated manufacturing process used in building the original Mac, the Mac II's internals have been engineered so that they can be dropped, aligned and fastened into place by factory robots. There is a real benefit to the user from all this careful design work — it doesn't take much brainwork to figure out how to disassemble the machine if it ever becomes necessary (that is, replacing a disk drive or adding more memory).

To the front right of the inside is space for two floppy drives — one 800k drive comes as standard. These are the usual Sony 800k double-sided drives and they will, therefore, accept and read disks prepared on any other Mac (there was no word on the possibility of eventually using the 1.6Mbyte drives that are currently being produced by Sony). Behind the floppy drives is mounted the optional SCSI hard disk (20, 40 and 80Mbyte SCSI models).

The Apple SCSI drives on the Mac II operate at the ideal interleave ratio of 1/1 and this makes them very fast indeed. In comparison, the hard drives on the Macintosh SE and the Mac Plus run at interleave ratios of 2/1 and 3/1 respectively. Apple is offering options of 20, 40 and 80Mbyte SCSI hard drives for internal or external attachment; the review machine was equipped with a 20Mbyte model. The good part of all this is that applications and files load and run faster and the Mac 'wristwatch' icon is around for much briefer periods than you may have become used to. The chore of waiting to return to the Finder after using an application is also a thing of the past.

Available for the Mac is Colour More from Living Videotext. Colour More is unusual in that it not only provides colour options for what appears inside the Macintosh windows, but you can actually select colour for the window frame itself

The floppy and hard drives are mounted on a single sheet of aluminium that is itself mounted to the main system chassis by only about four screws. By removing these screws you can push the drive aside and gain access to the motherboard with its 68020 chip, 256k ROM (up from 128k on the older machines), and RAM chips.

Closest to the front of the motherboard are the Motorola 68020 32-bit CPU and the standard Motorola 68881 floating-point co-processor. Immediately behind the 68020 lies the socket for the optional Motorola 68851 memory management unit which is required if you wish to run Unix on the Mac II. If you really want to get an idea of how fast the Mac II can be, just get a demo of the system running a piece of software that supports the 68881 co-processor — its performance is nothing short of stunning compared with a Mac Plus or Mac SE.

The ROM and RAM chips are located towards the back of the board near to each other. Apple has decided to go with surface-mounted 256kbit RAM chips to provide the standard 1Mbyte of memory, but this is expandable to 8Mbytes on the motherboard by replacing the 256k modules with 1Mbit chips. If you want to go further than that you must look to the six NuBus add-on card slots located between the disk drives and the power supply which can be used to push the total memory capacity beyond 2Gigabytes.

The six expansion card slots provided by the Mac II are based on the NuBus standard, a bus architecture optimised for 32-bit data transfers. Engineers I spoke to both inside Apple and at third-party developer sites had good things to say about NuBus. Typically, they referred to the 'power' and 'flexibility' of the system.

In terms of power, the NuBus architecture supports full 32-bit addressing providing for an ultimate total of 4Gigabytes of addressable memory. Three data sizes — 8-bit (byte), 16-bit (half-word), and full 32-bit (word) — may be transmitted synchronously at speeds of up to 10Mhz.

In the Mac II you can certainly have 8Mbytes of RAM on the motherboard and theoretically support another 2Gigabytes or so via the NuBus slots.

While the hardware specifications look good, there are two current software limitations with regard to NuBus resident memory on the Mac II. One limitation is that applications developed for the 68000-based Macintosh systems perform 24-bit addressing, and so 24-bit to 32-bit conversions have to be carried out by the 32-bit Mac II. Apparently, one implication of this is that you will only be able to access a maximum of maybe 1Mbyte of memory per slot while running software that uses 24-bit addressing.

The other problem is that since Mac software has always been designed to expect contiguous memory spaces (there has never been anything else!), when it comes to using NuBus resident RAM memory there will be maybe a 40 per cent to 50 per cent degradation in access speeds. Given the overall power of the 68020 it remains to be seen whether this is a significant problem or not.

In terms of flexibility, NuBus is intended to remain independent of any specific system architecture; can support multiple processors; and overcomes the need to set internal configuration switches or jumpers by requiring ID ROMs on each NuBus card. The ID ROM not only tells the Mac II where a particular card is installed (a geographic location), but it also informs the system as to the card's capabilities. Each time the Mac

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II is switched on, the operating system checks each available ROM and then ensures that the card is properly initialised and that any required drivers are installed.

Fig 1 shows how standard NuBus address space may be allocated. The upper 256k of the total 4Gigabyte NuBus address space is reserved for what is called 'slot space'. This 256k is then sectioned into 16 areas of 16Mbytes each that correspond to the sixteen possible NuBus card slots or ID codes. The remaining address space is pretty much left up for grabs by the system and/or attached NuBus devices.

NuBus-style cards intended for use in the Mac II are of a similar size to the type of full-size card you would install in an IBM PC. They feature 96-pin edge connectors and a single hexagonal head screw is used to fasten the board into place inside the Mac II.

One company that announced new hardware for the Mac II and Mac SE in time to be included in this review was AST Research of Irvine, California.

The Mac II products are exciting in that they form part of the solution to running PC and Unix software on the Apple system. AST will be selling two co-processor boards — one with an Intel 8086 and another with an Intel 80287. Combine this with an external 5¼in PC-style disk drive (to be manufactured by Apple) and the right kind of software (reportedly being developed by Phoenix Technologies in the US), and you should be able to run all major IBM software packages on the Mac II.

A 4Mbyte memory card, called the AST-RM4, was also announced.

The two SE products described were grouped under the product family name 'MacPak'. They include: a multi-function card that features a 68020 chip with 68881 co-processor and 1Mbyte of RAM; and the AST-ICP intelligent communication processor card which features a 68000 CPU, 512k of RAM and four serial ports.

The ICP card will support AppleTalk, AppleToken, X.25 and SNA communications protocols, according to AST.

Many users may want to use the 12in monochrome monitor first since this is what the Mac II supports as standard. The standard video card (with a one to four bits per pixel range and 256k RAM onboard) provides the ability to display up to 16 shades of grey on the mono monitor. By upgrading the video card to 512k of frame buffer RAM, you can then have up to eight bits per pixel which translates into support for 256 colours or shades of grey from a look-up table of 16.8 million colours.

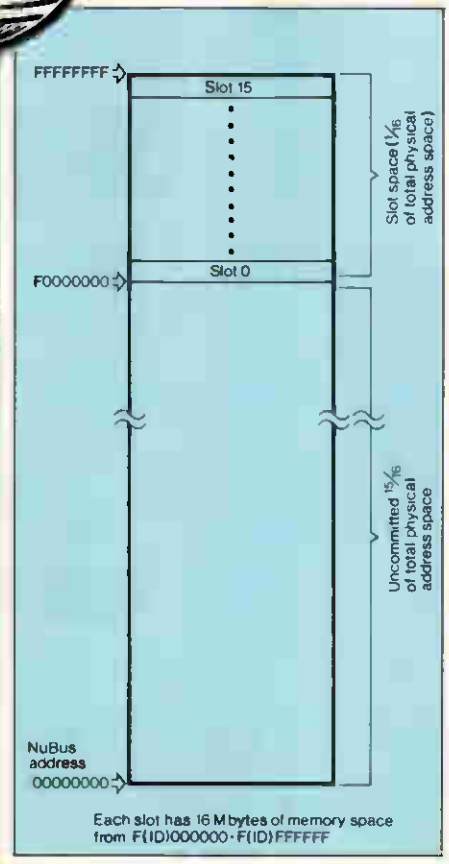

Fig 1 NuBus address space

The Mac II colour monitor is a 13in Sony Trinitron unit with some unusual features. Firstly, its vertical refresh rate (number of scans per second) is set at 66.7Hz instead of the more typical 60Hz. Secondly, the red/green/blue screen mask has apertures of only 0.026mm in diameter compared with the more typical 0.031mm.

The net effect of these two features is that the monitor is capable of producing very high quality 640 pixel x 480 pixel colour or monochrome images (compared with 512 x 342 pixels on the standard Mac Plus screen).

The colour, for a colour monitor, is great; the black and white, for a colour monitor, is excellent. The only difference you'll notice is that while displaying monochrome images the desktop grey pattern is slightly paler than it appears on the standard 9in Mac screen.

Except for an early prototype which got a bad case of the jitters and had to be left to cool down for a while, the Mac II colour monitor produced a rock steady image that was free of any undesirable colour hue.

At first it's a very odd feeling seeing the Macintosh interface and all your favourite applications up on these relatively large screens. Having been constrained within the boundaries of a 9in screen for so long, it's easy to move the cursor around a little wildly at first — but you soon get the hang of it. As with prior Macs, the Mac II control panel allows you to ratio cursor movement in relation to mouse movement if you need to slow things down a bit.

Two new keyboards have been announced by Apple that can work with the Mac II, the Mac SE, or the IIGS for that matter.

The first, codenamed the Eastwood, is an 81-key model that features a 10-key numeric pad on the right-hand side. It has two Apple Desktop Bus connectors, one at either end: one is used for connecting the keyboard itself to the system unit; the other is used to attach the mouse to the keyboard. A large switch key is placed along the top left of the keyboard and this is used as a convenient system on/off switch, although both the new machines have separate power switches on their real panels.

The Eastwood is virtually the same size and has the same functions as the Apple IIGS keyboard.

The second keyboard, codenamed the Saratoga, is a much larger keyboard in that it has 105 keys including: a group of four cursor control keys arranged in an upside-down 'T' pattern; a 10-key numeric pad; and, most significantly, 15 function keys.

The main idea behind including the function keys is that this makes it really easy for users to work with IBM-style applications on the Mac II when they are supported by co-processor boards sporting Intel 8086 and 80287 chips. Unlike the PC keyboard, the Saratoga's function keys are set in a line above the main alphanumeric keys and are grouped into three sets of four and one set of three keys.

I had the opportunity to use both keyboards and felt that they were just fine. However, I'm not sure that I like the way that the mouse is connected to one edge of the keyboard instead of directly into the system unit. This arrangement does tend to result in a little more cable 'snaking' around the desk than you might like.

The low-profile mouse supplied with the Mac II and the Mac SE uses a mechanical tracking/optical shaft encoding mechanism to communicate x/y coordinate data to the system unit. A single button is provided for selection purposes.

System software

At the time of writing the new System and Finder files have not been finalised and so it is not clear what features the release versions will

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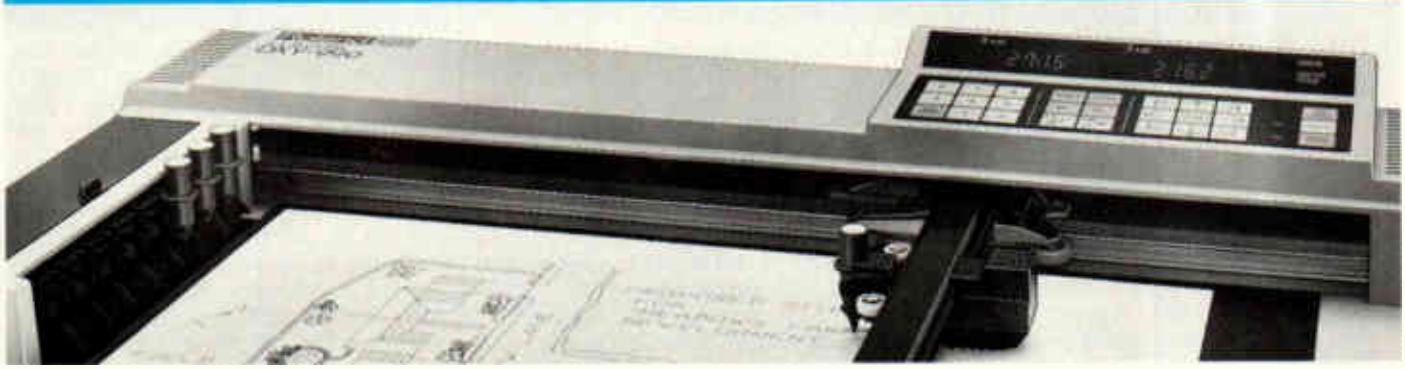

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actually have. Certainly, the new environment will definitely not feature any multi-tasking capabilities as some people had hoped. In the near term it seems much more likely that Apple will instead take many of the features in Andy Hertzfeld's Switcher application and fold them into the Finder to provide multi-application work environments.

Those users who want multi-tasking right now will have to buy the optional Motorola 68851 memory management unit (PMMU) to run Unix System 5, version 2 that is to be made available.

Multi-tasking aside, there are a number of added system features that can still be usefully mentioned here.

To begin with, the Finder interface will retain almost all of its monochrome characteristics — in keeping with Apple's exhortations to third-party developers about using colour features sparingly and appropriately. The main way to tell when you are in colour display mode is by looking at the Apple menu at the top left of the screen — in colour mode the small Apple image appears in full rainbow colours, just like the company's logo. Also, whenever colour images are displayed, the mouse cursor is given the same rainbow colours so that it can be clearly seen — no matter what the background colour.

Note: On a Mac II provided for this review, there was one feature that didn't seem to be on the other machines I used. When I copied files from a floppy disk I noticed that the name of the duplicate file in the destination window/folder was displayed on a light yellow background until that file was itself selected with the mouse. Everything else remained monochrome. There was no confirmation as to whether this feature would appear in the final version of the Finder.

A further feature now added to the 'Options' menu is Restart which relaunches the Finder. Shut Down now performs a software power off on the Mac II — the switch at the back is in fact only a power 'on' switch.

A major development, although it seems subtle at first, is the restyled Control Panel. Whereas the first Control Panel was essentially a Macintosh version of the old Lisa 'Preferences' feature, the new Control Panel has been turned into a general-purpose application. In addition to being able to set general options (the mouse characteristics, the RAM cache size, the speaker volume, or the background desktop pattern, and so on), the new version (see Fig 2) has a scrollable window on the left-hand side that will display a variable number of selectable icons.

As each different icon is selected, the window to the right is updated with new features or some special configuration program is launched.

An example of the latter is an RGB gun-focussing program which displays a full-screen cross ('+') and allows the user to adjust the colour focus control until the separate red/green/blue gun scans combine into single white horizontal and vertical lines. It's sort of like the Mac II's equivalent of the BBC Test Card.

Control Panel options will apparently be installable in much the same way that you might install a laser printer driver or any other device driver on current Macs. Third parties are said to be developing drivers even as I write.

One desk accessory available under the review machine's Apple menu was called the VidPicker, although this may not be its final name. Choosing this option displayed the dialog box shown in Fig 3.

The idea behind the VidPicker is that it allows you to pick the monitor mode — black and white versus colour — and the number of bits per pixel that video cards installed in the Mac II might support.

Note that the titles for slots 4 and 5 are greyed, indicating that there are no video cards installed in either position. The VidPicker 'knows' which card is installed where via the ID ROMs that reside on each NuBus add-on card that is installed. This approach overcomes the need to set DIP switches every time a card is installed or swapped for a different one. To actually use the VidPicker all you do is select the monitor mode you wish to use and then click on the 'Accept' button — this sends a redraw command to the relevant video card and the screen image is redisplayed in the correct manner.

An interesting note related to the various bit levels used in producing images is that, in the future, applications developed specifically for the Mac II will be able to switch these levels intelligently as the situation requires.

Apple's handling of screen colours is particularly clever. From the control panel, and also under software control, it is possible to assign between one and eight bits to each screen pixel. This means that accessing extra colours gobbles up memory but keeps the screen resolution the same — 640 x 480. Assigning the maximum of eight bits per pixel allows the selection of up to 256 colours out of a palette of 16.8 million.

Since it requires a lot more work to scroll a full-colour image than it does a black and white one, colour graphics programs (for example) might support a full eight bits per pixel for displaying images but automatically switch to lower bits levels when the user wants to scroll the screen. I checked this out manually on the test machine to see how much of a difference this would really make and, believe me, it was dramatic.

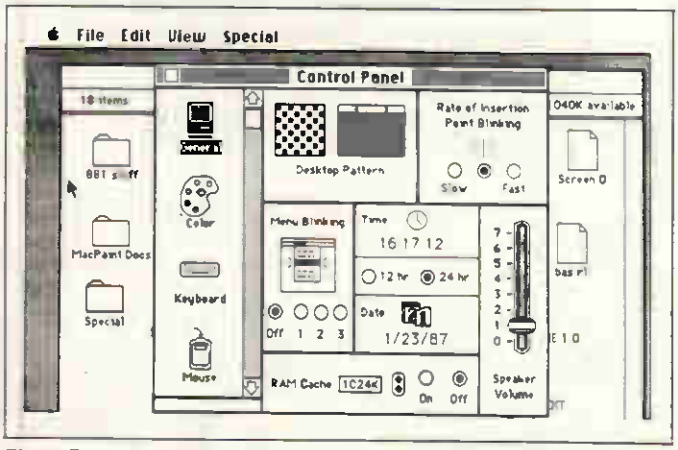

Fig 2 The general-purpose Control Panel allows you to set various options as before, but a new feature is the scrollable window which displays selectable icons

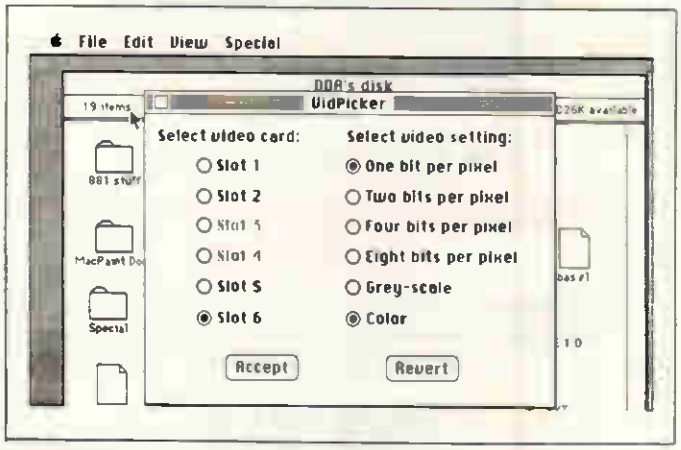

Fig 3 The VidPicker desk accessory sets the pixel depth. This determines in turn how many colours you get on the screen

There are two 'cute' changes that the Apple software developers intend to include in the new Finder. One is a trash can icon which expands in size (it bulges, actually) as unwanted items are dropped into it, and which then sinks back to its original form when the 'Empty Trash' option is selected. The other is a wristwatch icon that has revolving minute and second hands. This particular feature is not original though — there has been a file called 'Macwait.Init' available for some time via bulletin boards in the US that does the same thing on standard Macs.

Applications software

Apple claims that both the Mac II and the Mac SE are highly compatible with existing Macintosh software. To test this I tried out some of the popular applications. Most of them ran just fine with the notable exception of Flight Simulator which features some rather naughty and non-Mac standard programming tricks.

And that seems to be the main dividing line between software that will work and that which will produce a system crash. If an application goes looking for a specific device at a specific system address it may not find it and, therefore, cause a system crash. If it uses the correct system calls everything should be OK.

Many public domain programs constantly live on the edge of extinction since they don't necessarily conform to Apple's Macintosh software design guidelines, so I tried out a few of them as well. Interestingly, most of them loaded just fine. The major problem was that the programs assumed that they were working on a 9in screen and would, therefore, not use all available space on the larger 12in and 13in Mac II monitors. Alternatively, the programs would assume an incorrect starting point and so place most of an image off the screen or wrap it around in some bizarre manner.

Obviously, for some, the most important feature of software for the Mac II will be whether or not it supports the features of colour QuickDraw code in the new 256k ROM.

Although not everybody is aware of it, QuickDraw, the Macintosh graphics package, has always been able to support colour to some degree. Until the Mac II the only way to see this was when you used some program that used QuickDraw's colour abilities to send output to colour hard copy devices such as plotters; Cricket Graph is just one example.

Developers could also use Macintosh Pascal to write programs that called QuickDraw's colour routines directly even though colours other than white appeared as black on the monochrome screen. The Pascal constants used for this purpose are: blackColor; whiteColor; redColor; greenColor; blueColor; cyanColor; magentaColor; and yellowColor.

While reviewing the Mac II, I made the discovery that Microsoft Basic for the Macintosh already supports colour even though this feature is not openly documented.

To draw a black rectangle with MS-Basic you could use the following LINE statement:

LINE(10,10)-(100,50),33,bf

where the number 33 is the accepted value for black and the 'bf' indicates that Basic should draw a box at the given coordinates and fill it with the specified colour. If the number 30 were used instead of 33, the rectangle would be filled with white: that is, it would appear as an empty outline on the mono screen.

Price

Final pricing for the Mac had not been set at the time of writing but an Apple spokesman said that it should retail for around £4500 for a single floppy machine and £5500 with an additional 40Mbyte internal hard disk.

Documentation

No documentation was available for the review.

Conclusion

The excitement that surrounds the Mac II does not necessarily come from any single technological breakthrough. Certainly the use of the powerful 68020 chip and its 68881 co-processor places it firmly in the 'advanced machine' league. Certainly the colour capabilities of the system are excellent. It's nice to have six expansion slots as well. But many machines already boast powerful CPUs, expandability, and colour.

The really important thing about the Mac II is that it marks Apple's entry into the realm of serious computing. All of the machine's components are married together in such a smooth manner that the Macintosh user interface, with its icons and select-and-go approach, becomes a tremendously efficient working environment instead of just a nice 'user-friendly' piece of code. You can disagree with any number of individual design details on the Mac II, but you can't call it a toy. END

Benchmarks

These timings were obtained using compiled Microsoft Basic files. Please note that because of the extra work involved in 'bit-blitting' images on the larger Mac II screen (12in mono or 13in colour), the time for the Textscrn Benchmark does not fully represent the speed difference between the Mac II and the Mac SE.

Intmath	0.26 seconds
Realmath	0.16 seconds
Triglog	1.68 seconds
Textscrn	2 minutes 6 seconds (full Mac II 13in screen)
Grafscrn	8.0 seconds
Store	2.36 seconds on 20Mbyte hard disk 5.2 on 800k floppy disk

For a full explanation of the PCW Benchmarks, see the December 1986 issue, page 164

Technical specifications: Mac II

Processor:	Motorola 68020 running at 15.6MHz
Co-processor:	Motorola 68881 floating-point device
RAM:	1Mbyte standard expandable up to 8Mbytes onboard and 2Gigabytes via NuBus add-on slots
Memory management:	Optional Motorola 68851 memory management unit, available for running Unix on Mac II
ROM:	256k
Mass storage:	Up to two 800k 3.5in floppy disk drives plus a 20, 40 or 80Mbyte SCSI hard disk installed internally or externally
Displays:	12in monochrome monitor providing 640 x 480 pixel resolution. 13in colour monitor providing 640 x 480 pixel resolution
Video card:	Apple custom video card featuring 256k RAM as standard that provides support for up to 16 shades of grey. Upgraded video card with 512k of RAM provides support for up to 256 individual colours from a look-up table of 16.8 million colours
Keyboard:	Any Apple Desktop Bus compatible keyboard
Standard interfaces:	Two 8-pin serial ports; one DB-25 SCSI port; two Apple Desktop Bus connectors
Expansion slots:	Six NuBus standard card slots
Sound:	Apple Sound Chip providing 4-voice, single channel output or capable of driving external stereo equipment
Power:	Self-configuring power supply capable of handling voltages between 90 to 270 volts AC and input frequencies of between 48 to 62Hz
Operating system:	Apple Macintosh

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_____ Telephone _____
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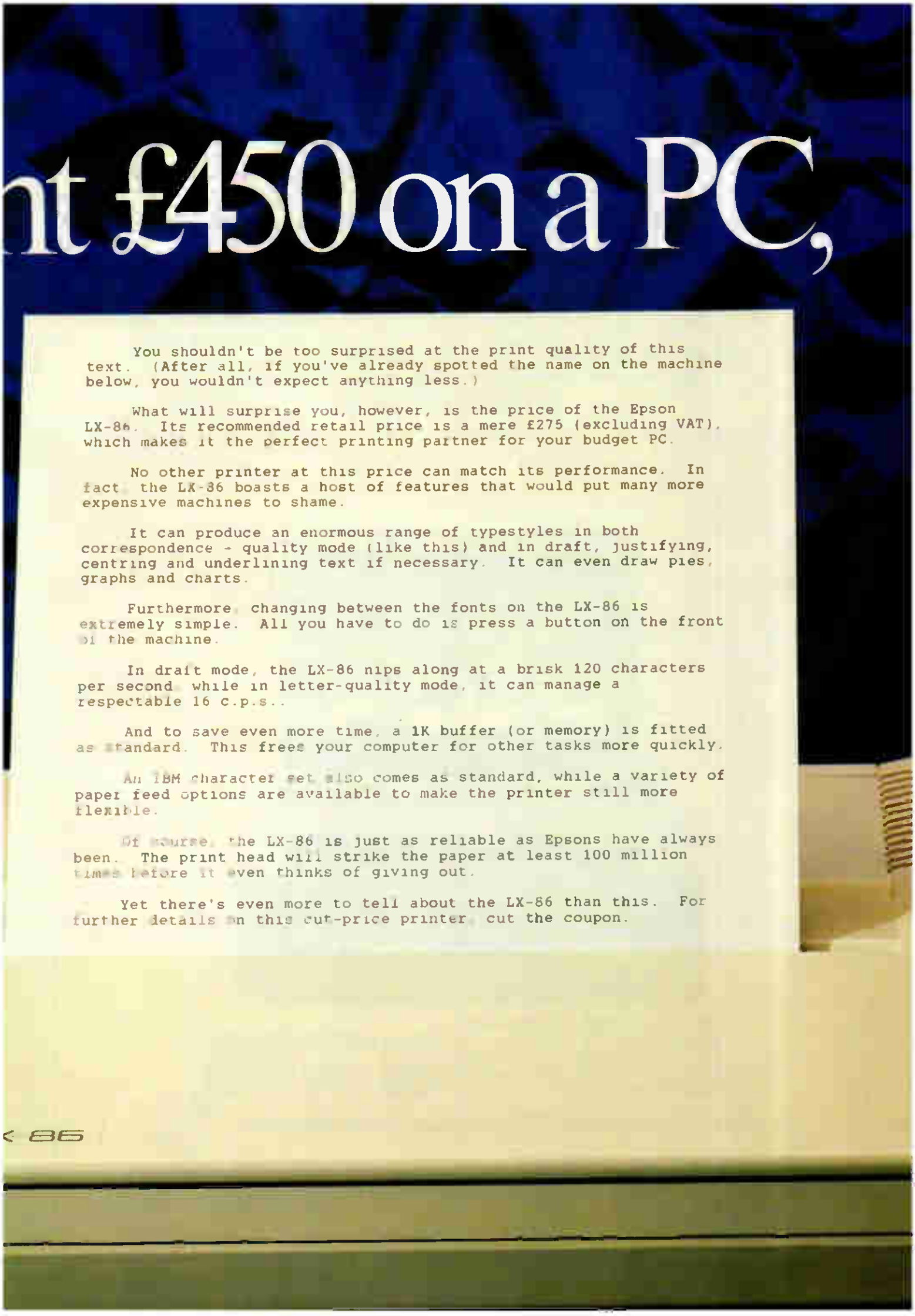


nt £450 on a PC,

You shouldn't be too surprised at the print quality of this text. (After all, if you've already spotted the name on the machine below, you wouldn't expect anything less.)

What will surprise you, however, is the price of the Epson LX-86. Its recommended retail price is a mere £275 (excluding VAT), which makes it the perfect printing partner for your budget PC.

No other printer at this price can match its performance. In fact, the LX-86 boasts a host of features that would put many more expensive machines to shame.

It can produce an enormous range of typestyles in both correspondence - quality mode (like this) and in draft, justifying, centring and underlining text if necessary. It can even draw pies, graphs and charts.

Furthermore, changing between the fonts on the LX-86 is extremely simple. All you have to do is press a button on the front of the machine.

In draft mode, the LX-86 nips along at a brisk 120 characters per second, while in letter-quality mode, it can manage a respectable 16 c.p.s..

And to save even more time, a 1K buffer (or memory) is fitted as standard. This frees your computer for other tasks more quickly.

An IBM character set also comes as standard, while a variety of paper feed options are available to make the printer still more flexible.

Of course, the LX-86 is just as reliable as Epsons have always been. The print head will strike the paper at least 100 million times before it even thinks of giving out.

Yet there's even more to tell about the LX-86 than this. For further details on this cut-price printer, cut the coupon.

< 86

Amiga 2000

Commodore's efforts to penetrate the business market have so far met with little success. The specification for its two new launches, the A-2000 and the A-500, is very impressive and should guarantee the machines their rightful place in the market. Julian Rosen and Nick Walker test them out.

Just over a year ago, Commodore launched the Amiga-1000 at the Which Computer? Show amid a flurry of press hysteria proclaiming the machine as the 'shape of things to come'. Now a year later the company has moved from Corby to Maidenhead and shrunk considerably in size. The A-1000 is only just beginning to sell in reasonable numbers following a recent price-cut, but the software market is still looking distinctly sparse apart from numerous games and hackers' tools.

Initially Commodore discouraged games software for its machine and tried to push the A-1000 as a general-purpose business machine, but after disappointing sales Commodore decided to re-focus its attention on specialist vertical market niches. Despite this the machine has chiefly sold to two groups: affluent game-players and hackers fascinated by the machine's powerful chip-set.

Now Commodore is launching two new Amigas in an attempt to capture both the business and the low-end, home user markets. This Benchtest concentrates mainly on the business machine, the Amiga 2000, but a brief description of the low-end Amiga 500 is included as a separate review.

With one 3½in drive and one 5¼in drive, the front of the 2000 looks like a peculiar hybrid machine

In order to give full IBM compatibility, Commodore now includes a PC/AT standard keyboard

Hardware

Externally the Amiga 2000 looks very much like an Amiga 1000 grafted on top of an IBM PC clone. The box is approximately twice the height of the 1000 and has a slightly larger footprint; the increased box size being dictated by the A-2000's ability to accept IBM PC/AT expansion cards. As is the case with PC/AT clones I found this system box too cumbersome to sit neatly on a desk-top and was disappointed that there was no facility to stand it on its side underneath a desk.

The Amiga 2000 has inherited most of the 1000's fine collection of ports. These consist of: composite video, analogue RGB, left and right stereo sound, a serial port, a Centronics parallel printer port, an external floppy disk port, a keyboard and two joystick/mouse ports.

The serial port has lost its non-standard extra power lines and changed sex, which means that it now conforms to the original 25-pin RS232 standard. The original pin-out is maintained as a set of vertical pins on the PCB for manufacturers who have created peripherals for the old scheme. The DIN socket (originally designed for an external TV modulator) has also been taken inside and now needs a small PCB-mounted modulator. The two mouse/joystick ports and the keyboard socket have been moved to a recess at the front, which to my mind is the sensible place for such things. Unfortunately, for some peripherals such as Mimetics' sound sampler, the recess makes connection impossible. This is easily rectified by an extension cable which some entrepreneurial company will no doubt supply in due course.

Internally, everything has changed. The relatively simple two-level circuit board of the 1000 has been replaced by one large PCB that covers the entire base of the machine. The right-hand side of this board is covered by a 'disk cradle' which is capable of holding up to three storage devices. The top of this cradle will take two 3½in devices and beneath this can sit one half-height 5¼in device. These can be floppy disks, hard disks, tape streamers or any other device that behaves like a generic storage device. The review machine had one 3½in floppy drive, one 3½in hard drive and a 5¼in floppy drive. I suspect that this will be the most popular arrangement as it gives maximum flexibility.

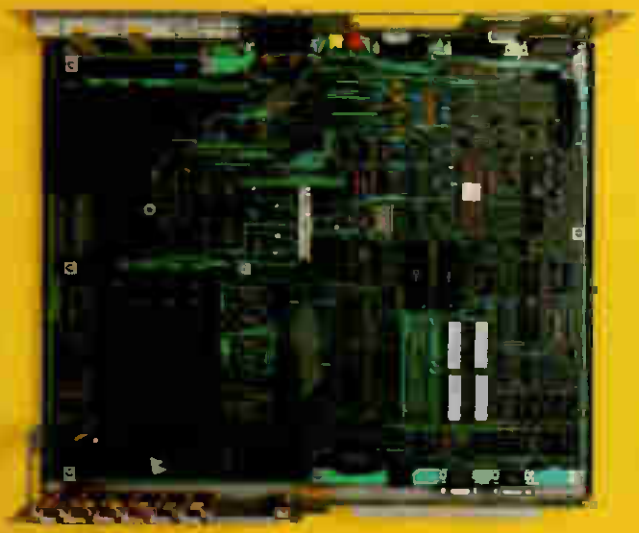
I was impressed when I first saw the Amiga's PCB, not particularly because of the quality, but because of the low chip count. On the A-2000 this chip count is further reduced by using larger RAM chips and integrating the control circuitry into fewer chips. The overall impression is one of a computer that consists of just four main chips, an enormous 68000 and the three fabled custom chips, Agnes, Paula and Denise. The processor is still a straight Motorola 68000 running at 7.159MHz and not the more powerful 68020 that many people were expecting.

The A-2000 comes with 1Mbyte of RAM as standard. On the review machine 512k of this was on an expansion card but production

machines should have the full 1Mbyte on the main PCB. For the more sophisticated Amiga applications, such as real-time sound sampling, this is expandable to a maximum of 10Mbytes. Commodore supplies two internal user-configurable RAM cards. The 2Mbyte board comes with either 512k, 1Mbyte or 2Mbytes fitted and the 8Mbytes board with 6 or 8Mbytes fitted. ROM on the new Amiga has considerably increased as the 'Kickstart' operating system is now entirely in ROM. The previous Amiga had such a good system of loading the OS into RAM (once loaded, the RAM was totally write-protected, so Kickstart needed loading only once per session) that the benefits of having Kickstart in ROM will not be apparent. Having Kickstart in ROM reduces the number of disks needed to boot-up to one, which considerably speeds up the process and gives Commodore tighter control over issuing new versions. However, upgrades will now involve inserting a new ROM chip rather than simply a change of disk.

It is of course the custom chips that give the Amiga its real power. The three custom chips remain exactly the same in the new A-2000, and Commodore assures us that the only variation we might see in the near future are 32-bit wide versions which will operate in conjunction with the 32-bit 68020 processor. It seems that much confusion has arisen over exactly what these chips do, probably due to the diversity of each chip's function. (For a full explanation of their capabilities, see the original Amiga review in *PCW*, August 1985.)

We will, however, summarise the position briefly. Agnes is fundamentally the 'blitter' which means it can move and modify large areas of screen directly without affecting the processor. Because of its direct memory access (DMA), it has also been assigned the task of moving (not creating or monitoring) sprites and transferring disk data to and from buffers. A supplementary function of Agnes is that it also has the ability to draw lines into video RAM,



The Amiga's PCB is roughly divided into two: on the right there are two bus systems, IBM and Amiga; on the left, the processor and custom chips dominate the board. The IBM bus system does not come to life until a 'bridge-board' has been inserted

The technology of an IBM PC has now developed to such an extent that it can occupy half an expansion card

Amiga 500

Along with the A-2000, Commodore is launching a smaller but totally compatible version of the A-1000 called the A-500. Cased in a Commodore 128-styled box, the A-500 comes with 512k RAM, a built-in 880k 3½in double-sided drive, a 95-key keyboard identical to the A-2000's with an expansion bus on the left-hand side, a modulated TV output, and a RAM expansion socket on the underside. The expansion bus is identical to that of the A-1000 but the low-profile casing will make it impossible to connect existing Amiga peripherals. The disk drive is on the right-hand side of the machine, Atari ST-style.

To expand the RAM, you simply remove a panel from the underside of the machine and slot in an additional 512k of RAM. All very elegant but it does mean that to take the A-500 past 1Mbyte you will need to buy an expansion cradle of the kind currently available for the A-1000. As on the Commodore 128, the power supply is now external and the size and weight of a hefty house brick.

In order to fit the electronics of an Amiga on a 128-size PCB, a new version of Agnes, the blitter and DMA chip has been produced. Renamed Fat Agnes it now incorporates much of the surrounding control circuitry or 'Glue' chips as they are commonly known. Altogether, with a US price of $650 or less this machine could take the market by storm. If Commodore managed to introduce it into the UK soon enough and succeeded in persuading such High Street chains as Dixons to stock it, a rolling demo of its sound and graphics capabilities would almost guarantee the machine sales.

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once again without slowing down the processor.

Paula, once known as Portia, has two main functions in life: looking after any peripherals, such as disk drives; and creating the Amiga's sound. Paula controls four sound 'channels'. These differ from the normal sound 'voices' in that a channel can produce a waveform and not just a frequency. This means that one channel on the Amiga is capable of simulating an entire orchestra compared with one voice on other machines simulating one instrument.

Finally, Denise, formerly Daphne, controls all the non-blitter orientated video operations. These consist of display animation and sprites; and colour bit-plane control, including the fantastic hold-and-modify plane which allows you to change the colour palette as a screen is drawn, providing up to 4096 colours per screen.

One drawback of the custom chips is that they can only operate on one particular chunk of 512k of RAM, known as chip RAM. However, this does mean that the remaining 512k and any expansion RAM is connected directly to the processor and can only be accessed by the processor at full-speed. This RAM is consequently known as 'fast RAM'. Overall the graphics and sound abilities of these chips are still unparalleled in the micro world, although the Apple IIGS's sound comes close.

The A-2000 has two overlapping bus systems, consisting of four 100-pin Amiga slots and five IBM PC slots. Three of the IBM PC slots are of the extended 16-bit PC/AT type. The IBM PC bus system is inactive until a 'bridge-card' connects the two systems at one of the two points of overlap and supplies the power to bring the IBM bus to life.

The review machine was supplied with an 8088-based bridge-card with all the supporting chips necessary to make this second processor a true IBM compatible. What Commodore has in effect done is to take the IBM PC Amiga add-on Sidecar and incorporate it into a single expansion card. The IBM compatible actually occupies about four square inches and consists of the Intel 8088 processor running at 4.77MHz, 256k of RAM, a floppy disk controller, ROM BIOS and even an empty socket for a 8087 maths co-processor.

'The overall impression is one of a computer that consists of just four main chips, an enormous 68000 and the three fabled custom chips, Agnes, Paula and Denise.'

The left-hand-side of the board consists of 128k RAM and the control circuitry necessary for the two machines to communicate. This hardware inter-connection has been named Janus by Commodore as, like the mythical two-headed man, it looks back in time to the world of the IBM PC and forward in time to the world of Amiga. Computer companies have never been famous for their modesty! By using interrupts and semaphores (a form of software lock that stops simultaneous access to the same area of memory) to manage communications, both systems can operate completely independently of one another.

The video portion of the IBM compatible is mapped directly into the 128k dual-ported memory on the left-hand side of the card. As this mapping is done by hardware and is thus transparent to the IBM PC, the video display is compatible with both applications that use the official ROM BIOS calls as well as applications that write directly to the video memory. Meanwhile, software running on the Amiga can use the data contained in the dual-ported memory to create windows that emulate IBM PC compatible displays. The software provided with this bridge-board emulates both the monochrome and colour graphics adaptors of the IBM PC, monochrome in a true window and colour in a full-screen pull-down window. As the two adaptors use different portions of the interface memory, both displays can be emulated at the same time.

Once the IBM PC bridge-board is inserted all the IBM slots become expansion slots for this machine. All the expansion cards that I tried for this Benchtest in these slots worked without problems: however, graphics cards, and cards which offer serial and parallel ports, cause conflicts with the existing capabilities on the Amiga. I also suspect the use of a 286 fast processor card would be wasted as the 68000 on the Amiga would not be able to update the PC window fast enough.

A hard disk can be connected to the Amiga either directly or via the bridge-board. Hard disks connected via the bridge-board, including hard-disk expansion cards, can be partitioned to give storage to both the Amiga and the IBM compatible. Operation on the Amiga side using this configuration will, however, be slower because data will have to pass through the dual-ported memory. The ideal solution would be to have two hard-drives, one connected directly to the Amiga and the second to the IBM compatible. The 20Mbyte drive on the review machine was extremely slow. After a long talk with CBM's technical department it was discovered that the hard disk had been incorrectly formatted *and* it operated via the 'bridge-board'. After a brief spell with an alternative hard disk system, we found the hard disk entirely satisfactory on the IBM side but a little slow on the Amiga side.

In addition to the two bus systems, there is an 86-pin processor expan-

The Amiga 2000 retains the fine complement of ports of the original Amiga but they now conform to IBM PC standards

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sion slot which gives identical pin-out to the Amiga 1000's expansion port. In the long term Commodore sees this slot as the place for a more powerful processor such as the Motorola 68020; on the first A-2000 it will contain 512k of RAM. Manufacturers of peripherals for the A-1000 might also want to extend this slot's pin-out to outside, to enable them to be used on the 2000. A dedicated video slot allows you to fit products such as Genlock which means that you can super-impose Amiga text and graphics onto the picture from, say, a video-camera or a video disk player.

The majority of incompatibility problems with the original Sidecar add-on for the A-1000 arose because of differences between the Amiga's keyboard and that of the IBM PC. The A-2000 has a fully PC/AT compatible keyboard missing only the little used 'Sys Req' key. The cursor cluster is now separated from the numeric pad and the QWERTY sections, making the whole layout easy to use. The two Amiga keys are maintained in order to retain compatibility with the A-1000. In terms of feel the A-2000 is also an improvement over its predecessor, having a positive click when the key has registered rather than the dead feel of the A-1000.

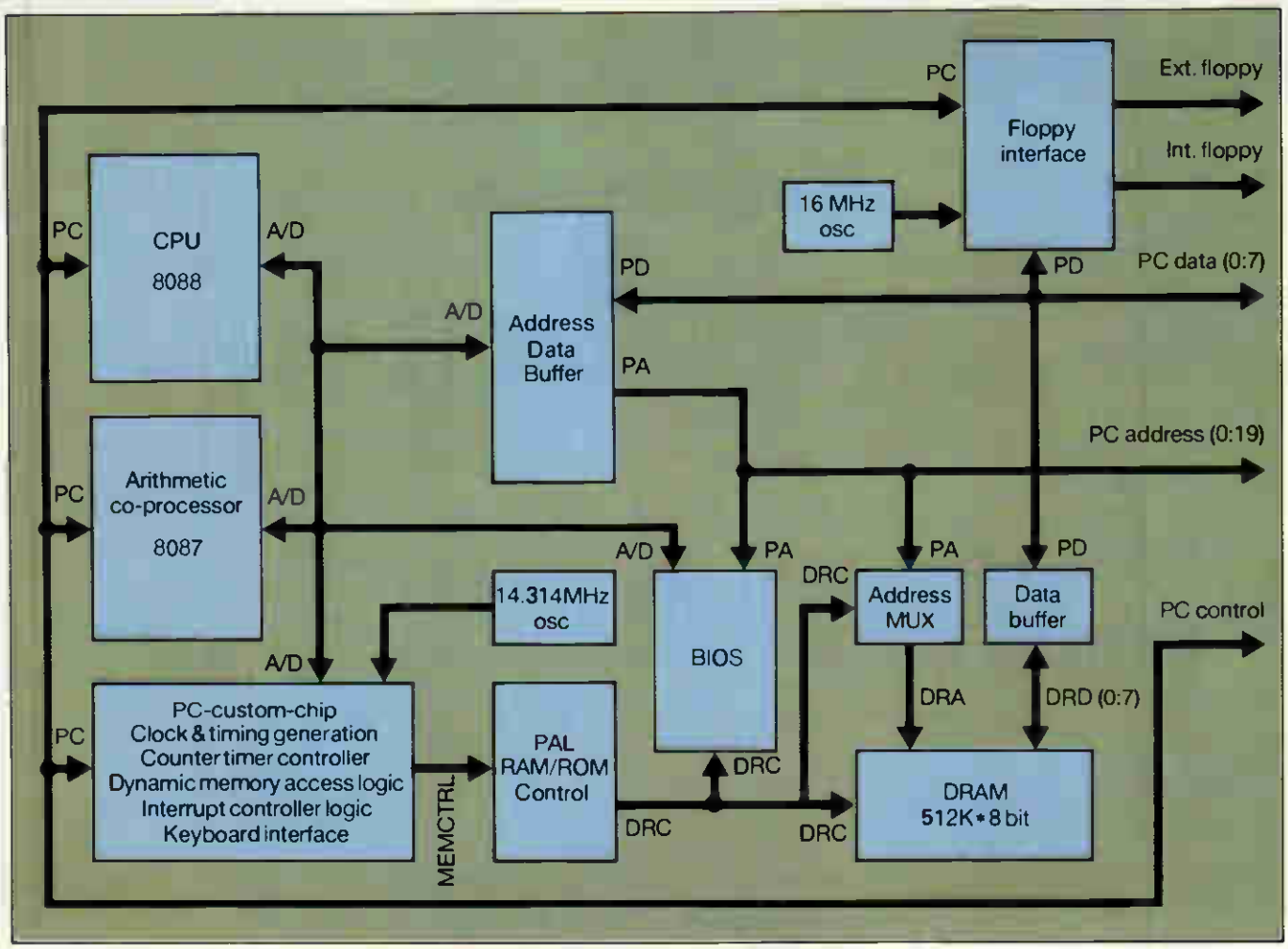
No screen is supplied with the Amiga 2000, though at extra cost Commodore will supply the A1081 medium resolution monitor. This monitor is fine for normal use, but in order to use the highest resolution Commodore has resorted to an interlace display. This means that only alternate scan lines are drawn each time the electron beam draws a screen, so it takes two complete sweeps of the beams to create a single high-resolution screen. In order to eliminate the flicker that this system causes it is necessary to use a special monitor which has a long persistence phosphor coating and costs nearly £1000.

'The majority of incompatibility problems with the original Sidecar add-on for the A-1000 arose because of differences between the Amiga's keyboard and that of the IBM PC.'

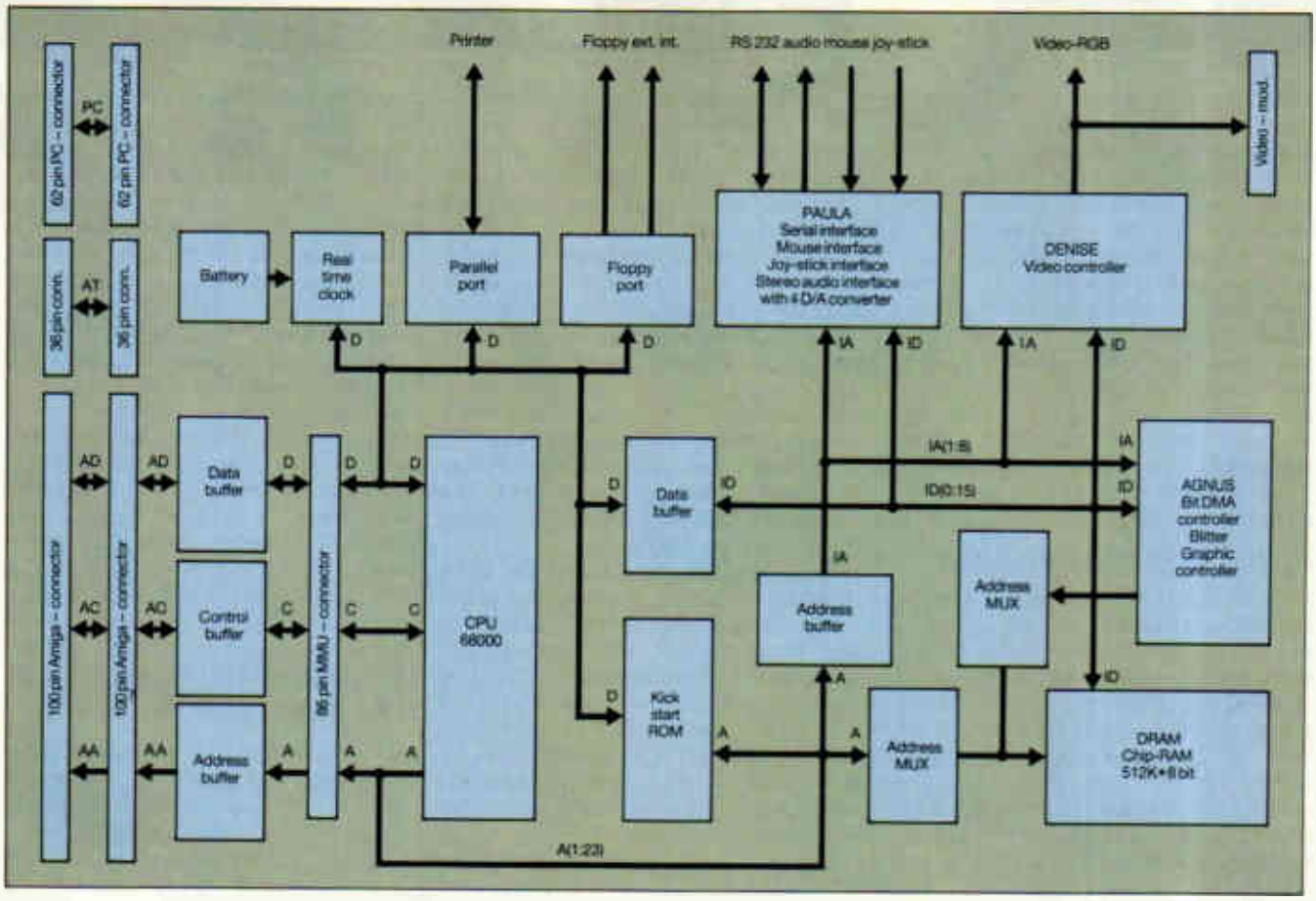
A number of products are in the pipeline from Commodore but as yet none have firm release dates. Under consideration are two alternative bridge-cards, one containing a 386 or a 286 processor, possibly with EGA standard graphics (although this would need the special high-resolution, long-persistence screen). A 68020/68881 replacement is being developed by Commodore, although these are already available from the US at a hefty $1500. This board gives an impressive increase in performance, particularly if the application requires a lot of raw number-crunching. Genlock, the video overlay facility, is almost ready and a second more advanced unit is being produced for professional studio use.

System software

The A-2000, like the A-1000, uses a



Block diagram of the bridge-board's architecture



Block diagram of the Amiga 2000's architecture

customised version of Tripos, transferred to the Amiga for Commodore by the Bristol-based software house Metacomco, and renamed AmigaDos. Existing Amiga users upgraded from Version 1.1 to Version 1.2 about six months ago and it is this that is contained in the A-2000's ROM. Version 1.2 corrects some minor bugs and introduces a new disk format that improves disk access speed in what is an inherently slow but secure disk organisation.

AmigaDos is a true multi-tasking system which means that it's possible to run more than one application at the same time. While this is undoubtedly useful and the windowing system of the Amiga provides an ideal environment for it, it does cause some problems. My major concern is that having a number of applications running means that there is potentially more data to lose should the machine crash.

All too often with the A-1000 the whole system crashed and lost all the data from a number of applications. With Version 1.2 of the system software this seems to happen less often and when it does there is a very good chance that only one application will crash and the others will keep going. The only foolproof way of protecting one task from another is to have the protection in hardware: the 68020 processor in combination with an MMU (Memory Management Unit) or the 68030 alone would make this possible. However, a German Commodore developer informed me that to use this hardware capability will require an extensive re-write of AmigaDos.

Intuition is the windowing interface for the Amiga and very capable of supporting the Amiga's powerful architecture. We found the screen appearance disappointing; the low-resolution, multi-coloured, chunky graphics desk-top is likely to put serious users off at first sight. It is possible to run Intuition in high resolution but this is only feasible with an expensive long persistence monitor. No amount of customising from the Amiga's control panel could make the desk-top acceptable to our eyes.

'In hardware terms the machine has everything going for it: large capacity drives, a good keyboard, expandability, excellent graphics and sound and IBM PC compatibility.'

As well as Intuition, the windowing software, there are two extra pieces of software on the Workbench disk that are needed in order to bring the bridge-card into full operation. During system power-up, the Amiga executes its normal bootstrap procedure. While this is happening the PC performs an internal diagnostic prog- and then waits for the Amiga to tell it to proceed. After the Amiga has placed a copy of its interface code in the dual-ported memory it tells the PC to continue. This allows the PC to install its local copy of the interface code. As soon as this has been done, inter-process communication is ready to run. All this is transparent to the user; all that is seen is the prompt 'Initialising Janus'.

Two icons on the Workbench labelled 'PC Monochrome' and 'PC Colour' represent the two Amiga programs needed to run IBM PC software. In order to load MS-DOS, the IBM PC operating system, it is necessary to run the monochrome software. An ordinary Amiga window will be created, in which will be the prompt for data that comes from the MS-DOS booting. All PC software, whether it be monochrome or colour, is launched from the monochrome PC screen. After initiating a colour PC application, expanding the PC Colour icon will open a colour screen containing the application.

The PC emulation windows come

with a complement of menu functions which allow the user to modify and control the PC displays in ways that are unavailable to PC owners. New features include capabilities to modify and control the PC display's colours, and the ability to mimic multi-tasking displays by opening multiple windows into the video display, and then freezing the information contained on one screen by simply launching another. Also, an auxiliary tool is provided which allows you to grab ASCII data from a PC screen and paste it into an Amiga screen.

Applications software

The last time I wrote about Amiga applications software, six months ago, I was still waiting for a decent word processor, database and spreadsheet to be made available for it. I've now found the database in the form of Superbase from Precision Software but I'm still waiting for the word processor and the spreadsheet. There are considerably more applications of all forms for the Amiga, but in terms of serious business applications the majority are either poor IBM PC conversions that make little use of the Amiga's facilities or are needlessly gimmicky.

A vast number of games and programming languages are now available for the machine; and in theory the availability of good programming languages should mean that good applications will soon be developed. Unfortunately, my experience with existing users suggests the majority of software being developed consists of superb demonstrations of the machine's sound and graphics capabilities and very little else.

A number of small packages were bundled with the Amiga. These include a clock, a notepad, a calculator and a psychedelic demo that should appeal to Jeff Minter fans. The only application that you could call in any way 'major' is Amiga Basic, which is Microsoft Basic compatible but includes excellent access to Amiga's sound and graphics and excellent structuring commands.

I tried a fairly extensive collection of IBM PC software on the bridge-board including Microsoft's Flight Simulator, Lotus 1-2-3, SideKick, GEM, PC-Write and a number of public-domain programs. Everything ran fine, although a number of applications that are capable of running in colour assumed a monochrome PC system and only ran in monochrome. On Sidecar it was possible to get round this by setting some dip-switches, but I could find no corresponding switches on the bridge-board. In the worst case a game called Digger refused to run because as far as it was concerned I was using a monochrome display. IBM PC compatability of course opens up the largest collection of applications ever available on a single micro architecture, though most of these will seem somewhat crude to knowledgeable Amiga owners.

Documentation

No documentation accompanied the machine, but assuming that it is based on that for the A-1000 it should be quite satisfactory, if perhaps a little lacking in 'in-depth' information. If you wish to get 'techie', you can always buy the four *Programmer's Reference* manuals from your local Amiga dealer at some ludicrously high cost.

Price

The US price for the A-2000 is $1500 for a 1Mbyte single 3½in floppy drive system. At the time of writing no UK prices had been decided. The first one thousand Amiga 2000s made will come complete with a bridge-board, a 20Mbyte hard disk and a 5¼in floppy, and will obviously be considerably more expensive.

Conclusion

There can be no denying that the A-2000 is very impressive in its adaptability, expandability and power. The internals of the machine make it the most versatile computer available in comparison with anything in a similar price bracket. In hardware terms the machine has everything going for it: large capacity drives, a good keyboard, expandability, excellent graphics and sound and IBM PC compatibility.

The Amiga 2000 is the most advanced micro you can have on your desk using current technology. However, it is good available software that sells machines and it is here that the Amiga falls down. The ability to run existing IBM software is nice but no-one will buy the machine on this basis alone, and so the A-2000's ultimate success will depend on the ability of Commodore to motivate software developers. END

Technical specifications

Processor:	Motorola 68000 running at 7.159MHz
ROM:	256k
RAM:	1Mbyte minimum expandable up to 9.9Mbytes via internal expansion cards
Keyboard:	95-key, full-stroke including ten function keys
Mass storage:	Minimum one 3½in floppy expandable to hold any two 3½in devices and one 5¼in device
Size:	9¼ins x 19½ins x 15ins (system unit)
I/O:	Serial, parallel, video out and in, stereo sound, two joystick/mouse ports, two IBM PC expansion slots, three IBM PC/AT expansion slots, four Amiga expansion slots, one processor expansion slot, Genlock and TV modulator slot
DOS:	AmigaDos (a version of Tripos)
Bundled Software:	Basic, desk accessories, 8088 bridge-board
Processor:	Intel 8088 running at 4.77MHz
ROM:	32k
RAM:	256k expandable to 640k via expansion cards
DOS:	MS-DOS 2.11

Benchmarks

	Amiga running Amiga Basic	Bridge-board running GWBasic
Intmath	1.7secs	6.0secs
Realmath	2.7secs	7.9secs
Triglog	6.7secs	44.7secs
Textscrn	150.3secs	96.7secs
Grafscrn	25.0secs	47.1secs
Store	16.2secs	9.7secs

The hard disk was incorrectly formatted; times for production machines should be significantly faster.

For a full explanation of the PCW Benchmarks, see the December 1986 issue, page 164.

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Husky Hawk

Husky has become well-known for building micros able to endure harsh climates. The Hawk retains some of this ruggedness, but its compactness and portability mean that the machine also suits a wide range of practical applications. Nick Walker gives it the eagle eye.

Photography by Dennis Bunn

I must confess to a large degree of ignorance when it comes to Husky computers. Over the last three years or so, the Husky Hunter 'rugged' laptop has been an excellent source of silly photographs for our ChipChat page, but otherwise too specialised for *PCW*. However, the Hunter has been selling quietly and constantly to those who need to use a computer in a harsh environment; and if the environment were particularly outrageous, such as among penguins in Antarctica, you could be sure that Husky would take a picture and post a press release.

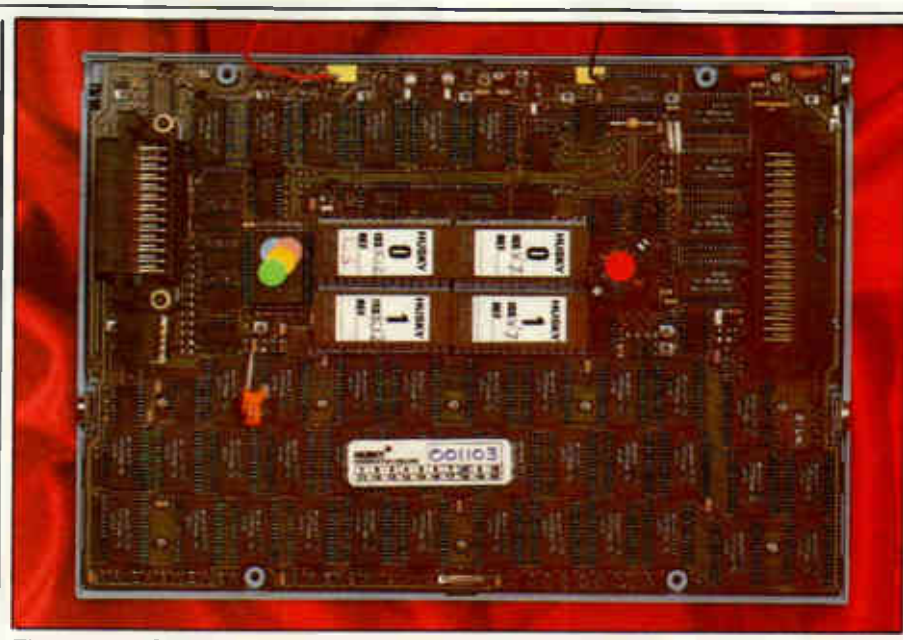
So when the Husky representative appeared in the *PCW* office to show the new Husky Hawk to the editor, my first reaction was to show little interest. However, on catching the odd phrase such as '352k RAM', '35 hours use on one recharge', 'WordStar' and 'weighs about 1.5lbs', I gathered that this was no ordinary Husky. It didn't take long for this machine to re-kindle my interest in pocket and small lapheld computers.

Hardware

The Husky Hawk is small, in laptop terms; very small. Other manufacturers have tended to use the paper-size A4 as a measure for the footprint of a laptop; Husky has gone one better and designed the Hawk to have an A5-size footprint, roughly equivalent to the size of a shorthand or reporter's notepad. The actual size is 8.5ins × 6ins × 0.8ins, which is about a quarter of the size of an average briefcase and as thick as a paperback book.

If it weren't for the cleverly sculptured base, the Husky Hawk would actually be a little awkward to use; it's too small to sit comfortably on your knees, yet too large to be held like a pocket calculator. Two recesses in the base allow you to hold the machine between your thumb and four fingers — actually very comfortable, and with the great bonus that you can use the machine while standing. Another thoughtful feature is the facility to attach a wrist-strap to either side of the machine, which eliminates the worry of dropping it (and allowed me to be reasonably relaxed using the machine on the London Underground without worry).

Although the Hawk is definitely not designed to take the rough treatment that previous Husky machines could endure, it has inherited some ruggedness: for example, the casing is a very solid, hard-wearing, black plastic; the screen is well-protected with a thick layer of plastic; and all the ports have protective coverings. The Hawk only weighs 1.5lbs but in an A5 casing this gives a reassuringly solid feel. I'm quite sure that the machine will take some quite severe knocks, but it *will* need to be treated with a little respect — it won't, for example, appreciate being used in the rain.



The central EPROMs dwarf the state-of-the-art PCB design

The top of the machine is divided roughly into two — the screen and the keyboard. On either side there are identical plastic coverings for the ports. These consist of: on the right, two RS232 serial ports, one of a 25-pin D-type and the other of an 8-pin mini-DIN design; and on the left, one 37-pin bus extension complete with power and control lines. A very novel form of port exists at the rear of the machine: four infra-red LEDs form an optical means of data transmission, apparently commonplace in retailing systems. The base of the machine contains a cold-reset switch which is activated by the point of a pencil.

Considering the delicate nature of the Hawk's CMOS circuitry, I was surprised to find only four Phillips screws holding the machine together. Inside there was no protection for the circuitry, just an A5-size PCB connected to a re-chargeable battery and speaker held in the back casing. The battery is a fast re-charge nickel-cadmium device giving typically 35 hours of use from a one-hour single charge. Previous fast-charge batteries I have seen have the drawback that after around ten charges they need changing; the batteries of the Husky, on the other hand, should last for at least ten times longer before changing.

The PCB itself is of a beautiful design using surface-mounted chip technology throughout. The processor is an HD64B180 which is an enhanced CMOS version of the 8-bit Z80 processor, with an increased instruction set and capable of running at higher speeds. The Husky Hawk drives this processor at 6.144MHz and complements it with battery-backed 352k RAM and an 128k EPROM. The processor, RAM and control circuitry use the latest chip packaging and hence occupy only about two inches square of the board. The EPROMs are of the more traditional DIL variety and dwarf the surrounding circuitry. Only 96k of the EPROMs' address space is used, leaving 32k available for user applications should you want to use it.

The rest of the PCB is populated with a total of 44 identical Sony chips whose sole purpose is to apply voltages to the individual pixels of the LCD screen. The only other thing of note is one tiny little chip labelled 'OKI' which I'm assured is the CMOS clock and calendar chip. A small piezo-electric speaker next to the battery gives a wide four-octave range of pathetic little beeps.

The LCD screen displays 40 characters by eight lines in text mode and 240 by 64 pixels in graphics mode. Particularly unusual is the inclusion of a low-powered back-light, hardly noticeable in daylight but nevertheless effective in low lighting. Constantly using the back-light reduces the battery life to around 12 hours which is still pretty impressive compared with the competition. The screen itself is about seven inches by two inches and of reasonably high contrast. Two keys to the right of the space-bar adjust the contrast and operate the back-light.

The keyboard of the Hawk is designed for two-fingered use and makes no attempt to be a full-stroke typist's device. For the majority of the Husky's applications this will be no problem and the miniature 'chicklet' keys are sufficiently spaced out to avoid hitting two keys at once. In total, there are 68 keys laid out as a qwerty section and a numeric keypad. Not surprisingly, many keys have more than one function associated with them — for example: the numeric keypad doubles as cursor control and editing section *à la* IBM PC and acts as a source of extra characters; and the ten numeric keys

at the top of the keyboard also act as ten function keys. Five blank keyboard overlays are provided for use with the Hawk when running your own applications. For machines that will be running only *one* particular application blown into ROM, Husky can produced dedicated 'cut-down' versions of the keyboard.

For a new machine the Husky Hawk has an impressive range of peripherals available. Husky groups all the available peripherals into two kinds: Sidebox peripherals that are designed to be used on the move and are powered by Husky's own internal battery; and Homebase peripherals which require a mains supply. The Sidebox connects to the bus expansion on the left-hand side and will accept the following modules: a portable 1200-baud Hayes-compatible modem; an analogue to digital converter; a RAM 'disk' expansion; a ROM 'disk' for user programs, and so on; and a general-purpose parallel interface. A mechanical stiffener firmly locks Sidebox to the side of the machine.

The Homebase expansion automatically connects the Hawk to a modem and charger, whenever the Hawk is placed on it. Connection to the modem is via the four optical couplers at the rear of the machine which use infra-red light. All further Homebase peripherals will use this optical serial link forming a kind of infra-red daisychain. The maximum data speed supported is 2400-baud, which is probably adequate for the near future.

Two other peripherals connect directly to the second 8-pin DIN serial port. These are: a battery-powered 3½in disk drive called the Husky Oracle (originally of Brother manufacturer), which is very slow and only capable of storing 100k per disk; and a bar-code reader which is a strong attraction for users in retailing.

System software

The Hawk's operating system is DEMOS (Disk EMulation Operating System) which is Husky's specially extended version of CP/M 2.2. I tried the few CP/M programs I had available on 3½in disk including WordStar, Reportstar and SuperCalc, all of which ran without problems. The full collection of CP/M assembly level BDOS calls is supported which suggests that DEMOS is *very* compatible.

While compatibility with CP/M 2.2 or less means that the fundamental memory is confined to 64k, DEMOS uses its own page-switching system in order to fit a 53.5k TPA (Transient Program Area), the operating system workspace, buffers and virtual screen stacks into this space. The remaining RAM is used to create a 284k RAM disk. In order to achieve this, Husky has extended the usual 16-bit address bus of the Z80 to 19-bits and used a hardware-decoding connection to the processor; this gives a total addressable memory area of 512k. Although the system works, it does seem a shame that it is not compatible with CP/M Plus, the official CP/M system of memory management. The only other 'enhancements' of DEMOS over CP/M are a low-level clock/calendar enquiry and bar-code reader handling.

Practically all CP/M programs assume an 80-column by 24-line terminal for screen output rather than the 40-column by 8-line screen of the Hawk. To overcome this, Husky uses some emulation software so that the screen acts as a virtual 'window' on a full-size 80 by 25 screen. As far as the CP/M software is concerned, it is operating with a Televideo TV 950 terminal, one of the most popular CP/M terminals.

Most of the time the screen will automatically move the screen in such a way that the cursor is always in the left-hand corner. It is possible, however, to move around the virtual screen by using 'Shift' and the cursor keys to move a character or line at a time, and a special key to the left of the space bar to move a horizontal screen at a time.

Five character fonts are included in the Husky's ROM which is very unusual for both CP/M and a laptop. Switching between these fonts is achieved by a perverse escape sequence and is only really intended for programmer use, the larger character sets giving true descenders but less lines per screen.

Applications software

In some ways the operating system is unimportant to potential users of the Husky; what *is* important is how easy it is to create user-specific applications and it is here that Husky has made some considerable effort. Locomotive Basic is a particularly good choice to bundle with the Husky Hawk as it is fast, capable and easily programmed for a wide range of users.

Locomotive Basic is a superset of Microsoft Basic and has been specially adapted by Locomotive to take advantage of the special facilities of the Hawk. In brief, those additional facilities are: graphics-handling (lines, boxes, circles, ellipses and points); device independence and channels; input from both serial ports and the infra-red port; wand input from bar-codes; event-handling and interrupts; and a large (by CP/M standards) basic workspace of 50k.

All Locomotive Basics have a powerful file-manipulation system known as 'Jetsam'. As well as the traditional sequential files and random access files of most Basic, Jetsam can create 'keyed' random access files. These allow you to specify a number of keys on the creation of a file and then perform searches specifying the data of the search directly in a Basic statement.

The only other 'bundled' applications are a very crude text editor and a comprehensive set-up program for configuring the serial ports. There is, of course, a vast collection of general-purpose CP/M programs which will be of interest to some users.

Documentation

The Husky comes with two manuals: the *Husky Hawk User Guide* and *Husky Hawk Portable Basic*. Both are well-written and very comprehensive. For example, there is detailed description on how to construct serial leads to connect the Hawk to most of the popular personal computers.

Perhaps the best tribute to the manual can be gauged by the fact that I only had to ask two technical questions directly to Husky instead of the usual 25 or so to most manufacturers.

Prices

The Husky Hawk in its basic configuration costs £895 excluding VAT. At the time of writing no prices were fixed for any of the peripherals.

Conclusion

It is probably easier to describe what the Husky Hawk is *not*, than what it *is*. If you are looking for a portable, general-purpose computer there are far better and cheaper machines available. If, however, you are looking to create a customised application in which portability is a very important attribute, then the Husky Hawk would be ideal. END

Benchmarks

Intmath	3.195secs
Realmath	4.3525secs
Triglog	19.25secs
Textscrn	137.155secs
Grafscrn	116.46secs

(done by plotting a 50 by 50 square and multiplying the result by four)

Store	6.69secs

(storing to a RAM disk)

For a full explanation of the PCW Benchmarks, see the December 1986 issue, page 164

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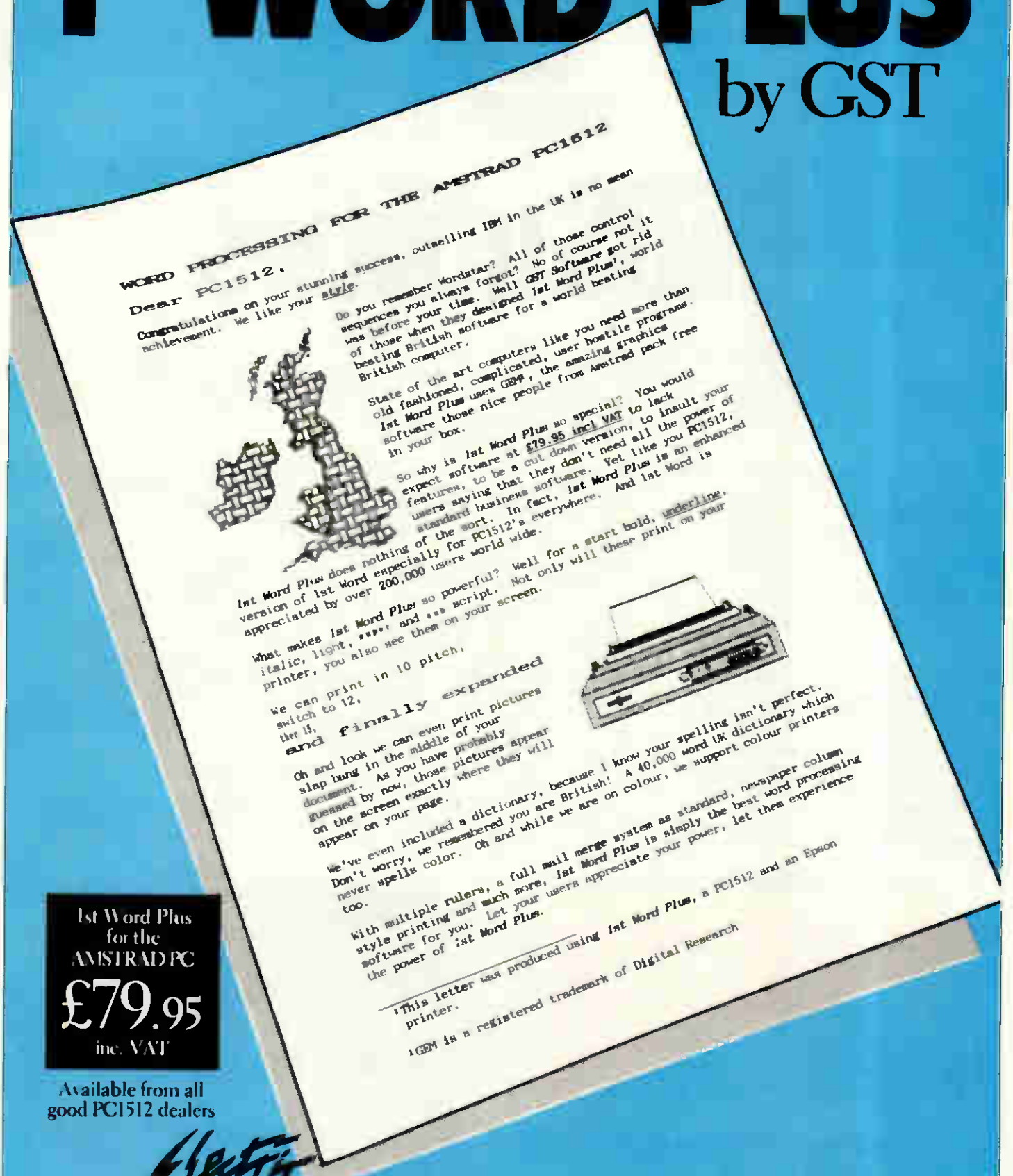

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GEOS utilities

Writer's Workshop, geoDex, Desk Pack 1 and Fontpack 1 are four utilities from First Analytical which greatly enhance GEOS, the rather jaded Commodore operating system. Tony Hetherington assesses their rejuvenative qualities.

GEOS (or Graphic Environment Operating System), the Mac-like disk operating system for the Commodore 64, was launched recently by Californian Berkeley Softworks to critical acclaim. The combination of icons and mice became the hallmarks of the Macintosh and were then simulated on the humble C64, but without the Mac's superior 68000-based hardware.

The GEOS disk came complete with: a graphics package, geoPaint; geoWrite, a basic word processor; and a collection of desk accessories such as an alarm clock, a calculator and a notepad that can be used independently or from within geoWrite and geoPaint.

The Mac image was completed by the choice of black on light blue screen colours (even though a Preference Manager program could set any combination) and even a trashcan icon to throw away or erase unwanted files.

GEOS quickly received Commodore's official endorsement and was to be bundled with the 64C, but unfortunately this never happened.

Having used GEOS for several months, I have found that the novelty of icons and pull-down menus has now worn off because the programs themselves aren't up to much.

geoWrite is very pretty, but it is little more than a basic text-handler without any facilities for line-spacing, screen formatting or headers or footers. As a result I left GEOS to one side as a I returned to less friendly but more practical programs. Now that is all set to change with the release of four new packages designed to put GEOS to work.

Writer's Workshop contains not only a full word processor but also an intelligent merging program to send individually addressed letters to a mailing list. Fontpack 1 includes 20 new typefaces to improve your printouts. geoDex adds a card index system, and Desk Pack 1 adds not only a graphics grabber that can use Print Shop, Print Master and Newsroom pictures, but also an icon editor, a calendar and diary program, and a Blackjack game.

Getting started

Each program is supplied on disk along with full documentation in an attractive box which proudly displays

geoDex is a simple cardfile system designed to be used as an electronic address book. geoMerge on the same disk gives a mail-merge facility from geoDex into a geoWrite document

geoWrite 2.0 updates the earlier bundled word processor and now includes full justification, headers, footers and multiple line spacing. On the same disk, geoLaser gives laser-quality printing from Laserwriter

Mac-like screenshots. However, you soon find that you will abandon the boxes, pile the manuals together and put all the disks into the same box as you embark on a remarkable session of backing up masters, installing programs and creating work disks.

Installing a new program is usually just a case of copying the program onto your work disks, but you must first key Writer's Workshop into your GEOS master disk. This is a most effective security system as, once linked, the Workshop cannot be run without the correct master disk. Copying files over to your work disks couldn't be easier: you simply pull the files you need over to the border of the original, swap disks, then enter the files into your work-disks' deskTop (this is the 'front' to GEOS and consists of icons which then load the programs, utilities, and so on). Throughout this stage you can rely on clear instructions but it's up to you to decide exactly which programs to have on your work disks. This isn't made any easier by the limits of C64 disk storage, but after a few false starts you should have all the files you need on your work disks and enough space left to use them.

When you've fought your way through the jungle of file copying and setting up, your system GEOS takes over with an impressive array of manual tutorials, onscreen prompts, icons and pull-down menus to guide you through.

Writer's Workshop

Writer's Workshop immediately fills the gap left in the original GEOS by providing geoWrite 2.0, a full and comprehensive word processor.

The original geoWrite was little more than a pull-down, menu-controlled text handler that let you enter and edit text, then print it out in only single-spaced lines. Although you could preview a page (display a graphic version of it) in order that you could see its shape and layout, you couldn't do much to change its format. Paragraph indentations had to be entered manually and there was no facility for headers or footers. The result was limited and only suitable for brief letters.

geoWrite 2.0 not only adds more invaluable features, but also speeds up the whole operation by introducing keyboard-command shortcuts. Pressing the Commodore key together with a second key moves you around the text freely, cuts and pastes copy, searches for words, opens, provides headers and footers, selects pages, and gives the choice of plain, bold, italic, online, underline, subscript and superscript text style. Subscript and superscript are two new text styles which can be written in any font or point size.

The original geoWrite screen featured a top line of pull-down menus, and a line-numbe, bar on which you could set left and right margins and tab markers. geoWrite 2.0 adds a paragraph marker to that number bar, plus a third command bar on which you can select either the first instance or all on left, right, centre and full justification; and single, one-and-a-half or double-line spacing.

Among the other new features is an intelligent search and replace function that allows you to search for a whole or part of a word, either the first instance or all on a single or all pages, then replace it with any string of characters.

Finally, you can select a single word for font or style alteration simply by double-clicking it; format paragraphs individually; print all or part of a document in draft (rough), high and near-letter quality; and define a header and a footer that contains text and graphics, and even the date and page number.

The result is a powerful word processor that is comparable to any on the market. However, the problem with using any new word processor is that all your old but still important documents were written on other word processors and stored on a variety of disks. You then find that you have to use a whole selection of different word processors, selecting the one that's best for that particular job. Thanks to its Text Grabber utility which is also supplied on the Writer's Workshop disk, geoWrite 2.0 has become the 'universal' word processor capable of reading and writing any C64 word processor file.

Using the Text grabber couldn't be easier, and is simply a matter of following onscreen prompts which ask you to select whether your document is either an EasyScript, SpeedScript or PaperClip file. If it isn't one of these, simply select the Forth 'Generic' option and the Text Grabber will do the rest. Conversion is automatic and only takes a few seconds, and you even have the chance to convert the whole disk so that it can be run from the GEOS desktop.

Conversion for the listed programs is now complete, but other programs processed through the generic option are still usable although they have no formatting instructions. I tried the Text Grabber on a VizaWrite file and soon had it converted, copied over to a GEOS work disk and edited in the format commands in only a few minutes. I could then alter fonts and styles, and even add geoPaint graphics.

A utility called geoLaser is also included on the disk but as this is only for preparing documents for printing on a laser printer or uploading them to the American network, Quantum Link, it's beyond the scope of this review and should be left to those with either a laser printer or an extremely large phone bill.

Alongside geoWrite 2.0, the Text

One of the four desk accessories, Graphics Grabber, lets you transport 'clip art' graphics from other graphics packages such as Printshop or Newsroom, and transfer them to geoPaint and geoWrite

The calender desk accessory is actually a personal diary system from 1900 until the year 9999. Each date on the calendar can be expanded to a time and appointment page in an electronic diary

SCREENTEST

Grabber and geoLaser programs is the impressive geoMerge program. It's not unusual for a word processor to be accompanied by a mail-merge program, but geoMerge can not only send form letters individually addressed to people on a mailing list, but can also send messages using its IF and IF ELSE commands.

As with standard mail-merge programs, letters can include bracketed words (<<label>>) which represent names and addresses held on a separate file. In geoWrite 2.0 this is a separate document with records separated by an asterisk. When a print is required, the letters are printed with the brackets replaced by details from the appropriate record. For single letters, this information can be entered manually by following keyboard prompts.

geoMerge takes this format one stage further with its facility to contain IF and IF ELSE conditions in the original letter. The IF command can be used to test the condition of a bracketed value (is it TRUE or FALSE?) and only prints a sandwiched phrase if it's true. The IF ELSE command extends this further by printing one phrase if the condition is true and another if it's false. These IF and IF ELSE commands can be nested to form a bewildering array of options. Therefore, using the same carefully planned original, you can demand or accept payment from a customer, ask for or refuse future work, and wish them a happy Christmas or Easter. geoMerge obtains the necessary information either from the user through screen prompts or from additional entries in the address file.

geoDex

geoDex is the GEOS electronic card index system which, as a geoDex card file can be used by geoMerge as an address file, also contains a copy of geoMerge. Double-clicking the geoDex icon loads in the program which appears as an angled card file. A blank record with spaces for name, address and phone number lies in front of a full pack complete with indexing letter tabs arranged at the top of the pack. Selecting a letter brings that card to the front, and so on, with an asterisk ending a file and a NEW card to create new records. Entering the information you need to store couldn't be easier, as it's simply typed from the keyboard with the Return key swapping the cursor between records. You can subdivide your records by splitting them into one of three groups, which is ideal for setting geoMerge conditions.

A line of icons down the side of the cards access a series of additional options which allow you to delete records, print some or all of the records either as address labels or just a list of phone numbers, search for a record, view a single group, enter geoMerge or, if you have the required modem, use geoDex to autodial any phone number.

Desk Pack 1

This bundle of software contains three invaluable utilities and a game. The Graphics Grabber is by far the most spectacular utility as it not only extends the usefulness of GEOS but also adds tremendous flexibility to the popular trio of Print Shop, Print Master and Newsroom.

The problem with these so-called 'productivity' programs is that they're very limited in position of graphics, and even size and position of text. For example, Newsroom has only three typefaces and three sizes of print. By using the Graphics Grabber GEOS can 'steal' any Newsroom, Print Master or Print Shop graphic and file it away in a photo scrap (for a single picture) or a photo album. Once stored, these graphics can be altered in geoPaint and incorporated into geoWrite.

Under full icon control you are free to swap between disks, examine any graphics and store them in any album which can be created as required, and even flip through (forwards and backwards) collections of pictures loaded in simultaneously from Newsroom.

This simple utility means that you can use the graphics from these programs, add text in GEOS's fonts and point sizes, and finish off with a geoPaint border and background. The result will be without equal.

A simple icon editor is included so that you can complete the customisation of your work disk when you've renamed it, and set the screen colours using the master disk's Preference Manager. Now you can change the image pixel by pixel, invert, scroll, or completely redesign any of GEOS's icons.

Apart from its obvious aesthetic purposes, this utility has a more serious application and can be used to convert non-GEOS programs and files to the GEOS format. These files appear on the GEOS desktop as large Commodore symbols (C=) and up until now have been unusable. Now they can be converted, given a GEOS file header and a custom-designed icon so that they can be copied to a work disk, and run by a simple double click (this represents LOAD "*",8,1).

If the icon editor organises non-GEOS files, then the Calendar utility will organise *you*. Loading the program reveals the familiar monthly calendar format with a square for every day. A pull-down menu is available to select a specific month from any of the 9999 years that are available if the default date (current date set in Preference Manager) isn't required.

Any important dates can be marked by clicking on them; this not only flags them with an asterisk, but

The icon editor lets you take existing icons and customise them or create new icons from scratch

No desk accessory set is complete without a game; the one with Desk Pack 1 is Blackjack

It is possible to flick through the pages of a window (in this case the diary) by clicking on the corners

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also creates and opens a page in a datebook. This is the same size as a page in the deskTop notebook and can be used to store appointments and reminders. If your aren't sure when you have appointments and you don't want to scroll through every month, simply click the question-mark icon at the bottom of the screen to reveal a list of dates that you have flagged. Click any of these and you'll go straight into the right entry in the datebook.

The final program supplied in Desk Pack 1 is a change from the file-handling utilities, and gives you the chance to enjoy another Macintosh tradition and relax with a game of Las Vegas Blackjack.

Fontpack 1

Twenty new fonts are included on this disk to add extra printing styles to geoWrite and geoPaint printouts. Unfortunately, GEOS can only handle seven fonts (plus the system BSW font) at any one time, although more can be present on a work disk. To use these new fonts you must copy them over, one at a time, to your work disk and arrange them so the seven you require appear first in the deskTop. To bring in a new selection, you must rearrange the fonts on the deskTop.

The fonts (some of which, incidentally, are named after parts of Berkeley, California) are restricted to certain point sizes. For example, Superb can only be used in headings as it's restricted to only 24pt letters. Some examples of these fonts and typesizes are shown alongside.

GEOS updates

To confuse new users (and some reviewers) the reverse side of all four disks contains updated versions of existing GEOS programs and a few new utilities and printer drivers.

Desktop 1.3 is probably the most useful utility and can easily overwrite and replace your existing deskTop. Apart from speeding up disk access, it also allows geoWrite 2.0-style single-key commands to open and close disk files (this saves a lot of time) and select an input device. New input devices supported include the Koala Pad and Commodore 1350 and 1351 mice, but not the NEOS mouse that's bundled with the 64C.

The GEOS updates also include geoWrite 1.3 which is basically the original geoWrite with additional keyboard shortcuts; an improved text-handling routine for geoPaint; and a more extensive collection of printer drivers to ensure that GEOS works with your printer.

The good news for GEOS users is that there's more to come, with two more applications, more fontpacks and even an entire 80-column C128 version.

Fontpack 1 includes 20 new fonts for geoWrite and geoPaint

The new applications will fill the gaps by providing a full database program to replace geoDex, logically called geoFile; and the inevitable spreadsheet program, geoCalc, featuring 28,000 cells, split-screen displays of two separate sections of the spreadsheet, and advanced calculations to nine places of accuracy.

Documentation

The manuals that are supplied with these utilities packs are the best I've ever seen. Clear and concise instructions guide you safely through the potential minefield of installation and creating work disks. Tutorials featuring clear, working examples and screenshots take you through the important stages of each program, leaving you confident to carry on. And each manual is clearly indexed so that you can find things quickly, and is provided in an A5 booklet format ready-punched to fit in a ring file. The only exception is the Fontpack 1 manual which has been printed entirely by geoWrite (the others have been typeset), and shows the fonts' actual appearance.

UK support

First Analytical is ready to continue its excellent and enthusiastic support for all the GEOS products, although it has abandoned its plans to anglicise them. The American nature of the programs only causes minor irritation at times, such as the zip codes in the geoDex files.

The alarm-clock problem isn't immediately obvious but is caused because the alarm-clock utility was written for American C64s which run at a different speed to the English versions, so one minute of real time is only 50 seconds to your GEOS clock!

First Analytical will not only offer to upgrade your GEOS master to the new 1.3 format for only £5, but will also supply you with the correct printer driver for the cost of the media and postage. In the US, this would cost you the full £26 for the geoCable disk.

Prices

GEOS 1.3, £49.95 Latest version of GEOS includes deskTop 1.3, geoWrite 1.3, geoPaint, printer drivers, calculator, notepad, back-up, Preference Manager, and text and photo-managing utilities.

Writer's Workshop, £37.50 Provides GEOS with a real word processor (geoWrite 2.0) and, thanks to a Text Grabber, can read and convert any C64 word-processor document. Also includes the geoMerge mail-merge program and GEOS update files.

Desk Pack 1, £26.50 Four new GEOS programs featuring the Graphics Grabber utility which can 'steal' Print Master, Print Shop and Newsroom graphics for use in geoWrite and geoPaint; an icon editor, calendar and datebook deskTop accessory; and a game of Blackjack (plus GEOS update files).

geoDex, £26.50 geoDex electronic index file program that can print out labels and phone numbers, and can auto-dial them if you have a modem. Disk also includes geoMerge and GEOS update files.

Fontpack 1, £23.50 Twenty new fonts to be used with geoWrite and geoPaint.

All prices include VAT and P&P.

Conclusion

GEOS, the Mac-like disk operating system that gave a new lease of life to the tired C64, has been given a boost by these new utility packs that transform it from a pretty but useless gimmick into a working system.

The opportunity to convert all your disks to GEOS format and run them from the icons of the deskTop will ensure that GEOS will become *the* C64 operating system. Technically the system still defies the limitations and sluggishness of the infamous 1541 disk drive, and provides a continuing future for this durable machine.

GEOS and its utilities are available through retail outlets and also directly from First Analytical, 70 Borough High Street, London Bridge, London SE1 1XF. Tel: (01) 403 5493. END

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Orator

Orator from Lion Systems is an innovative voice and data messaging system for the PC which is excellent value for money. Dick Pountain sends and receives.

The computer and the telephone are natural partners. A computer processes information and a telephone conveys information; even our antiquated voice-only phone network can be made to carry information in electronic form by using a modem. Already, sending paper computer printout by post feels equivalent to shuttling passengers from Gatwick to Heathrow by donkey. Since ICL released the One-Per-Desk, the idea of integrating computing telephone and computer services has been so obvious that I am slightly surprised when any new computer is launched *without* a built-in telephone. I am, therefore, surprised very frequently. Only Apricot, with the Xen-i, has made any attempt in this direction, and that was largely cosmetic.

Now Lion Systems has launched Orator, a hardware/software combination that brings an unprecedented degree of integration to telephone management on an ordinary IBM PC or clone. In addition to the familiar facilities, namely a modem with auto-dialling and a computerised phone book, Orator provides for storage of digitised voice data and so can act as an intelligent answering machine. Unlike an answering machine it can also *send* voice messages without operator intervention, a feat which previously would have required a very fancy tape recorder indeed.

Orator is innovatory not only in what it does, but in the way it does it. The hardware portion of Orator, a single IBM PC expansion card, contains a general-purpose, digital-signal processing chip. This device can be made to emulate a modem or digitise speech, synthesise sound from digitised data or perform error correction, all under software control.

Hardware

The Orator hardware is called Orator Link. It consists of a rather fat IBM PC card with a plastic housing which conceals the works, pretty much the size of a slim hard-disk card. I had no trouble fitting it in my half-empty expansion chassis, but you might have to juggle other cards to make sufficient space for it. The housing contains two quite sparsely populated boards. The signal processor appeared to be a chip called 320C10-25 to my untutored eye, but there are four other large ICs, one of which looks like a UART and another of which might be a microprocessor. No standard modem chip set is used.

Emerging from the card is a lead terminating in a BT connector which goes into a BT telephone wall socket. Your own telephone handset is then plugged into a similar socket in the card; this involves removing the end-plate but this is not difficult. Your telephone handset is not necessary for the PC to be switched on, or Orator software loaded to make a manual call.

A third lead, terminating in a Walkman-style mini-jack, connects a separate Orator Handset which is only used to enter and listen to voice messages. It would have been nicer if your own telephone could have doubled for this purpose, but at present the electrical characteristics are wrong. The Orator Handset sits in a cradle that attaches to the side of your monitor by sticky pads. It is planned that future releases of Orator will use the telephone instead of the Handset.

Orator Link takes over from the PC's RS232 serial port; it is not possible to use both at the same time. The Orator software allows you to select between COM1 and the Orator Link so that you can still use your PC as a serial terminal, or to drive a printer or mouse when you need to.

Orator Link can emulate a modem running to the V21 (300bps full duplex), V23 (Prestel 1200/75bps), V22 (1200bps full duplex) and V22bis (2400bps full duplex) standards. I found that the emulation worked flawlessly and was able to access US conferencing systems over IPSS at 1200bps without any problems. The Link provides auto-dialling in pulse or tone mode, and can also be used to control the fancy features provided by modern PABXs, including 'divert all calls', 'divert on busy', and so on.

For data communications, Orator Link provides three different forms of error correction: EPAD, as used on British Telecom's PSS network; Vascom; and Lion Systems' own proprietary scheme which can, of course, only be used when communicating with another Orator system. I didn't test any of these schemes as I lack the necessary expertise and facilities.

When in 'speech digitisation' mode, Orator Link uses a modification of the method known as Linear Predictive Coding (LPC) to compress acoustic signals into a manageably-sized binary data file. Sampling the speech 8000 times per second results in high-replay quality, but could produce huge files; LPC reduces the size of the digitised files by about ten-fold.

It's important to realise that digitised speech is just binary data which can only be turned back into sound by the Orator. Orator cannot produce ASCII text files from speech, a task which belongs to the realm of speech recognition technology and is still in its commercial infancy; some such systems do exist but they cost hundreds of thousands of pounds and are still of very limited capability. Orator can handle speech on a PC, which is an important breakthrough, but speech and text remain separate categories, just as text and graphics are separate categories on the IBM PC.

Software

The Orator Manager is the software which controls all of Orator's activities. This is a very serious piece of software indeed, as it is both memory-resident and multi-tasking. As a consequence it really stretches

the capabilities of a mere PC, and will probably look much happier on an AT or even a 386 machine. I must also point out that the software I tested was only beta-test and not the full release version.

Orator Manager can be used in two modes, and is loaded by running the program ORATRPR.EXE. When it's running you can leave in two ways: if you leave by pressing CTRL-ALT-SHIFT, then it stays resident and can be summoned at will by pressing CTRL-ALT-SHIFT again. If, on the other hand, you leave by pressing function key F10, then it terminates normally and must be reloaded if you need it again.

I used it mainly in the latter mode because it is very large. I have only 512k of memory in my PC and Orator Manager is too big to allow me to run my normal system while it is resident. The figures go like this. When I boot my system it has 484k free after loading DOS. After loading Orator Manager this is reduced to 158k. I can just run my word processor in that space, but not SideKick, Superkey and my resident mouse driver software. Adding these programs reduced the free memory to 20k which wasn't enough to run anything at all (I could have scrounged a few more kbytes by reducing SideKick's Notepad, and so on). A 640k machine should be regarded as the minimum necessary to run Orator if you are used to a sophisticated environment; 512k will only suffice if you intend the machine to become a more or less dedicated communications workstation. Having said this, Orator appeared to co-exist happily with SideKick and Superkey, as long as it was loaded last. (*Editor's note: Lion Systems is planning that the release version of the software will use overlays in order to run within 256k.*)

Orator Manager consists of a series of linked menu screens which control all the operations. They are summoned by pressing function keys, and half of each screen is taken up by a 'map' which depicts in semi-graphical form the function key assignments in that mode. Online help is provided by moving a block cursor to the picture of each function key in turn, when a help script appears in a window at the right, but this consists of little more than a list of the names of the operations.

The Orator Manager is multi-tasking. If you set it up to receive and record voice or data calls, then it will continue to do so in the background while you perform other tasks. When you re-enter the Manager, an indicator at the foot of the screen tells you whether any new messages have been received. It does not attempt to interrupt the foreground program to warn you of incoming messages.

Orator Manager worked quite well for me, though it did crash once or twice for less than obvious reasons. While nicely designed in many ways, it has some rough edges compared to the best of current US PC software. Character input was exceedingly slow, giving rise to that 'rubbery' effect where you fill up the type-ahead buffer and then overshoot the mark when moving the cursor or deleting characters. This would probably not be noticeable on a faster computer.

To achieve any kind of performance at all on a humble PC, Lion had to use direct video memory access, and this causes a band of 'snow' down the left-hand side of the screen which pulsates in an annoying way as the multi-tasker goes through its

cycle. Installation for a colour monitor is rudimentary, allowing a choice of seven foreground colours on a black background, but not the reverse video which I prefer.

In use

I found Orator very easy to use once I had discovered which screens controlled what, which could be done largely by inspection without referring to the thick and unattractive manual.

Phone calls are made from a directory of phone numbers which is accessed by pressing F1 from the main menu. Up to 999 different directories can be stored and swapped at will. The directory screen shows shortcode, name and phone number on a single line, and you can dial a number merely by moving the cursor to highlight it or typing in the three-character shortcode. There is also a search facility but it is rather primitive, as it will only match on the initial characters of the name field rather than anywhere in the name as SideKick's Dialler does. Directories can be merged, and only those numbers which have changed can be written to a previous version of a directory. This feature makes life easy for large offices where lots of people are using the same phone list and adding to or revising it.

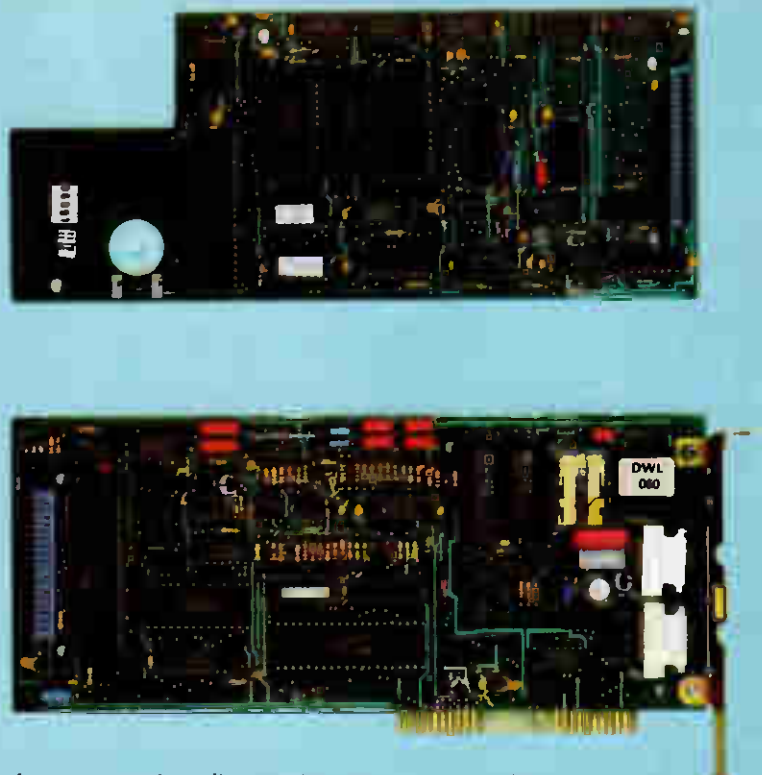
Both voice and data phone numbers are held in the same directory, which is very convenient. Every directory entry includes a set of communications parameters which can be displayed or hidden by pressing F8, though for a voice number they are mostly irrelevant. For data numbers, you may specify the parameters exactly if you know them (for example, mode V22, 7 data bits, no parity, 1 stop bit). However, if mode is simply set to 'data', the Orator will automatically adjust to the parameters of the remote system; this worked every time for me though it might run into trouble with Transatlantic direct dial calls.

Setting up data calls was easier than on any other system I have ever used. Three terminal emulations are built-in (TTY, VT100 and Prestel) and are selected by a single keystroke. The Prestel emulation includes full teletext graphics in colour. There is a simple and effective system for building auto log-on scripts, and the Manager maintains such a file for each phone number transparently to the user. The script itself is created using a built-in text editor which is simple but effective. Scripts are largely built from two simple commands: RECEIVE: <string> which waits until that string is received from the remote system; and SEND <string> which tells Orator what to reply with. A script can also capture data into a file. To log onto Telecom Gold, the script is just:

```
SEND: \c\c
RECEIVE: PAD>
SEND: CALL 83\c
RECEIVE: Please Sign On
SEND: ID etc, etc,
```

Where \c means send a carriage return. I had no trouble writing scripts to log-on to BIX via IPSS and they all worked first time. The Manager automatically checks the syntax of script files before it lets you save them. One thing I noticed immediately is that Orator dials the phone much faster than my own SideKick/Miracle WS3000 combination, and the script files run much faster than those in ProComm do; as a result, I could get on to a service in less than half the usual time.

The unique selling point of Orator is the voice message system. It can store voice greetings for use as an answering machine, and record voice messages from callers. To record a greeting you enter the greeting screen, and then speak your message into the Orator Handset using the space bar to start and stop recording; received voice messages are replayed in the same way. Voice



Orator's two boards perform transmitter (bottom) and receiver (top) functions. The main chips are a DSP 320C10 digital signal processor (top left) and a standard 8-bit 8051 processor (bottom left). Loading different software into the onboard RAM could enable it to perform different functions

messages appear on a menu similar to the phone directory screen and are chosen for replay by highlighting and pressing Return. The quality of the digitised speech is surprisingly good — orders of magnitude better than the 'Dalek-speak' achieved by voice synthesisers. My voice is clearly recognisable as me, the only degradation being a slightly grainy quality.

The digitised files are quite bulky but not impossibly so if you have a hard disk; a nine-second greeting produces an 11k file. A problem could arise if you have particularly loquacious friends who think they are talking to an ordinary answering machine (and there's no reason why they should guess otherwise, the quality is that good). A half-hour rabbiting session would fill any hard disk. In practice, you will probably need to 'prune' your message directory quite frequently.

One extraordinary feature of the Orator is that it can handle both incoming voice and data calls simultaneously. The auto-answer mode can be set to 'voice', 'remote', 'auto' or to any one of V21, V23, V22 and V22bis (used if you know who is sending and what modem they have). In auto mode, Orator will play back the chosen greeting and then record either a voice message or receive a file without further instruction. I tried it out on the *PCW* office staff, and it received a small program file without a hitch. I presume it performs this wonder by recognising the difference between a human and a modem tone and then testing the communications parameters.

This is a real breakthrough. Up until now, if you own both an auto-answer modem and an answering machine, you have had to choose which one is connected to the phone or rent two separate lines for voice and data. Orator will handle both on one line. If you have one of those whistling gizmos (officially called a DTMF Tone Sender) you can replay your messages from a remote phone, just as with an expensive answering machine.

You can also control Orator itself from a remote computer by using the 'remote' auto-answer setting. The remote computer must also have an Orator installed, and then you can have access to your own computer just as if you were sitting at its keyboard. Password protection is provided for this (and for the playback of voice messages) to stop vandals messing up your system. Remote use allows access to all PC functions except that it isn't possible to reboot your computer from a remote link, and that badly behaved software which uses direct video access cannot be run over a remote link as such screens cannot be captured onto the remote computer.

Another immensely powerful act in Orator's repertoire is the 'timed action' file. There are already many comms programs on the market which allow you to send files at predetermined times via an auto-dial modem. Orator, however, adds a whole new dimension to this facility because it can handle voice, too. You can record a voice message and send it to someone in the US at midnight to save the phone bill. The PLAY command, included in an 'action' file, causes the named voice message to be played twice, followed by hanging up the phone. The potential for abuse by blackmailers and heavy-breathers doesn't bear thinking about.

Timed Action Files resemble auto log-on script files, and are created and maintained in a similar way. The time instructions include date as well as time-of-day. TAFs can receive and send both voice and data at set times, and since they can alter the auto-answer mode, they may be used to create a smart answering machine that does different things at different times of day, or days of the week. Here is an example:

```
At 04:00 30/1/87 CONNECT US1
  TRANSMIT C:\ACCOUNTS\
  WEEK4.PRN
AT 05:00 31/01/87 CONNECT US2
  PLAY GREETING.G03
AT 05:20 31/01/87 DEACTIVATE
```

US1 and US2 are the shortcodes for two telephone numbers in the USA. The file GREETING.GO3 is a voice file and WEEK4.PRN is the ASCII version of a Lotus 1-2-3 spreadsheet.

All Orator filenames have extensions which identify the kind of file: .Mnn is a received message file; .Gnn is an outgoing voice message file; and .Dnn is a data file, and so on. The first part of the name (for example, GREETING) is set up in the System Control section of the Manager and is shared by all similar files, so that Orator can create new filenames by merely incrementing the two digits (nn) in the extension. This means you are limited to 99 of any one kind of file, but it means that the files are handled transparently without Orator pestering you for new filenames all the time (which might in any case be impossible if the machine is running unattended). Therefore, your messages will all have names like:

```
MESSAGE.M01 6 Feb 1987 11:00
MESSAGE.M02 6 Feb 1987 11:23
MESSAGE.M03 6 Feb 1987 12:17
```

Every received file is time and date-stamped, and the Manager knows when you have read a message and signals that new ones have arrived.

About the only things missing from Orator Manager at the moment are file-transfer protocols for binary files. None of the standard protocols such as XModem, YModem or Kermit are supported, but this is not quite so disastrous as it sounds. One of the parameters that you can set in the System Control menu is the 'disconnect string' — that is, the string Orator will look for to know that a file transmission is finished. For ASCII text files this will normally be set to ^Z, the DOS end-of-file character. However, you can set this to anything you like, or nothing at all (in which case the phone line being dropped acts as the end-of-transmission signal). By setting the disconnect string to something unlikely to occur in a binary file (for example, ^C^C^C^C^C^C^C^C^[^[^[^[^[) it should be possible to send binary files between Orator systems, though not necessarily to download them from other systems, and error correction could be applied by the hardware. Nevertheless, I think it would be a good idea to support at least XModem and Kermit in future versions.

Documentation

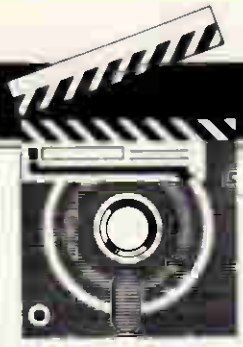
The manual is pretty awful and hopefully the final version will be much improved.

Conclusion

To use Orator, you need a serious PC system with 640k of memory and almost certainly a hard disk, too. I found Orator very much easier to use than a normal modem/comms program combination which forces you to get involved with all the nuts and bolts of communications. The voice messaging system works very well and would be an acceptable substitute for an answering machine in my circumstances (though Robert Redford might need a bigger hard disk). The resident 'pop-up' nature of Orator Manager makes a whole new way of working possible, whereby you can log-on to a remote database from inside your word processor to look up a vital fact. You can also record incoming voice and data calls without being disturbed while you're working. In fact, Orator shows the way forward for communications on a personal workstation.

I found one or two things to gripe about. The sheer size of the Orator Manager software is a problem on memory-limited PCs, and one hopes that things will improve when 80386 machines become the norm. Also, I felt that the Manager's user interface could be polished up a bit by studying the best of current US software.

At a price of £795 (plus VAT) Orator represents excellent value for money when you consider that a 2400bps modem alone costs close to that, and an answering machine with anything like these facilities will be around an extra £200, leaving aside the software. But more to the point, Orator does some things that no existing combination of separate components can handle. END



SCREENTEST

Lotus Manuscript

Designed specifically for creating complex manuals and long documents, Manuscript boasts many impressive features and will be a boon to writers of all persuasions. Robert Schifreen perfects his style.

Manuscript isn't a word processor — the title screen tells you that as soon as you load the program. It's actually a Professional Document Preparation System and, as you spend time with it, you tend to agree that Lotus's description is more appropriate.

Although it can be used quite easily for writing and editing short letters and memos, the product is specifically designed for creating long, complex manuals and technical documents. Assuming you have enough expansion memory, or sufficient space on your hard disk for all the temporary files that get created instead, Manuscript will allow you to have a single document file of around a thousand pages, with things like outlining, inclusion of pictures and formulae, the author's name, choice of typefaces and current version number handled automatically.

Two features not normally found on word processors but indispensable to the writer at which Manuscript is aimed, are 'Print Preview' and 'Document Comparison'. Assuming you have a monitor that can display graphics, the Print Preview system will drive the screen like a printer, displaying a full A4 page of text and letting you see exactly how the finished article will look, with any included graphics shown, to scale, in the correct place. This is similar to the Preview screen found on expensive typesetting systems and can be a godsend.

Compatible graphics files are generally (though not surprisingly) those produced by Lotus's own products, Freelance Plus and 1-2-3.

The Document Comparison will compare the current version of a file with a backup and print the current document with all updates marked by vertical bars in the margin.

Manuscript is fairly easy to use but, because of its complexity and the number of features that normal word processors don't have, it took me almost two weeks of solid use before I felt familiar enough with it to write this review. Having written manuals myself (18 months with a well-known Japanese printer manufacturer), there are certain features I would have liked to see and I knew what I was looking for.

Installation

Getting everything set up is easy. Manuscript is designed for use with a hard disk system only and, since the program is not copy-protected, installation involves nothing more than typing COPY A:*.* enough times to transfer everything from the eight floppy disks supplied onto the hard drive. Eight disks is a lot of word processor, taking up 70 files and very nearly 1900k. A third of this space (30 files) is taken up by drivers for various graphics displays and printers, so you can delete the ones that don't apply to you; unfortunately, the manual doesn't mention this. You'll need at least 640k of RAM to use Manuscript properly. Long documents can be dealt with by using lots of temporary disk files, so you won't need 3Mbyte RAM cards. If you have them, though, things go a lot faster.

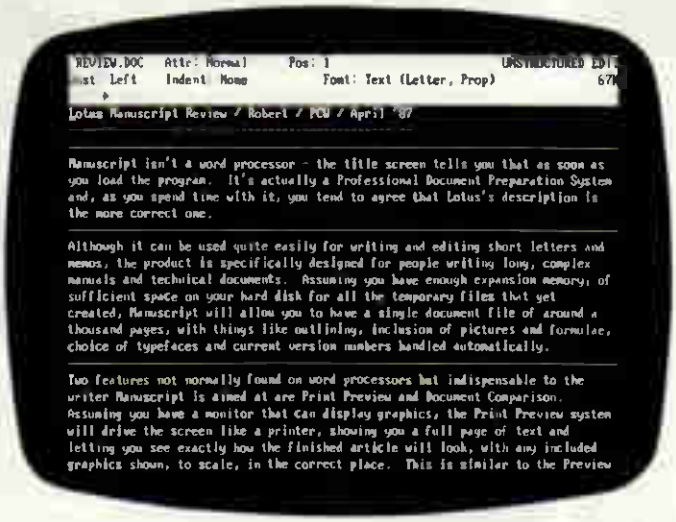
Having copied the disks, the next job is to assemble the manuals. Each chapter has to be separated, paired with a divider page and clipped into the ring-binder. There are also 33 update pages supplied separately which have to be inserted in the correct place and the old versions removed. There are a dozen or so sheets of brown card that can be thrown away and, by the time everything was ready to use, my rubbish bin looked like I'd just unwrapped a season's supply of shirts from Marks & Spencer. It makes you wonder why the manuals were typeset at all, though experience tells me that the people who wrote them probably never saw a final version of the software. I've still not found the pin.

To start the program, the manual said I should type MS. Seeing that there was a sample file called CNSDRAFT.DOC, I thought I'd be smart and typed MS CNSDRAFT to load the file in one go. 'CANNOT FIND APPLICATION (CNSDRAFT.EXE),' it said, and threw me straight back to MS-DOS. Because Manuscript is so large, everything is handled by separate programs that you call up from an opening menu called the 'Document Manager', in a similar way to WordStar. You can bypass this opening menu by specifying which program you actually want to use, so what I should actually have typed was MS MSEDIT CNSDRAFT to load the editor module and then the file.

For this reason, I would like to have seen a complete list of all the files that make up Manuscript and a short note about what each one does. I couldn't find one. One file that puzzled me was SPELLDOS.SYS. I thought at first that it might be a device driver that lets you check words as you type, like Lightning. It wasn't, and you can't.

Although the Document Manager is handy, it saves time not to use it. One vital option it contains, though, is SETUP, which you must run at least once. Among other things, it tells Manuscript how you want to deal with virtual memory. If you have an expanded memory board, this is the place you say so. If you haven't,

The preview screen is one of Manuscript's main selling points. You can see a whole A4 page at a time and zoom in on small areas



Manuscript's status information is normally confined to the top two screen lines. The block separators can be removed but the gaps still remain

you have to use this option to tell Manuscript how much of your hard disk it can use for its temporary files. The default settings (1024k of disk space) allow for the creation of a document of 100 pages. If you plan to write more than that, you have to increase this by 10k per page *before* you create the document. If you don't, a warning box will appear at an inopportune moment advising you to do drastic things, such as deleting the spelling-checker's dictionary files immediately to avoid losing the current document.

With everything set up you can create or edit a document. Once you have given the file a name, a panel appears on the screen. From here, you can alter the current directory and file name, as well as the name of the template file. The template file holds layout information like fonts and typestyles, ruler settings, and so on. There are also fields to enter a one-line description of the document, the name of the author and the revision number.

Like other Lotus products, the panels appear in white on a colour monitor and can't be changed to other colours. The revision number starts at 1.000 and is incremented automatically every time you edit the file. This number, as well as the author and description fields, don't automatically appear in the document but can be included in the text by use of backslash commands — the equivalent of WordStar's dot commands. To accept the entries on the panel you press the INS key. Manuscript uses this key everywhere to accept choices from a menu. You'll keep pressing RETURN by mistake for a few days, but you'll adapt eventually. You'll also keep pressing INS to change from insert to overtype mode, and nothing will happen. The correct key for this is Alt-F5, which is far too inconvenient a place for such an often-used key.

One convenient touch is that the name of the document you edit is recorded in a Manuscript data file and automatically appears as the default setting next time you use the program. The current cursor position is saved along with the text in the document file itself, so loading an existing file really is like carrying on where you left off.

> *'Two features not normally found on word processors but indispensable to the writer . . . are "Print Preview" and "Document Comparison".'*

When you load a long document, Manuscript loads all of it into virtual memory. In the case of a very long document (350k, say), the loading process is really just pulling the first few pages into RAM and spooling the rest straight back out again to temporary files on disk or in the expanded RAM. Still, a status box ticks over at the bottom of the screen to show how much has been loaded. Unless you know how long the file is, though, you don't know how long there is to go. On my standard PC with hard disk running at 4.77MHz, my 330k test file took two and a half minutes to load in.

Editing a file

With all options specified, the text screen appears and you start typing. At the top of the screen is a two-line status panel containing the name of the document, current text attributes, the cursor position and whether you are in structured or unstructured mode. Structured mode is Manuscript's outliner. The cursor position is given as a single number that tells you the horizontal position. You get no indication of how many lines are in the current document, or how many pages you have entered. You can opt for an extended (three-line) status line that also contains the current font information and the amount of virtual memory being used, but this figure is no guide to the size of the current document. This review (4400 words) took 26k of disk space but 59k of virtual memory. You can get a word count, though, at any time. Also on the standard status line is an indication of whether the document has changed since last being saved. If it has, attempting to quit the system will prompt you to save first. If it hasn't, the MS-DOS prompt will appear that much faster.

The key to creating documents in Manuscript is the 'Block'. Basically, you have to enter text in chunks and, before starting each chunk, you press Ctrl-A to start a new block. This is the case whether you use structured or unstructured mode. Each block is normally a paragraph, though headings, tables, graphics, and so on should also be given a block to themselves. Organising things this way makes it easier to pick typefaces and styles. Normally, a new block inherits the format of the preceding one but you can give individual blocks their own characteristics, such as different margin settings, spacings, and so on.

What I don't like about the block system is that a solid horizontal line appears between each new one. There is an option not to display the line, but there is still a gap on the screen and you often forget why. Also, when paging up and down through a document, the cursor skips over the block dividers so vertical movement is not as smooth as it should be.

The manual advises that you should stick to the use of blocks in

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order to make full use of Manuscript; in truth, there's no way you can avoid them. If the length of a block exceeds about one screen full of text, everything slows down to a crawl.

As long as blocks are used to separate each paragraph, everything is fine. I tried entering a 30k document all in one block. When I wanted to highlight a portion of the text, the cursor took ten seconds to move down one line, and my hard disk went into a spin.

As long as everything is in blocks, moving the cursor from top to bottom of a 350k document is instantaneous. Also, blocks can be sorted alphabetically, which means that preparing a glossary is easy. Manuscript can read and write IBM DCA files for converting to and from other WP formats — DCA files are turned into one-photograph-per-block format when loaded into Manuscript.

Although you work in these units of text, normal functions referred to as block functions on other word processors are still available. You can copy, delete or move portions of text, and a portion can be a true Manuscript block, a part of a Manuscript block or a larger portion that spans two or more blocks.

Getting help

As seems to be becoming a standard among PC software, pressing F1 gives help. It's vaguely context-sensitive, so pressing F1 while in the middle of the spelling-checker will tell you about spelling. The 'help' isn't very helpful, though. You can't type in ATTRIBUTE and get help on that subject. You can look it up in an onscreen help index, but there are only 35 entries and it probably won't be there. Even if it is, you will be told all about what 'attributes' are and which ones you can have, but nothing about how to set them.

With similar inspiration, Lotus includes a list of all the backslash commands, in alphabetical (not subject) order. The one-line descriptions are understandable, but you can't search through them automatically. The first topic I wanted help with had me searching in vain through the screen displays and, eventually, consulting the reference manual. The topic was how to remove the little triangles that get put at the end of every line. Luckily, you can remove them.

Menus and shortcuts

Commands and functions are accessed through single-line menus that appear on the status display. Menus are summoned with either a plain function key or an ALT-ed function key. Two keyboard templates are supplied — one for each type of IBM keyboard. Because the CTRL and SHIFT keys are not used with function keys, there are 20 unused function key combinations and I'd have expected these to be available to the user as programmable macros. The manual didn't mention it anywhere. A useful menu tree is contained in the manual, which I unclipped and kept by the keyboard.

Once you know what options are available from menus, they can be accessed by what Lotus calls 'accelerator keys'. Ctrl-B, for example, turns on bold type until you do a Ctrl-B again. If your monitor can handle it, the text really will appear bold on the screen. Not all the program's options appear in the menu in which I'd expect to find them. The PRINT menu is where you find the PREVIEW and SPELL options.

Backslash commands

WordStar has its dot commands and Manuscript has the backslash variety. Backslash commands are used for two purposes: to tell Manuscript to do something like\pagebreak\or\table\ or\section\; or to substitute a value. For example, putting \date\ in the document will substitute the current date when the document is printed. The same goes for \time\. You can also read in values that identify the current document, like\author\, \revision\, \description\ and so on. If you include a picture in a document (more of which later), you use something like\picture This Graph Shows First Quarter Sales\ to specify an entry which Manuscript will turn into a table of figures if you want it to.

One useful backslash command is \equation\. This lets you specify an equation using normal characters which are turned into mathematical and Greek symbols at print time. The equation is sent as graphics data to the printer. The quadratic formula of

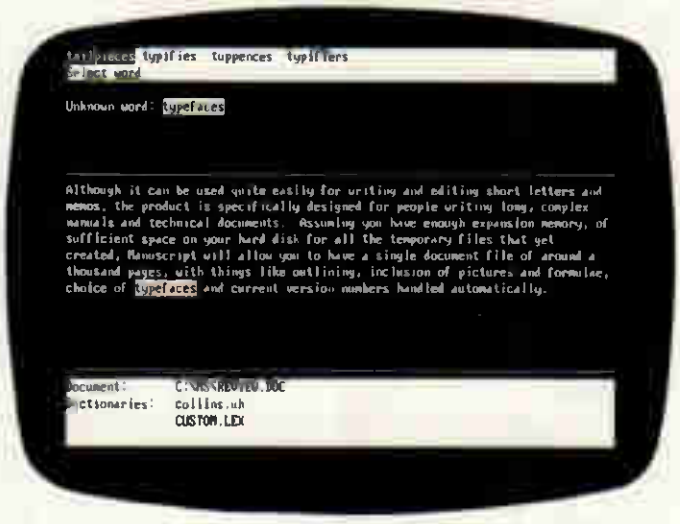
$$x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$$

can be incorporated into a document with the command \equation x=[-b + - root[b super 2-4ac]]over [2a]\. The \equation\ command knows around 150 symbols and characters.

Windows

You can split Manuscript's screen horizontally into two windows, and you can edit a different document in each window. Indeed, you *have* to edit a different document in each

A spelling checker is included but there is no thesaurus. Manuscript doesn't start guessing at words until you say so, though, which slows things down



The opening menu, called the Document Manager, serves a similar purpose to WordStar's main menu. It can be bypassed by selecting options in advance

window as you aren't allowed to edit the same one twice. You can't actually move the windows around, but you can specify how much of the screen each one takes up.

A maximum of two windows can be open at a time, whether visible or hidden.

Tables and columns

Preparing a table is fast and painless so long as you stick to the use of blocks. Every row should be a separate block, and columns should be defined using the column facility. The column command will divide the screen into vertical columns and, as you type in a column, words wrap within it. As one column fills up, any parallel columns are extended to match.

With every entry in a table enclosed within a unique area of a certain column and block, the table just about defines itself. All that remains is to mark out the area required and select a border for it. Borders use the IBM box-drawing characters and can be composed of single or double solid lines.

Outlining and structure

When you're editing a document, you can be in either structured or unstructured mode. Structured mode is what Manuscript calls its built-in outlining system. It is useful for compiling reports or technical manuals where each point or section is numbered and structured. Numbering is automatic and can be in decimal, Roman or any style of numbering you desire; the package was quite happy to let me create an outline where the number contained so many levels that it ran off the screen. If you start composing a file in unstructured mode, it's possible to convert it to a structured format quite quickly. The reverse, though, is not allowed unless the structured document contains only one block.

Like any outliner, you can hide all text under a certain level. Pressing ALT with a number hides any text below that level. The most useful number is '1', as pressing ALT-1 hides all the text and displays only the major subject headings in order to give you a quick overview of the document.

Unique format information can be defined for the first five levels of outlining. This allows you to specify different-sized fonts and typestyles for different levels of heading. If you have a style sheet that dictates how all your documents are supposed to look, this information can be programmed into a global setting file once and then forgotten.

Compare documents

Manuscript allows you to compare two similar versions of the same document and produces a marked-up copy indicating where changes occur. The two documents are read into memory (real and virtual) and compared; and deleted, inserted and moved text is highlighted. You can produce a document with vertical bars in the margin to indicate updates. Ideally, I'd like to have been able to create a third document containing just the updates, for distribution as an update sheet, but the manual made no mention of how this can be done.

The marked-up document can be printed to disk with all printer control codes included, for printing in background mode with the MS-DOS PRINT command.

Comparing two documents changes neither of the two files.

Spelling-checker

The package contains a spelling-checker but no thesaurus. Although the software and the manual think that you have the American dictionary file called WEBSTER.UH, UK users get COLLINS.UH and you have to inform the software accordingly. The first time you specify the name of the dictionary file it gets stored in the startup file and everything will go smoothly in future. I'm still working out what the UH extension on the dictionary files stands for.

The spelling-checker can be called up from the Document Manager screen or from within the editor. I chose the latter option and regretted it. To start the spell-checker you select SPELL from the PRINT menu. Before the speller is loaded, you are asked if you want to save the document being edited. I said 'No'. I should have said 'Yes'. The spelling-checker, I found out, is a separate program and works only on saved files. If you say 'No' at the "Save file?" prompt, your current document is lost forever and the spelling-checker works on the old version from disk. This is unacceptable, and the lack of warnings in the manual makes it even more so.

Unknown words are normally highlighted and a menu appears with a default option that lets you accept the word and carry on checking the document. If you want the system to guess what the correct spelling should be, you have to press G. The guessing algorithm works well and 'becuase', 'mising', 'problen' and 'hte' were guessed correctly first time; the last of these usually fools most spell-checking algorithms. 'IBM' isn't in the dictionary and was, interestingly, guessed as 'abeam', suggesting that the system is using phonetic rules somewhere.

My main complaint is that the system won't start guessing at an unknown word until you type 'G'. This makes the process slower than packages that start guessing immediately and abandon the task if you accept the word. I was strongly tempted to leave Manuscript and use a different speller.

If you add a word to the dictionary,

The help facility is limited. This single screen is the full extent of the onscreen help index, which won't get you very far

The advantage of dividing text into blocks is that each block, or level of heading, can have unique format and attribute information specified for it

SCREENTEST

that word will appear in future guesses. For example, if you put 'Amstrad' in and then type 'Amstard', the correct spelling of the word will be guessed and appear. Not many other word processors have this feature.

Including graphics

Although there are no built-in facilities for creating graphics images with the Manuscript editor, a number of different format image files can be included at print time and some can be previewed *in situ* onscreen. The \picture\ command inserts a specified file, and the \figure\ command helps Manuscript build a table of figures if you want one.

Compatible graphics files include those created by Lotus's 1-2-3 and Freelance Plus packages. Bitmap files produced by a digitiser can also be used, and files containing PostScript commands can be passed to a suitable laser-printer but not displayed on the preview screen.

Metafiles produced by Lotus's Freelance Plus presentation graphics system can also be used.

The manual doesn't make much of the types of files that can be included as \picture\s. Details are relegated to Appendix E and information is scarce. My attempts at using the facility worked satisfactorily, though.

Print and Preview

Spend quarter of a million pounds on a typesetting system and, if you're lucky, you'll get something called a preview screen. It's a VDU with (almost) the same resolution as the final typeset paper copy and allows you to check the layout of a page, choice of fonts, and so on, without wasting any of the expensive photographic paper that typesetting uses.

Manuscript is the first word processor that offers a preview facility, though expensive desktop-publishing packages often include it. The preview facility uses the PC's screen and a number of different drivers are included on the disks so that you can take advantage of your particular monitor's capability. I tried the system on a standard colour screen and also an EGA one and both were impressive. The preview facility drives everything in graphics mode; this means that non-graphic monitors can't be used.

Preview shows a whole A4 page at a time and, if the screen can cope, bold and underlining show as well. Fonts are all reproduced properly.

Even on an EGA monitor, normal text won't be completely readable when reduced so much in size, so you can zoom in on a small portion to check minute details. Equations, I found, don't display too well at all, and on my EGA I couldn't read them. There is an option that expands an equation to fill around half a screen. This can then be expanded again to show even more detail. However, I managed to semi-crash the system (only once) by expanding an equation twice and then pressing RETURN a couple of times while the machine was still generating a display. I got an 'INTERNAL ERROR M2 (UNRESOLVEABLE REFERENCE TO CON:RVIDEO)' and ended up back at the document manager screen. I couldn't reproduce the error, so I hope it was a one-off. I *was* using a full release version of the software, though.

'If you add a word to the dictionary, that word will appear in future guesses. For example, if you put "Amstrad" in and then type "Amstard", the correct spelling of the word will be guessed and appear. Not many other word processors have this feature.'

Like the spelling-checker, both the Print and Preview are handled by separate programs that work only on saved files. This means that you *have* to answer 'Yes' to the "Save file?" prompt that appears before you print or preview a document that you are editing.

There are two ways to print a document: namely, draft and final print. In draft mode, the printer's fastest font is used. Backslash commands are not interpreted but are printed out as they appear on the screen. Only the draft font is used. A draft print allows you to get the text printed on paper for checking, without wasting time producing graphics, fonts and letter-quality print.

Once the text has been checked and the layout looked at through a preview, you can produce a final print. In this mode, all global and local fonts and typestyles are printed correctly, and backslash commands are acted upon. The printer is automatically put into its best quality typeface. Text is printed in text mode, and the printer is switched into graphics mode to produce graphics and equations.

Printing is not performed in background mode, so you have to wait while the job is printed. You can specify, before starting, which parts of the document are to be printed, and whether the title page, contents list, index, table of figures, and so on, are to be printed as well. You can print a whole document, or just details of the global setting in force.

Conclusion

I like Manuscript. It's not marketed as a general-purpose word processor and I wouldn't want to use it as one. In order to keep the available memory to a maximum for long documents, all the package's functions are in separate modules and loading is slow. However, I've written 500-page manuals for a living before now, and some of Manuscript's features would certainly have been appreciated in that respect.

The package is a mainly text-based, desktop-publishing kit. If you have a good quality dot-matrix or laser-printer, camera-ready artwork (ready to be duplicated and bound) can be produced cheaply and quickly using nothing more than a desktop PC and printer. If you intend to eventually have everything typeset, though, many of the facilities provided by the software lose their benefit. Contents and index pages, for example, won't be of use unless the typeset version keeps exactly the same page numbers. And it probably won't.

Also useful for driving laser-printers is that measurements can be specified in centimetres, millimetres, inches or points (72 points to the inch). This means you can specify, in meaningful terms, where various elements of a page go. You also get intelligible error messages when printing, that say something like "invalid picture file, three inches from top of page".

I don't think I'd switch to Manuscript for the work I do now for *PCW*, as the program lacks a thesaurus and I don't like being forced to use blocks for everything. But, for producing technical documents and manuals where it's easier not to trust a typesetter to get it right, or if you do the sort of work that would benefit from the preview facility, it would be ideal.

Lotus Manuscript release 1 is available from dealers and costs £395 excluding VAT END

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Larger than life

Computer simulations are an ideal way of discovering how successful (or not) you would be in real-world situations alien to your own. Marcus Jeffery examines the survival of the fittest in a man versus machine environment.

One of the most exciting and captivating of computer applications is the area of simulations. There can be few people who have not marvelled at the complexity of present-day aircraft simulators with their detailed graphic cockpit displays. Even such 'games' as Microsoft's Flight Simultor or the numerous air traffic controller products available for home computers provide more than enough complexity and challenging realism for all but the most skilled operators.

Though these real-time systems are no doubt the most glamorous forms of simulation, they are by no means the only type. A steadily growing area of computer simulations is that of financial modelling.

When teaching someone to fly a plane, putting a trainee pilot behind the joystick of a real aircraft can have devastating results. So too in business, where giving a trainee manager premature responsibility could lead to myriad accounting problems and even bankruptcy.

And this process does not stop at company level. How can people gain

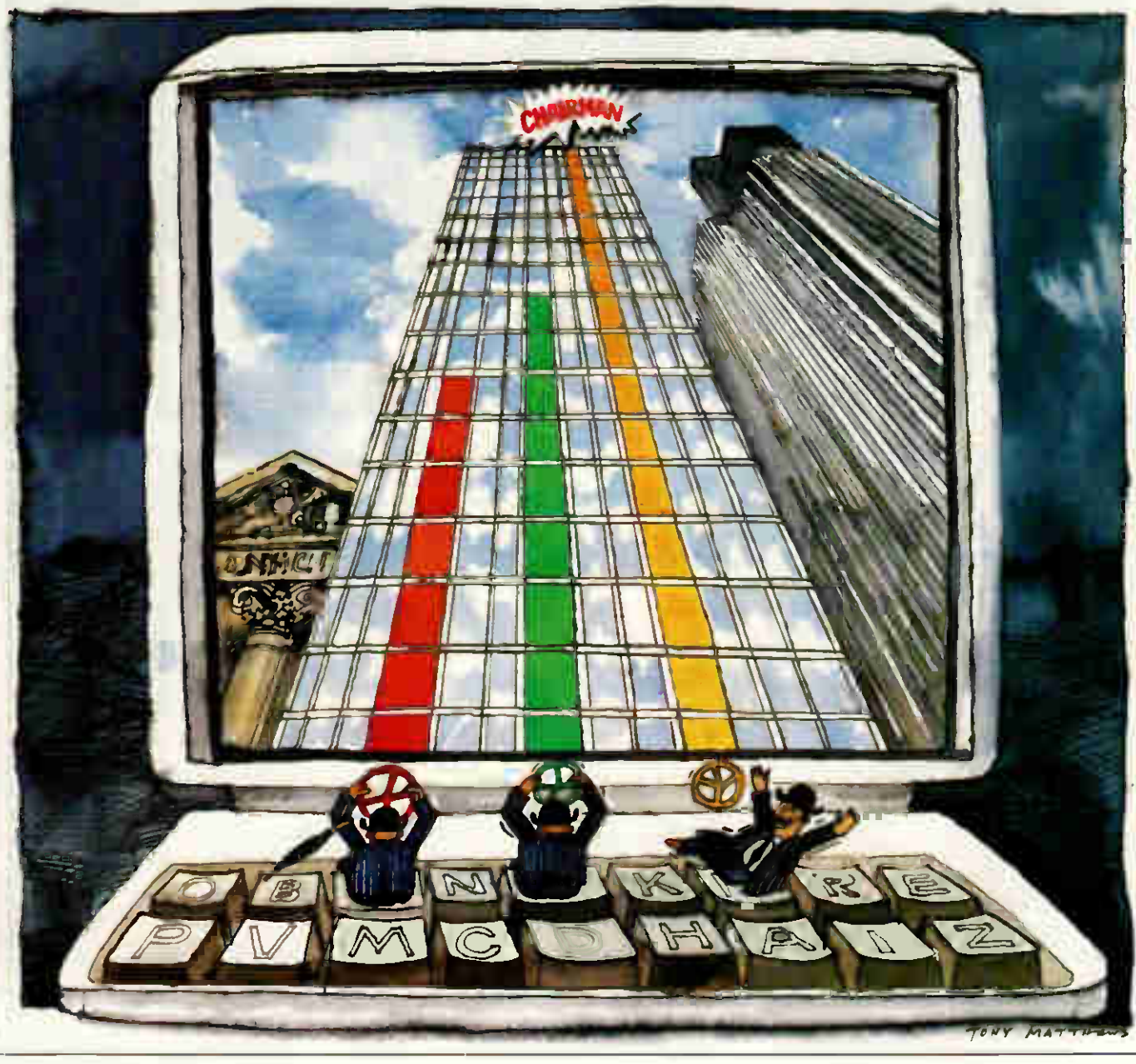

Illustration by Tony Matthews

experience of controlling the national economy without the risk of mistakes whose consequences could affect millions of people and take years to undo?

Setting up simulations

Simulations work by defining a model of the process to be simulated. RE Shannon gave a good definition of simulations as:

> '... *the process of designing a model of a real system and conducting experiments with this model for the purpose of either understanding the behaviour of the system or of evaluating various strategies (within the limits imposed by a criterion or set of criteria) for the operation of the system.*'

The main difficulty in setting up a simulation is designing the model. Models are merely abstractions of the original object under construction. A model is an abstraction because, for the sake of simplicity, it does not have all the properties of the object it is modelling. The important factor is that the model retains the most relevant properties of the original object, while discarding confusing details.

Therefore, aircraft simulations can model the real world and work sufficiently well to be of use in training pilots without having to model each blade of grass, small bumps in the runway, the exact size and shape of the control tower, and so on. Taken further, if the plane being simulated crashes in a populated area it is only necessary to indicate that the pilot got it wrong, without modelling the precise locations of buildings, whose back-garden the plane landed or how many washing lines were pulled down!

Such simplifications also occur in financial modelling. The difficulty is that though the aircraft simulator's equations are extremely complex, they are at least fairly well-defined. The choice of features to include in a financial model, and how they interact, is far less clear.

Do not be under the misapprehension that these models must be based on a computer. Though it is fair to say that computers have had a great deal of influence in the development of models, other forms exist. Indeed, you have almost certainly used a simulation yourself, and probably one of a financial nature. Have you ever played Monopoly, or any other game for that matter? Described as a property trading game, Monopoly is indeed a financial simulation though not a particularly realistic one. Most games can be viewed as simulations, be they vying for power in medieval England, playing a board game of cricket, or battling for world supremacy. Many of the games currently on the market are financial simulations. Polyconomy 'reflects the way government, finance and industry interact when private enterprise operates within a system of parliamentary democracy.' Others include Calamity, which simulates international trade in high risk insurance; and Speculate, which models the buying and selling of stocks and shares.

Though simulations, these games have failed to retain the important aspects of the original real-world situation: it's rather difficult to buy most of London, then erect hotels and houses, all for a few thousand pounds! Similarly, the real-world situation isn't determined by the throw of a dice, though some people would argue that this reflects the uncertainties of life.

Computer models

There are a number of advantages in having a computer model. One of these is that these genuine random factors can be eliminated, while retaining the variation in play, from one time to the next. This is achieved through pseudo-random numbers which can be weighted to better reflect the situation, rather than being a constant distribution based around a few six-sided dice. Also, this pseudo-random sequence can be reported, which enables a user to try to improve on a previous performance, or allows different users to be tested under similar circumstances. In fact, many models eliminate any form of randomness, relying solely on the player's decisions and the model's equations of interrelated factors to determine the result.

The other major advantage in having the simulation on a computer is that the computer can act as the opponent. In the instance of a company, the computer could either manage a rival company or simply simulate the rest of the market.

It is not really even necessary to have an opponent at all. One game of this type has had a number of different titles, but is probably best known as Hammurabi. In this very elementary simulation, you are appointed administrator of an ancient Sumerian city. You buy and sell land, which the population uses to produce grain. This grain is then used to feed the population which expands or contracts, depending on whether or not enough grain is produced. Obviously, if your population expands, then you're going to have to produce more for the following year. Even simple, unrealistic models such as this can be great fun — assuming you can avoid being kicked out of office — and are by no means easy to play. The player in Hammurabi is hampered further by the inclusion of random events, such as plagues of rats.

Similar simulations have been printed in the Program File section of *PCW*. An example of this is the Space Trader game from December 1984 (for the BBC Micro). In this game you travel the galaxy, trading in various items and trying to make a profit, while maintaining or improving your ship. In some ways, this is similar to the trading side of the game Elite.

Management training

Coming back down to Earth, even real-life simulations need not be overly realistic. Hotcakes from Private Tutor is one of the 'player versus computer' type games where the computer operates a rival cake company, though this is just optional. The game allows for up to six players, with the computer playing one of them if desired.

Though modelling a real-life situation, Hotcakes is only slightly more sophisticated than the Hammurabi-type programs. Its main weakness lies in the lack of any limits to the pricing and marketing decisions. After a handsome victory over the computer model in my very first game with some friends, we decided to test it to the limit, aiming for maximum growth through heavy advertising — the simulation went haywire!

The lavish doughnuts which we were originally selling at £1 (well, they were very good doughnuts) became so popular, due to our advertising, that however much we spent on increasing plant capacity we could not keep up the demand. Successive price increases did not help, and we were eventually stopped from increasing the price beyond £10 per doughnut, with the message 'I suppose you think that's funny!' To be honest, we did. Battling on for three years, we ended up with the results:

THE WINNER-LOT COMPANY (Us)
£1,654,417.90
PRIVATE TUTOR CAKES (Computer)
£7427.33

This serves to illustrate the difficulties involved in trying to produce a simulation of this sort. Despite these problems, many companies have managed to produce extremely reasonable simulations which can be of serious use in management training. Such sources are able to quote long lists of customers who use their products in a training environment. For instance, Plan-It from Understanding Systems includes Bradford University Management Centre, Northern Foods, and British Home Stores among its users. The Agate management game from Edit 515 has an even longer list, having been developed as long ago as 1969/70. This includes the National Westminster Bank, Royal Insurance, the Institute of Management Services, and

even the Israel Management Centre among its customers.

In a training situation, these simulations are used to introduce trainees to company operation; to illustrate specific management activities within a company; teach company accounting and how to analyse accounts; forecast sales; control stock; and so on. In addition, most of these models are designed to be played by teams, thus encouraging team work.

Deciding between the large number of management games can be quite a tricky job. One of the first decisions you must make is whether you want the computer to merely simulate the market, or whether you would like it to take an active part as a rival company. Secondly, you must decide whether you want a single team to play against the computer (either as an opponent or the market), or whether you would prefer the computer to referee multiple teams interacting with one another.

The single-team approach has a number of advantages for management training. The trainer can better monitor and analyse a team's performance if it is not necessary to interpret the effects of decisions by other rival teams. Also, the training manager can 'set' the situation to determine how the team fares under different circumstances, such as a stable market, an expanding company, or a company facing financial difficulties. Although the starting situation can often be changed with multiple-team simulations, all teams must be started off on an equal footing, so it is difficult to show, say, a healthy market where only the player's company is in difficulty.

In addition to this, when playing with multiple teams, all the teams must obviously abide by their decisions. However, with a single team playing against the computer, there is no reason why it should not retract a decision and study the effects of alternate strategies — the computer isn't going to object! This is particularly evident in Understanding Systems' Plan-It game, where a tutorial actively encourages going back to the decision stage to change items.

When the tutorial is running you play the game as normal, but, using what Understanding Systems refers to as 'blackboard techniques', a sequence of boxed messages appear at appropriate points, giving help and instructions to lead the user through the first faltering steps.

The tutorial initially asks: 'What happens if we don't make any decisions during the first period?' On reaching the balance-sheet stage, this does not appear to be such a good idea as the business goes bankrupt.

OK, continues the tutorial, let's try to raise a loan to cover ourselves. Returning to the decision stage, the tutorial boxes indicate where to place the decision to raise a loan, and what size of loan to take. A little later, at the balance sheet, the company has

Running the country

As well as small-scale models of individual companies, there are also macroeconomic simulations available which model the economy of the country. These are extremely complicated and include hundreds of interrelated equations referring to economic factors such as the Balance of Payments, unemployment, bank lending rates, and so on. One of these models, called Semaphore, is run by the London Business School.

The KF Wallis book (see 'Bibliography') defines this form of macroeconomic model as:

'. . . a mathematical representation of the quantitive relationships among macroeconomic variables such as employment, national output, government expenditure, taxes, prices, interest rates, and exchange rates.'

There are five models which have been developed with support from the Economic and Social Research Council. These are at the London Business School, the National Institute of Economic and Social Research, the Cambridge Growth Project, the City of Liverpool Business School, and Liverpool University. The last three of these are annual rather than quarterly models; they are also based on different economic theories, such as Keynesian or monetary.

In most case, the results are published in available journals such as *Economic Review* and the *Quarterly Economic Bulletin*.

The London Business School operates a model of the economy called Semaphore, which is described as being an 'international monetarist' model.

In addition to Semaphore, which contains over 800 economic variables, the London Business School also has a smaller model for use in education. Called PC Model, this has only 32 variables and is based on the book by Giles Keating (see 'Bibliography'). Despite the apparent variation in complexity between the two versions, they can both produce equally accurate forecasts. The difference lies in the number of factors which are included. The results of Semaphore are published for use by a wide variety of people, and consequently it has to model much more detailed aspects of the economy. The London Business School also has plans to produce a game model where the user would try to manage the economy by making adjustments to interest rates, taxes, and so on.

Both forecast models are written in Fortran, and use iterative techniques to solve large sets of simultaneous equations in order to produce the necessary results. These equations are held in an ASCII file and a code production program, called Semacode, is used to produce the Fortran source file from this. In this way, the equations and coefficients can be constantly updated to try to improve the accuracy of the results. In addition to these equations, exogenous variables, such as the price of oil, government, and so on, are entered.

So, how accurate can these models be? Obviously, modelling something of this complexity will never produce wholly accurate results. In addition to the vast array of economic variables, the model also has to cope with 'rational expectations' where anticipation of future events produces present changes. For instance, the prediction that interest rates will fall in the near future, or that Labour will win the next election with a resounding majority, will affect current factors.

Some factors, such as the Balance of Payments or the Public Sector Borrowing Requirement, are notoriously difficult to forecast accurately. On the other hand, accuracy is helped by the inertness of the economy. Even quite major events (such as the well-remembered Oil Crisis) which would be expected to heavily disrupt forecasts, have a diminished effect as the sluggish economy reacts to them. By the time the effect of the event is felt in the economy, a new economic forecast has been calculated to include the change.

Development of Semaphore is backed not only by a grant from the Economic and Social Research Council, but also by a consortium of companies which have access to it. However, the London Business School is by no means alone in the competitive market of economic forecasting. In addition to the other groups mentioned, there is also a model of Her Majesty's Treasury, and other models exist which are biased towards certain information such as that which might be of interest to stockbrokers.

Economic simulations

Agate
For IBM PC with 256k and twin floppy disks, and IBM XT/AT with hard disk
Designed for multiple teams, the Agate package includes five main program disks, 50 playing manuals, pre-printed continuous output paper, an operating manual, tutorial slides with audio tapes, three sets of game histories for each of two different starting positions, and a set of decision sheets. An interface to Lotus 1-2-3 is optional.

Features to be announced include the automatic capture of decision data from a spreadsheet, an analysis and report module, and a Telecom Gold/Dialcom interface allowing geographically widespread teams to participate.

In addition to the Agate game, Emerald is a less complex extension to the system; and Famex is a relatively simple alternative simulation, designed specifically for supervision and assessment.
Supplier: Edit 515,
tel: (031) 445 1405.

Baron: Real-estate simulation
For use on IBM PC
One player/team trades in property (Residential, Business and Land), each with varying supply and demand, through five US states, with local trends, depreciation and cash flow.
Supplier: Action Computer Supplies, tel: (01) 903 3921.

CAR-100
For IBM PC/AT/XT
Simulation of the car manufacturing industry. The package can be bought in a number of forms ranging from an executive modelling single-user system, through a trainee's single-user system, to the full Master system for up to 100 players in as many as nine teams.
Supplier: April Computing Executive, tel: (0928) 35679.

Comanex
IBM PC and SuperBrain
A single-user system, notable for its interactive facilities (as with Plan-It), where a number of decisions are entered in three key areas: Production, Sales and Finance.
Supplier: Sapphire Systems, tel: (01) 554 0582.

Hotcakes
For IBM PC and BBC B
This rather simplistic simulation is of little use for management training, but can be an enjoyable game.
Supplier: Sapphire Systems,
tel: (01) 554 0582.

Plan-IT
IBM PC/XT
Like Comanex, this is a single-user, interactive system. It has a comprehensive tutorial system, and is based around players having complete knowledge of the market. A number of versions are available with an optional Lotus 1-2-3 interface, overhead projector slides, and so on. A team-building module, based on the book by R Meredith Belbin is also available.
Supplier: Understanding Systems, tel: (01) 794 0839.

avoided bankruptcy, but the business still makes a horrific loss.

No wonder, says the tutorial, we're selling our widgets at a price of zero; effectively giving them away to whoever wants them. Now, I can't understand why anyone would want a widget in the first place, but giving them away is certainly a bad idea. Returning to the decision stage, the tutorial indicates where to enter a price: this avoids most of the loss, but the company still doesn't look too healthy.

The main reason for this seems to be that as soon as the company charged for its product, the demand fell sharply. Not surprising, really. I'm quite happy to take a widget for nothing, but I doubt that I'd pay for it! The tutorial suggests a demand probe (market research) which indicates, through a pictorial demand curve, that the reason for demand not being high enough is the lack of investment into advertising. When this has been changed, demand increases beyond the amount being produced. Consequently, production is increased, new workers are hired and new machines ordered, though they won't arrive for a while. Eventually, the business turns a small profit — nothing substantial, but a major achievement for the beginner. Of course, things don't stop here. Being able to retract decisions, the user can now continue to 'tune' the system to achieve better results.

The advantages of a multiple-team game are that it is arguably closer to the real world, and certainly more fun. There are few people who would argue that the satisfaction in beating another team is greater than that in beating a computer; this brings in the competition aspect. The Agate Management Game has been run as a competition through *The Scotsman* newspaper for the past seventeen years. However, even single-team games can be used competitively. The Plan-It game was chosen by ICMA/Longman for its Better Business Game in 1985, where all the teams played against the computer and their results were compared. Obviously this method does not allow teams to deliberately, say, swamp the market with cheap products in an effort to bankrupt the other teams.

Another factor which distinguishes some simulations is the ability to include random events. Comanex from Sapphire Systems includes supplier failures, competitors going into liquidation, strikes, credit squeezes and adverse sales rumours, much as Hammurabi includes a rat plague as a random event. These events add to the enjoyment and unpredictability of a game, though it is doubtful that they aid management training. It is fair to say that in real life such events would occur, but from the training manager's point of view, it is much more difficult to analyse a team's performance if it has had to contend with such occurrences.

Specific simulations

Until now we have been considering management games based around an unspecified product, such as widgets. Some companies claim that this gives the game more appeal to a wider audience, but some specific-product simulations are available. Baron from Blue Chip Software models American real estate investment, where starting with a lowly $35,000 you must try to make $1,000,000 and gain the title of Property Baron. Alternatively, Car-100 from April Computing Executive is based on the West European car manufacturing business, where teams compete for their share of the market, design new car models, and so on.

Conclusion

Financial simulations are not only extremely useful for training, group development, analysis and forecasting, but they can also be a lot of fun. The feeling of power and sense of achievement when the company over which you have complete control starts to turn a profit, can be equalled by only one thing — the sense of glee when you run the other guy out of business! Whether business simulations are used for fun or for training, the computer can offer anyone the chance to play the budding tycoon without the risk of losing their shirt.

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Management Teams: Why they succeed or fail by R Meredith Belbin (Heinemann)

SCREENTEST

Crystal & VP-Expert

Software houses have been only too quick to jump onto the AI bandwagon in an effort to sell their wares, but products often fall far short of the mark. Owen Linderholm tests out two new programs, Crystal and VP-Expert, which claim to be expert system tools.

There is an old con racket familiar on the streets of any city called the three card trick. A man shows a watching crowd three cards, one of which is a queen. He then shuffles the cards rapidly and asks the onlookers to bet on which card is the queen. At this stage most people choose to stand and watch a bit longer, but one hands over some money and points to a card. It is the queen! Without argument, the man with the card pays out twice what he was handed.

Now the crowd's interest is whetted as they see how easy it is to win. The man with the cards does his trick again and people fight each other for the chance to bet on which card is the queen. The most forceful hands over twenty pounds — and the card he picks . . . is not the queen. Half the punters have their scepticism restored, but a few more stay and lose a bit more money. Before the crowd gets too angry, the cardsharp suddenly drops the cards and runs. When he gets to the next corner, he stops and the man who first bet joins him. The two of them split the money and move on.

You may think that you have never come across the three card trick in practice, except perhaps on seedy street corners, but the same thing can happen when you buy software. Expert system shells for micros are a good example. You walk into a dealer having heard that expert systems are the cutting edge of artificial intelligence. You want some of this prestige and power to come your way, so you ask the dealer to demonstrate. Already the subtle power of the three card trick has begun to work on you.

In this case, the dealer and the software house represent the bunko artist and his companion. The software house has told you what wondrous treasures can be yours if you use its expert system, while the dealer has built up a whirlwind presentation to *sell* the idea to you. The computer is switched on; the package is loaded and the dealer says: 'Here is a simple example to show you the power of the system.' Before you know where you are, the computer is asking whether you have white pimples on your skin and an itchy, runny nose. You answer as your fancy takes you and are told: 'From the information given I deduce you have yellow fever — see your physician immediately.'

Several more impressive demonstrations may follow, advising you on how to repair a car or what obscure Californian wine to drink with your dinner. Some of the conclusions may seem a little wrong, but the salesman explains smoothly that these *are* only demonstrations. If they were real, high-powered expert systems, then they would sell them for lots of money — just like you will be able to do when you have written something using the expert system shell.

The moment of truth arrives. You have carefully followed the queen as the salesman whisked it about the tabletop and you haven't been fooled — you've got your eye on it. You pay your money and triumphantly carry off your prize.

But you were wrong. A week later you realise that the program can't do what you thought it could, but it's now too late — and so the queen got away after all! Meanwhile, the dealer and software house have met up 'on the corner' and split the profit.

This analogy may not be entirely accurate but it does show how easily a punter may be duped and parted from his money, as things are not always what they seem. It was in this light that I decided to look at two new products which claim to be expert system tools: Crystal from Intelligent Environments and VP-Expert from NewStar. Crystal describes itself as 'the expert system builder' while VP-Expert calls itself an 'expert system development tool', but in my opinion neither of these descriptions is true. Neither Crystal nor VP-Expert enable you to produce an expert system; what you *can* do with them is access information in a sophisticated way.

Crystal and VP-Expert are in effect

Crystal rule-building: The main window shows the rule currently being modified. Notice the English-like rule structure. The second window shows a form associated with the rule

A typical display produced by Crystal when running. Notice the way a neat and simple menu can be included for answering the question. Pressing F1 brings up the rule currently being evaluated

sophisticated database management front-ends. If you have a large and complicated database of information and need to make it accessible to a lot of people, then these programs can help. From now on, this review will treat the programs as such.

To be an expert system, a program must simulate the thought pattern and actions of an expert in solving a problem; it must also arrive at the same answer as the expert. To do this it needs to be able to obtain information, learn, reason, justify and decide.

On a superficial level, expert systems created with VP-Expert or Crystal can do this — but so can people. Where the programs fail is in the more complex and difficult situations needing human experts. The problem is that these programs *don't* have artificial intelligence.

The major difference between real expert systems and Crystal or VP-Expert is the former's ability to learn new information and rules all the time; while Crystal has to be explicitly told all the rules it uses and VP-Expert is just marginally better in that it can be made to induce rules from a table of information. Once this is done though, any new rules have to be added by human experts.

It is also interesting to note that more 'intelligent' programs can easily be written in any ordinary programming language. The simple Basic 'animals' program that asks questions and makes guesses about an animal you have chosen is an example. If it cannot guess the animal you have chosen, it then gets you to tell it *how* to distinguish the animal from those it knows about. This information is then added to its 'rule-list' for future consultations. The two programming languages Prolog and Lisp are particularly suitable for writing expert systems programs.

Bridge test

To test the programs I set up a task for them to do — simple bridge-bidding. Since I had no idea what I could achieve in a given time, I simply decided to start with one of them and give myself two days to get as far as I could. Then I would give the other program two days to get further.

Bidding in bridge is hard to understand at first, but it becomes clearer with practice. The purpose is to inform your partner about what cards you are holding. By doing this, the two of you can decide how many 'tricks' you can win and what suit should be 'trumps'.

The final bid reflects the information gained and determines how the hand is played. All sorts of bidding 'conventions' are used to pass on subtle information about hands. To use these successfully requires a considerable amount of practice and understanding. I decided to restrict the computer to 'natural' bidding — this is where the bid directly reflects the cards in the hand.

Crystal

I started by trying to teach Crystal opening bidding. This is different from the rest of bridge-bidding because it is the first step into the unknown. Since you don't know anything about the cards the other players are holding, you have to make an 'educated' guess and bid appropriately.

When I ran Crystal the first time, an opening screen 'dissolved' in and then 'dissolved' out again too quickly for me to read it. At the time I thought it very pretty. It was only the second time I ran it that I noticed the sinister legal web I had inadvertently trapped myself in. The screen that slowly appeared showed the following message: *'This software may only be used subject to the License Agreement. You agree by pressing any key.'*

I had already pressed a key before the message appeared and so had 'accepted' the Licence Agreement. (Incidentally, this also means that the only way to back out is to turn the computer off. Not the best way to win a customer's trust.)

Once the program starts, you are presented with a simple but classy menu in blue and white on a grey background. Selections from the menu pop up further menus or windows. The sample examples (creditworthiness or expenses authorisation) also ran in the same smart windows with menus.

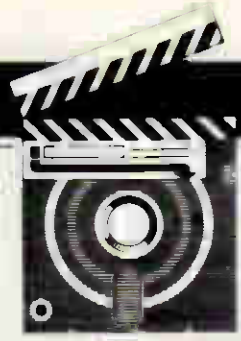
Crystal works by getting the user to create a tree structure of rules and conditions. These are used to control and access information from other sources. In practice, the program asks the user to reply to a series of questions. Crystal then uses these questions and answers and any other knowledge it knows to come up with a conclusion.

Components

Crystal is started by a master rule which defines the overall goal of the knowledgebase. It is possible for this rule to be a dummy, which gives the program more flexibility. Rules are expressed as 'IF' statements with 'AND' and 'OR'. The conclusion of a rule is in English and can be accessed by other rules. For example:

You can bid
IF You have a valid bid

Here, 'You have a valid bid' is another rule further down the tree. There are many other possibilities instead of calling another rule. Messages can be displayed, 'Yes/No'



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questions asked, graphic screens displayed, flags set, calculations made, menu questions asked, forms displayed, and so on. This is one of the areas where Crystal displays considerable flexibility. In fact, the flexibility possible means that Crystal is effectively a simple programming language controlled by 'rules'.

One of the important functions of Crystal is to get information from the user by making him/her answer questions. The range of answers is very large so Crystal provides several ways to answer questions. The most useful of these is the menu. The knowledgebase builder sets up a question along with a list of possible answers. Crystal then turns this into a neat menu. The menu assigns the chosen value to a specified variable which Crystal can access.

Menu questions can also activate a 'slider' which the user sets to any position within two values. Crystal then automatically calculates the value to return to the variable.

Another type of question is a 'Yes/No' question. This displays some text and requests a 'Yes' or 'No' answer. A variable is assigned this value.

Crystal can also display a great deal of information to help users to make decisions. Text can appear in windows, and the program can load graphics screens. Crystal can also run other programs from within itself, which means that it can run animated graphics demos to illustrate a range of choices and help the user answer a question correctly.

Crystal has a wide range of built-in functions for calculations on variables. The usual mathematical functions are available as well as a wide range of financial ones. Perhaps the most important function provided is one to perform Bayesian analysis to combine probabilities. In this way, Crystal uses probabilities and combines them within rules, which makes the whole system much more flexible.

Program interface

The most important facility of Crystal is its ability to interface with other programs. This lets it take data from them for its own use; for example, Crystal could interface with databases or spreadsheets. There is one big disadvantage: you need an interface program, written in C. Intelligent Environments supplies a couple of examples with Crystal but they aren't very useful. This unfortunate lapse means that a potentially very useful feature *isn't* (a perfect example of the three card trick in action).

The program interface does, however, let you extract text and numbers from other programs. If this is used carefully, then large existing databases could be used to feed information into the knowledgebase.

Crystal also has a wide range of features to help explain to the user what the program is doing. This is because it is accepted wisdom that it should be possible to check any 'reasoning' the computer may do. The program will default to a display of the rules used to reach a decision. Optionally, it can be set to display explanatory text in windows. It can even call up text files and graphics to help explain a question or statement.

Creating a knowledgebase with Crystal is reasonably straightforward but, like any complicated task, it needs planning. The knowledgebase you are creating must be forced into a tree structure. *Forced* is perhaps the wrong word since tree structures are very flexible. Crystal itself keeps track of the structure as you enter rules and commands; entering rules is fairly straightforward and the manual provides plenty of clear and sensible examples. The logic of the rules is more difficult and it is this which should be planned in advance. Again, the Crystal manual explains this and makes no attempt to hide the fact that it is the most important part of creating the knowledgebase.

Although entering rules into Crystal is foolproof, it is slow. To get around this, Crystal can also accept ASCII files of the rules. These can be written into a word processor and loaded into Crystal.

Crystal also provides several facilities to make entering rules easier. The most important is a dictionary containing rules and variables already in the knowledgebase. You can look them up and easily copy them into other places. Crystal also provides facilities to move around the tree structure of the knowledgebase quickly and easily.

Editing and modifying rules is also very easy. Whole rules can be marked and 'picked up' and moved. This operates in a way similar to outline processors such as PC Outline where the selected part of a rule is highlighted and moved up and down by the cursor keys.

Documentation

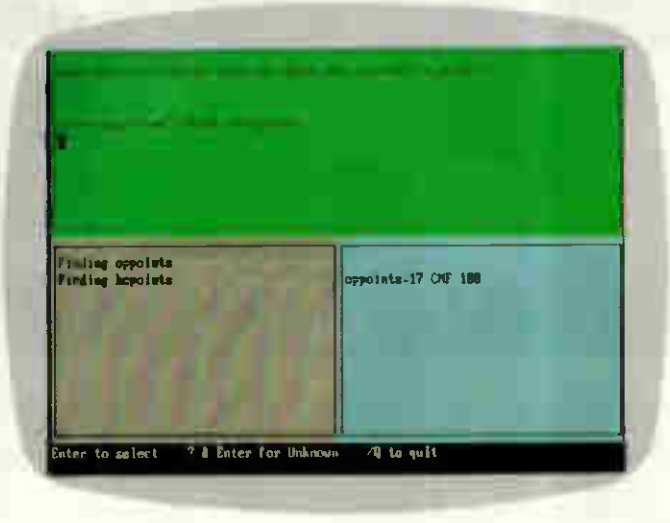
The documentation for Crystal is excellent. The program comes in a plastic ringbinder together with the documentation printed in a trendy grey and pastel yellow. The manual itself has several sections which are sensibly organised. It starts with background information and moves on to a 'beginning training' session. A comprehensive and clear reference section follows and the manual ends with several appendices covering advanced features. My only query was the subtle way the documentation *implied* that Crystal was the pathway to amazing power.

Price

If you are of a nervous disposition, close your eyes at this point. The price of Crystal at the time of writing was £695 excluding VAT.

I had heard that the price was changing, so I called Intelligent Environments to check. In fact the price is going up! The new price will be

This screen shows an expert system under construction in the VP-Expert editor. The ACTIONS block of the bridge-bidding system is displayed and describes what the expert system is to look for



The VP-Expert bridge-bidding system in operation. The main window is for interaction with the user, while the other two provide information about the 'thinking' of the system

£795 excluding VAT.

The only redeeming factor is that Intelligent Environments does provide a comprehensive support and training programme. But £795 to my mind is highway robbery. I can't recommend the program at that price, although it is without doubt friendly and relatively easy to use.

Postscript:

How did Crystal get on at bridge-bidding? Well, in two days I found it pretty easy to teach it opening bidding, but there I stuck. Adding responses and further bids proved too difficult. Nevertheless, the program could do opening bidding quite respectably. Of course, I have set it up to bid the way I do. For example, the following hand was bid as 1NT:
Spades: J 3
Hearts: K J 6 2
Diamonds: A Q T 3
Clubs: Q 8

VP-Expert

Since I had only managed to get Crystal to do opening bidding, I decided to try to get VP-Expert to do everything *except* opening. The version of VP-Expert I had to review was only a beta-test one. This meant that both the manual and software were pre-production. Despite this, at least one commercial product, released in the US, was made using VP-Expert.

Starting up VP-Expert was easy, although not as slick a production as with Crystal. The program also didn't coerce me into accepting the licence agreement. VP-Expert isn't as easy to use or as well-presented as Crystal. There aren't any pop-up menus or windows; only simple text menus and fixed windows. Neither are the explanations for the commands as clear as Crystal's. When a knowledgebase is consulted, VP-Expert defaults to opening up three windows. One of these is an interactive window where the consultation takes place. The others provide a trace of the consultation and show values being assigned to variables. Both of these can be turned off. Despite this, even the best display VP-Expert can produce doesn't really look that professional.

VP-Expert works somewhat differently to Crystal, although it achieves similar results. A knowledgebase in VP-Expert consists of a sequence of actions to be performed and a set of rules and commands used to perform the actions.

The actions are defined in an 'ACTIONS' block. This is the first section of a knowledgebase and defines the goals of the consultation. The essential command is 'FIND' which tells the system that it needs to find the value of a given variable. VP-Expert then looks in the second section of the knowledgebase for rules or statements which assign this variable a value. Other operations may be specified in the ACTIONS section, but FIND is the most important.

The rules for the knowledgebase are defined after the ACTIONS section. These can be arranged in a much more freeform and natural way than those in Crystal. VP-Expert takes upon itself the job of sorting out which rules to apply in which cases. This is much more a typical AI operation than anything Crystal does but still isn't enough to justify VP-Expert's claims to be an expert system shell.

Rules take the form of an IF ... THEN ... ELSE construction combined with AND and OR. If a set of conditions is matched, a value must be assigned to a variable. This is rather limiting in my opinion and makes it hard to work out a good way to set up a knowledgebase.

The most important statement available in VP-Expert is 'ASK'. This takes information from the user and can be set up to present a simple menu or obtain a numerical value. It is also possible to assign more than one value to a variable in VP-Expert; a very useful feature, especially since the program again looks after this. It allows you to make multiple choices from a selection, and 'checks' that the value of a variable will be compared against all the possible values.

VP-Expert assigns a confidence factor to every variable. If these aren't changed, then they are assumed to be 100 per cent. This allows VP-Expert to calculate probabilities and pick the most likely option from a range, for example. One problem is that the confidence factors are somewhat difficult to manipulate.

A major feature of VP-Expert is that it can 'induce' knowledge. It can transform a table of values into a set of rules for the knowledgebase. This can be a very good way to begin constructing a knowledgebase. Unfortunately, it was of no use with my bridge-bidding since that needs calculation and is very hard to turn into a table with explicit values.

Knowledgebases are entered by simply typing them into a text file with an editor. VP-Expert comes with a built-in and slightly lobotomised version of Paperback Writer. This is not too surprising since it is Paperback Software's own word processor. Much to my surprise, I found it easier to use this than leave the program, edit in NewWord 3 (my favourite) and then re-run VP-Expert.

Once finished, control returns to VP-Expert to run (or consult) the knowledgebase. If there are any errors in the file, then VP-Expert automatically returns you to the editor at the point of the first error.

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Otherwise the knowledgebase is executed.

VP-Expert can display information, but only text. This is automatically formatted to look reasonable on the screen. Besides the trace and variable windows, it is also possible to provide text explanations to the user of what is happening. These appear when the 'Why?' and 'How?' commands are used during a consultation.

VP-Expert's other major feature is the ability to integrate fully with Lotus 1-2-3, dBasell, III, III+ or any work-alike programs. VP-Expert can extract information and store information in both of these. It can also run any directly executable program from within itself as long as there is room in memory. Unfortunately, it cannot fully integrate with anything other than dBase or 1-2-3 files. VP-Expert can also chain together several different knowledgebase files.

VP-Expert has several other control structures, commands and functions. These are sufficiently wide-ranging to make the program very flexible. The highlights are a WHILEKNOWN . . . END construction, printer control and access to external text files.

VP-Expert has a reasonable set of mathematical functions — but they are not as extensive as Crystal's; however, it doesn't have financial functions.

I had one major problem while working with VP-Expert. It turned out to be necessary to enclose all numerical variables in brackets to calculate values correctly. For example, number1=number2 will set the variable number1 to the string 'number2'. To set number1 to the value of number2, you need to put number1=(number2). This is only casually mentioned in passing in the manual and since none of the examples provided used numbers, it was very difficult to work out. It also isn't what you would expect, especially since VP-Expert showed unusual sophistication in understanding rules.

Documentation

The documentation I received with VP-Expert was appalling. It took me a couple of hours to summon up the courage and energy to start reading it seriously. I could say more, but since it was only a pre-release copy with an obviously unfinished manual I don't *want* to be unfair. The approach of the manual, which won't change, was unhelpful. I also don't think inexperienced users will find the introductory sections very useful.

Price

VP-Expert costs only £99.95 including VAT. It isn't as nice-looking or as friendly as Crystal, but it is just as capable. I have reservations about the usefulness of either program, but VP-Expert is reasonably priced for what it is.

Postscript:
I had decided to give each program two days to see what I could get out of it, but there was nothing working with VP-Expert at the end of the second day.

I was, however, on the verge of a breakthrough, so I carried on for another half day. This gave me something usable — a knowledgebase that would do all the bridge-bidding with the exception of the opening. It was also acceptable — but only just.

Conclusion

Neither of these programs is a real expert system shell. Don't let this discourage you, though. If you *want* or *need* an intelligent front-end for a database or other application, then these programs could be useful. But don't be fooled by the three card trick. You will need to do some very serious thinking before deciding to use either of these programs and you will have to put in a lot of work once you've bought one.

Crystal is ridiculously overpriced, especially in comparison with VP-Expert which looks fairly crude. Both programs essentially do the same thing but neither is really capable of replacing a trained and knowledgeable human expert, except in trivial situations. So next time you see the man shuffling the cards, remember you have a choice: you don't *have* to join in the game.

Crystal is available from Intelligent Environments on (01) 940 6333. VP-Expert is available from NewStar on (0277) 220573. END

As the final example of the two programs in action, here is a hand dealt randomly and bid by the two programs. All bidding up to the first opening bid is by Crystal and all subsequent bidding by VP-Expert.

NORTH
♠ Spades: 9 5 3
♥ Hearts: Q T 7 4
♦ Diamonds: K 9 5 2
♣ Clubs: 9 5

WEST
♠ Spades: T 8 2
♥ Hearts: A 9 5
♦ Diamonds: A Q 6 3
♣ Clubs: Q 8 3

EAST
♠ Spades: K J 7 4
♥ Hearts: K 8 6 3
♦ Diamonds: J 4
♣ Clubs: J T 6

SOUTH
♠ Spades: A Q 6
♥ Hearts: J 2
♦ Diamonds: T 8 7
♣ Clubs: A K 7 4 2

North (dealer)	East	South	West
PASS	PASS	1 Club	1 No Trump
PASS	2 No Trumps	PASS	PASS
PASS			

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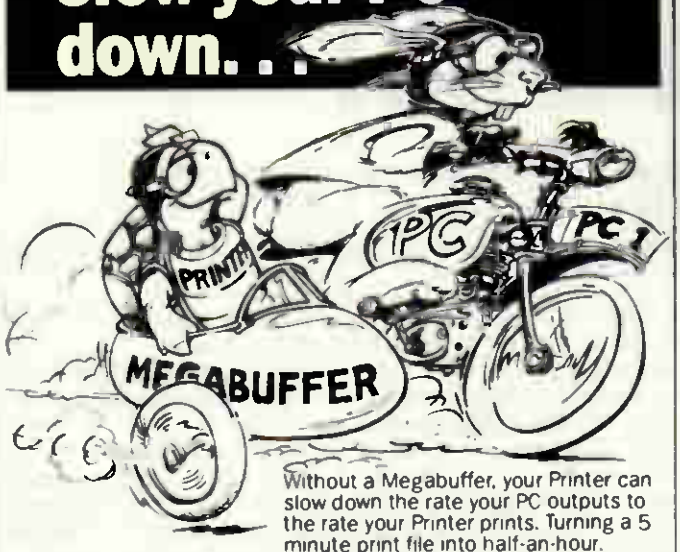

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Clock this!

The real-time clock chip on the IBM PC/AT contains much more than just a clock. Robert Schifreen explains the make-up and function of the 'clock' chip, with some working examples of an alarm-handler routine.

With IBM's introduction of the AT came a number of features not found on a standard PC. One of these features was a real-time clock, the contents of which are preserved by a battery even when the computer is turned off. The clock board used in the IBM AT and on many clones is just a single chip, mounted on the motherboard, with additional connections to link it to a battery. The chip is made by Hitec (Hitachi Electronic Comonents) and is known as the HD146818.

As well as being a clock, the RTC chip (real-time clock) has two properties which potentially make it very useful to programmers or to those who have a general interest in MS-DOS machines. Firstly, it contains 64 bytes of CMOS RAM — memory which is backed up by the battery. Some of these are used by the chip itself to store the time and date but others can, with care, be used for your own purposes. Secondly, a standard feature of the Hitachi clock chip is that it contains an alarm that can be programmed to go off every 24 hours at a predetermined time, or more frequently if you prefer.

As the Hitachi RTC chip is used only on AT-like machines and not standard PCs, no software that I know of actually takes advantage of any of this ability. However, if you have an AT then there's no reason why you can't experiment.

Most manufacturers use the battery-backed memory to store information about the current configuration of the machine. For example, when the SETUP program asks which type of monitor you are using, your answer is stored in the CMOS memory, so MS-DOS can read it each time you turn on. The advantage of the CMOS is that its contents survive even when you turn off the power. On a straight PC with no CMOS memory, information has to be stored in a disk file or set through internal DIP switches and involves taking the machine apart.

This article covers the Hitachi RTC chip and gives some details of what it does. Firstly, it explains what information is usually stored in an AT's CMOS memory, and what use your own programs could make of those details. A chart gives a detailed map of the 64 bytes in question, and the CMOSVIEW.BAS listing allows you to look at the memory in action.

Next come details of the chip's alarm facility. A basic listing. CMOSALRM.BAS, implements a programmable alarm clock for the computer and the machine code program INT4A.ASM tells the system what to do when the alarm actually goes off.

Finally, the CMOSEDIT.BAS program extends the CMOSVIEW program to provide a facility that allows you to change any byte or bit of CMOS memory as well as looking at it. Due to limited space and the complexity of these programs, these listings are given in the Program File section of *PCW*. Do *not* attempt to run them before reading the entire article.

Most of the information presented here will be understandable to anyone who has programmed in Basic; the section on the alarm facility, however, assumes a thorough understanding of machine code routines.

Where to start

The safest way to start experimenting is to look through the data stored in the CMOS RAM on your machine to ensure that it is organised in the same way as other ATs. The chart on these pages shows how the CMOS memory is allocated in most ATs. Now try running the GWBasic program which produces a constantly updated display of the contents of CMOS RAM. The address of each byte is shown first (numbered in series from Oh to 3Fh) followed by the contents of that byte, again in hex.

One byte worth looking at is the very first — byte 0. This contains the current seconds count for the clock. Assuming the Basic program runs fast enough, you will see it tick over every second. Bytes 2 and 4 hold the minutes and hours of the clock, while bytes 1, 3 and 5 store the seconds, minutes and hours respectively of the time the alarm is set for. Bytes 7, 8 and 9 hold the date.

Bytes 15 and 16 tell you how much memory is installed on the motherboard. The value in byte 16 is the number of blocks of 256kbytes installed, so a value of '2' would indicate 512k. A value of 80 in byte 15 means an extra 128k of onboard memory to add to the value in byte 16.

If you have any expanded memory above the 640k limit, this is in bytes 17 and 18, encoded in the same way. The current century is in byte 32.

The type of floppy drive installed as drive A is indicated in byte 10. (See the chart for a list of possible values.)

The 64 bytes of CMOS RAM on the RTC chip are held *on the chip* and are not part of the computer's memory. This means that you can't use Basic's PEEK and POKE commands to access it but have to use special routines.

The first 10 bytes of the CMOS RAM (bytes 00h to 09h) hold the current time and date as kept by the RTC. This area also holds the data for the alarm, which I'll cover separately below. There's not much point in altering MS-DOS's time and date by directly altering these bytes — the TIME and DATE commands provide safer ways to do this.

The other bytes on the CMOS RAM, though, are potentially very useful. Not all of them are used by the system, though the exact use of each one could vary on your own machine. I've tried a real IBM AT as well as clones by Hewlett-Packard, Walters, Tandon, Olivetti and Victor and everything appears alright. The listing opposite is correct on all the machines I have tried, and will serve as a useful guide if you can't persuade the manufacturer of your particular micro to part with more specific details.

The alarm

The Hitachi clock chip includes a programmable alarm clock as standard, though most software writers tend to ignore it. The main reason it has not been exploited before is that

it works only on an AT and not on a PC. If you have an AT, it's fairly simple to write some software to implement an alarm clock. A complete, working example is given in Program File, but it could be improved considerably.

As the chart shows, the time bytes for the alarm are stored in BCD, which stands for Binary Coded Decimal. This means that, for example, a value of 23 (decimal) seconds is stored as 23 hex and not 17h. You'll see the way that everything is stored if you sit and watch the output from the CMOSEDIT program for a while.

To program the alarm clock, you set the required time in bytes 1, 3 and 5 in the CMOS memory block. These are seconds, minutes and hours respectively, stored in BCD. You also have to make sure that bit 5 of byte 0Bh is set to 1, as this enables the alarm. Once these two tasks have been carried out, the alarm will go off at the set time every 24 hours until you disable it by setting bit 5 of byte OBh to zero.

The way that the alarm 'goes off' is very flexible. It doesn't just beep, for example. What happens is that the RTC chip generates a software interrupt 4AH. For non-assembler programmers, this simply means that when the alarm goes off the machine automatically jumps to a program whose address is held in four bytes of memory starting at location 0000:0128h. (So, four times 4Ah is 128h.) These are locations in the computer's memory, not bytes of CMOS RAM in the RTC chip.

The program which starts at that address is called an alarm-handler. It needs to be in machine code, and must end with an IRET instruction. To provide a simple alarm clock, the program could simply beep. Once the IRET instruction is executed, the machine carries on doing what it was up to before it was interrupted.

It doesn't matter what the machine is doing when an alarm goes off — it can be running a program, playing a tune or just sitting waiting for you to type an MS-DOS command. Although this allows an alarm-handler program to provide a number of useful facilities, it means you have to be careful when you write the handler code. For example, the program will need to check which graphics mode, if any, is currently in use and whether the screen is set to 40 or 80 column width. It will also need to check whether any disk access is in progress and, if it is, wait until everything is neatly finished before doing any disk access itself. One golden rule to bear in mind is that your alarm-handler must not use any of the MS-DOS function calls or any DOS interrupt.

Everything must be done through BIOS calls or direct hardware access. The reason for this is that MS-DOS may be in the middle of executing one DOS call when the alarm goes off and, at the end of the alarm-handler, control may not return to the correct place.

The assembly-language program shown on these pages is a working, but short, alarm-handler. It is a resident program that installs itself in memory out of harm's way and should not interfere with any other software you use. Once it has installed itself, the program puts its starting address into the interrupt 4Ah vector (those bytes at address 128h) so that it gets called when the alarm goes off. If you are interested in resident programs in general, see Dick Pountain's article in the January 1987 issue of *PCW*. The program is written for use with Microsoft's Macro Assembler.

I wouldn't suggest that you test it by seeing if alarms work from within your favourite software, as they probably won't and the thing will crash. From the MS-DOS prompt, though, everything works nicely and the message will appear at the duly selected time.

To set the alarm, see the CMOSALRM.BAS program. This is a GWBasic alarm clock that shows you what time the alarm is set for and lets you change it. The current time also ticks

How the AT uses CMOS RAM

All addresses are in hex. Hours, mins, seconds, date, month, year and century are BCD.

Byte	Summary Description	Bit	Contents
00	ts		Time seconds. Holds the seconds for current time
01	as		Alarm seconds
02	tm		Time minutes. Minutes value of current time
03	am		Alarm minutes
04	th		Time hours
05	ah		Alarm hours
06	dw		Day of week. Sunday = 1 etc. On some machines, the day is computed from the current date when needed and is not actually stored in this byte
07	dm		Day of month (1-12)
08	mo		Month (1-12)
09	yr		Year (last two digits). See byte 32 for century
0A	vf		Various flags
0B	vf	7	always 1
		6	If 1, periodic interrupt enabled
		5	If 1, alarm enabled. As used by CMOSALRM.BAS
		4	If 1, update ended interrupt enabled
		3	If 1, square wave enabled
		2	date mode
		1	selects 24 or 12-hour mode for clock
		0	if 1, selects daylight saving time. American version of BST vs GMT
0C	vf		Various flags
0D	vf		Various flags
0E	vf	7	if 1, clock has suffered power loss and needs resetting
		6	if 1, checksum is OK
		5	if 1, system configuration incorrect
		4	if 1, memory size seems incorrect
		3	floppy or hard disk controller status
		2	if 1, current time is valid
		1-0	reserved
0F	vf		Various flags
10	ab	7-4	Type of drive installed as drive A 0000 = no drive 0001 = double sided 0010 = 1.2Mbyte, 5.25in 0011 = 720k, 3.5in 0100 = 1.4Mbyte, 3.5in
		3-0	Type of drive installed as drive B. Same as above
11	nu		Not used
12	cd	7-4	Type of hard drive installed as drive C 0000 = no drive nnnn = types 1-14 (nnnn = 1 to 14) 1111 = refer to byte 19
		3-0	Type of hard drive installed as drive D 0000 = no drive nnnn = types 1-14 1111 = refer to byte 1A
13	nu		Not used
14	fd	7-6	Number of floppy drives installed 00 = 1 drive; 01 = 2 drives 10 and 11 reserved
		5-4	Display type 00 = reserved 01 = 40-column, colour 10 = 80-column colour 11 = monochrome
		3-2	unused
		1	if 1, 8087/80287 math co-processor installed
		0	if 1, floppy disk drives installed (see bits 7-6 for number of drives)
15-16	bm		Base memory on motherboard (takes two bytes to store) 0100h = 256kbytes 0200h = 512kbytes 0280h = 640kbytes
17-18	em		Amount of expanded memory. Coded in same way as above
19	tc		Type of number of hard disk as drive C. No.s 15-16
1A	td		Type number of hard disk as drive D
1B-2D	rd		Reserved
2E-2F	vf		Various flags
30-31	17,18		Copy of bytes 17 and 18
32	19		Century value for clock
33	vf	7	If 1, 128kbyte expansion installed
		6	Reserved
		5-0	Not used
34-3F	rd		Reserved

SUMMARY CHART

Address	00	01	02	03	04	05	06	07	08	09	0A	0B	0C	0D	0E	0F
Contents	ts	as	tm	am	th	ah	dw	dm	mo	yr	vf	vf	vf	vf	vf	vf
Address	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
Contents	ab	nu	cd	nu	fd	bm	bm	em	em	tc	td	rd	rd	rd	rd	rd
Address	20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
Contents	rd	rd	rd	rd	rd	rd	rd	rd	rd	rd	rd	rd	rd	rd	vf	vf
Address	30	31	32	33	34	35	36	37	38	39	3A	3B	3C	3D	3E	3F
Contents	17	18	19	vf	rd	rd	rd	rd	rd	rd	rd	rd	rd	rd	rd	rd

away at the bottom of the screen so you can easily set an alarm for a couple of minutes ahead and then get out of Basic while you wait for things to happen. Don't bank on the alarm appearing while you're in Basic, as GWBasic interpreters have a habit of claiming normally unused interrupts for their own ends. If any of the alarm bytes in the CMOS (bytes 1, 3 or 5) contain a value of FFh then that is known as a 'don't care' value and an alarm will go off regardless of what that byte is set to. For example, if you set the alarm minutes byte to 15, the seconds to 0 and the hours to FF (for don't care), an alarm will go off at quarter past every hour. If all three bytes contain FF, then an alarm goes off every second.

How to read and write the CMOS RAM

In a standard IBM AT and most clones, the clock chip (containing the CMOS RAM) is connected to the computer via input/output ports 70 and 71 hex. Input/output ports are the way that pieces of hardware (like the clock chip) are linked to the computer from the programmer's point of view. The programmer just reads and writes data to and from the ports using IN and OUT commands, and the machine takes care of the rest. This means that if you program in a language that lets you read from and write to ports, then you can write programs to access the CMOS directly.

Port 70h is the address port and port 71h is the data port. To read the value from a byte of CMOS memory, tell the address port which byte you want to read. Then, read the data port and it will contain the contents of the required address.

To write a value into a byte of CMOS memory, again tell the address port which byte you want to write. Then, writing a value to the data port will automatically put it in the required byte of CMOS, overwriting what was there before.

If you want to read or write the same byte twice, you still have to send the required address to the address port even if the address you are using has not changed since you last used it. (See the sample routines on these pages for examples of how to read and write to and from the CMOS RAM).

For those who may want to experiment with the CMOS RAM in their machine, a simple Basic program called CMOSEDIT is given in Program File. Written in Microsoft/GWBasic, it should run on any AT. It gives a constantly updating display of all 64 bytes of the CMOS memory and a list of single-key commands appears at the bottom of the screen. The program is bug-free but, in order to keep it short and sweet, lacks any error detection — so be careful that you type in valid numbers when asked. The program only reads the keyboard inbetween updating entire screens, so if you press a menu key while the cursor is half-way through updating the screen, you'll have to wait two or three seconds before anything happens. If you have a Basic compiler, compiling the program speeds it up around sixfold

Before you use the program, though, be aware of an important point. It is probable that your machine uses one or more bytes of CMOS RAM to store details about what type of hard disk you have installed. If you inadvertently change this byte, the computer will lose all record of the hard disk and refuse to boot from it. What's more, even if you boot from a floppy, then MS-DOS will refuse to log you into drive C, insisting that you have entered an 'Invalid drive specification'. I know this for a fact — I've done it twice, on two different machines. In both cases, running the original SETUP program that came with the machine fixed everything, so make sure you have a bootable MS-DOS utility disk before you start experimenting. Even those bytes officially marked as unused may actually be used for something important.

Assuming you find some bytes that really are unused on your machine, you could use them to add new facilities to your system. For example, you could protect data with a password system that relied on a password stored (in coded form) in one or more spare bytes of CMOS. Alternatively, you could have the system automatically keep track of the current directory so that, when the power is turned on, you are automatically placed in the same directory you were in when the power was turned off. There are a number of possibilities, though admittedly all of them can be achieved using a temporary (hidden?) file on the hard disk instead.

Consequences

After reading all this you may or may not wish to play around with the intricacies of the Hitachi clock chip on your AT. Before you do, though, think about the possible consequences and, if your hard disk contains any irreplaceable information, think even more. If you do have problems, call the manufacturer of your machine and make sure that you haven't corrupted any vital parts of the CMOS. If you want to play safe, restrict yourself to using CMOSVIEW to scan through the information stored in the CMOS RAM — there's no harm in looking.

If you change something in CMOS and then realise you should have left it alone, one remedy is to remove the case of the computer and disconnect the RTC chip from the battery for a while. When you boot the computer, it should realise that the RTC's data has been lost and should work out what to do for itself. You may have to disconnect the battery for up to 24 hours, though, as CMOS chips discharge their power *very slowly*.

For complete technical information about the Hitachi chip, your electronics dealer should be able to supply you with the official datasheet for the device. END

GWBasic CMOS RAM viewer

```
1000 REM CMOS RAM
1001 VIEWER FOR PC/AT
1010 SCREEN 0:CLS
1020 LOCATE 1,17
1021 PRINT "CMOS Ram
     Viewer - All values
     in HEX"
1030 LOCATE 2,17
1040 LOCATE 23,32:
     PRINT "Q - Quit"
1050 FOR X=4 TO 19
1060 FOR Y= 1 TO
     61 STEP 20
1070 LOCATE X,Y
1080 N=((4*(X-4))+
     ((Y-1)/20+1))-1
1090 H$=HEX$(N):
     IF LEN(H$) <2
     THEN H$="0"+H$
1100 PRINT H$;" = ";
1110 LOCATE X,Y+6
1120 OUT &H70,
     VAL("&h"+H$)
1130 P=INP(&H71):
     P$=HEX$(P)
1140 IF LEN(P$)<2
     THEN P$="0"+P$
1150 PRINT P$;" "
1160 LOCATE X,Y+10
1170 NEXT
1180 NEXT
1190 K$=INKEY$
1200 IF K$="" THEN 1050
1210 IF K$ = "Q" OR
     K$="q" THEN
     COLOR 7,CLS:END
1220 GOTO 1050
```

Writing a value to the CMOS RAM

```
10 print "What byte to alter (0-63)"
20 input b
30 if b > 63 then goto 10
35 print "New contents (for byte)"
36 input v
40 out &h70,b
50 out &h71,v
```

Reading a value from the CMOS RAM

```
10 print "What byte to read (0-63)"
20 input b
30 if b > 63 then goto 10
40 out &h70,b
50 v = inp(&h71)
60 print "Value in byte is";v
```

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Balancing the scales

In the third part of his series on programming in Prolog, Mike Liardet introduces the language's list-processing and data-structuring facilities.

There are twelve pool balls, numbered 1 to 12. Eleven of the balls are of identical weight, but one of the balls is slightly 'out'. Devise a scheme for weighing the balls on balance-scales, to determine which ball is the wrong weight and whether it is over or underweight. The outcome of each weighing will either be that the scales balance or else the left-hand pan will be heavier than the right, or vice versa. No more than three weighings are allowed.

No, you haven't turned to this month's problem in *PCW*'s Leisure Lines: the solution to the 'pool problem' given above is an ideal example for expressing in Prolog.

The first two sections of this article will describe just what are Prolog 'structures' and 'lists', and how they can be used. The third and final section will describe how Prolog can solve the pool ball puzzle. Lists and structures are indispensable to the Prolog solution of this problem, so this provides an excellent illustration of how they might be used 'in anger'.

We have already seen how Prolog programs can manipulate and reason with constants — either symbolic constants (for example, names like paris, london, and so on) or numerical constants (for example, 12, 12.34, 99, and so on). A number of interesting problem areas can be attempted using just constants, but Prolog's problem-solving power can be greatly extended by the use of structures and lists which, between them, allow highly complex data structures to be built.

This is part three of our Prolog series. Parts one and two appeared in the February and March issues of PCW, copies of which are available from Back Issues.

Remember that all the example programs given here are written in Turbo Prolog and may need some modification before they will work with other versions of Prolog. Most notably, the declarations at the top of each example (everything up to and including the word 'clauses') should be omitted for other Prologs.

Structures

In programming, a structure is typically used when it is desirable to represent, as a single unit, an object with a number of attributes. Languages like Pascal and C have good structure facilities, but some programming languages offer nothing at all. For example, Fortran and Basic programmers must manage without them, and most versions of Lisp have only a fairly weak 'property list' facility which is a poor substitute for the real thing.

In Prolog, structures are created almost as a 'side-effect' of stating a fact. For example, a stock-control program may contain the following fact clause:

```
instock(clothes(sweaters,5,medium)).
```

meaning that there are five medium-sized sweaters in stock. The 'clothes(sweaters,5,medium)' is the structure, a single object as far as 'instock' is concerned, but actually containing three attributes — sweater, 5 and medium. Turbo Prolog differs from other Prologs in that structures have to be declared at the beginning of the program in the traditional manner.

In some situations a programmer could choose to represent the above clause, without using a structure, as:

```
in_stock(sweaters,5,medium).
```

But what if there are other different *types* of item in stock as well? Referring to Fig 1, after the sweaters stock record, the two remaining fact clauses state that there are also in stock: 10lb of Jazz Drops, selling at 35p a quarter; and three copies of the book *Algorithms* by Sedgewick, published by Addison-Wesley in 1983. The information on sweets, books and clothes is quite different, but by using structures to represent each different type of item, it would still be possible to make a general enquiry of 'instock'. For example, with the program in Fig 1, try the goal:

```
instock(X).
```

This should give a run-down on everything in stock, of whatever type.

With the structure representation, it is also possible to be more specific and write programs to seek out certain types of stock item. For example, the 'reorder_sweets' clause in Fig 1 determines which sweets have to be re-ordered by checking which ones are in stock, but in quantities of less than 20lbs. And it ignores entirely any stock items which are not sweets. If you try the goal:

```
reorder_sweets(X).
```

the system should tell you that Jazz Drops are running short.

Structures can be nested so that one of the items of a structure can itself be another structure, and possibly of the same type. This facility is invaluable for building up recursive data structures, such as 'trees'. I won't elaborate further here, but the solution to the pool ball problem below uses structures this way to build a 'decision tree'.

In Prolog jargon 'sweets', 'book' and 'clothes', as used above, are cal-

led 'functors'. The contents in the brackets following a functor are simply referred to as the arguments — they can be thought of as the attributes of the particular record being represented. Notice that the syntax of structures is the same as that of relations. (We have already dealt with relations — they are simply the goals, or heads of clauses). Out of context, it is not possible to tell whether, say:

person(fred,29,20000,manager)

is a relation or a structure. Used as a relation, it could occur, as it stands, in a Prolog program as just a fact clause. Alternatively, as a structure, it could appear as a term in a clause such as:

seen_in_my_street(person(fred,29, 20000,manager)).

This similarity between relations and structures is deliberate, and advanced users can make use of it by writing programs to create structures which can then be executed as programs. We won't be doing that at this stage, though!

Lists

The list in Prolog is analogous to the array in other programming languages. Prolog does not have arrays, and most other languages do not have lists. In programming, both arrays and lists are used for similar reasons, usually to represent *sequences* of data. There are pros and cons as to which representation is the more effective, but that's another matter.

Lists are written in Prolog in square brackets, with each element separated from the next by a comma. Some typical lists might be:

[cat, dog, hamster, budgie]
[yo, ho, ho, with, a, bottle, of, rum]
[hi, ho, hi, ho, its, off, to, work, we, go]
[0,32,15,59,100,212]
[]

and these might appear in clauses, such as those in Fig 2. Lists can appear anywhere in clauses, and not just in the head as we have shown here. Notice that the empty list, denoted by '[]', is perfectly legitimate.

In most Prologs, lists can also contain other lists as elements, or mixed symbols and numbers, and so on, but Turbo Prolog is more restrictive. Concentrating solely on the 'ditty' clause of Fig 2, try the following command-line goals:

ditty(P).
ditty([yo, ho, ho, with, a, bottle, of, rum]).
ditty([P, Q, R, with, a, bottle, of, rum]).
ditty([yo, P, P, with, a, bottle, of, rum]).

These goals all match with the ditty clauses in a fairly obvious way. Most of the effects could have been achieved without lists at all — just by

Illustration by Simon Edwards

```
domains
        item = clothes(symbol,integer,symbol);
               sweets(symbol,integer,integer);
               book(integer,symbol,symbol,symbol,integer)
predicates
        instock(item)
        reorder_sweets(symbol)

clauses

instock(clothes(sweaters,5,medium)).
instock(sweets(jazz_drops,10,35)).
instock(book(3,algorithms,sedgewick,addison_wesley,1983)).

reorder_sweets(X):-
        instock(sweets(X,Y,_)),
        Y<20.
```

Fig 1 Examples of structures

```
domains
     intlist = integer*
     symlist = symbol*

predicates
     possible_pet(symlist)
     ditty(symlist)
     cent_and_fahr(intlist)
     empty(symlist)

clauses
ditty([yo, ho, ho, with, a, bottle, of, rum]).
ditty([hi, ho, hi, ho, its, off, to, work, we, go]).
cent_and_fahr([0,32,15,59,100,212]).
possible_pet([cat, dog, hamster, budgie]).
empty([]).
```

Fig 2 Examples of lists

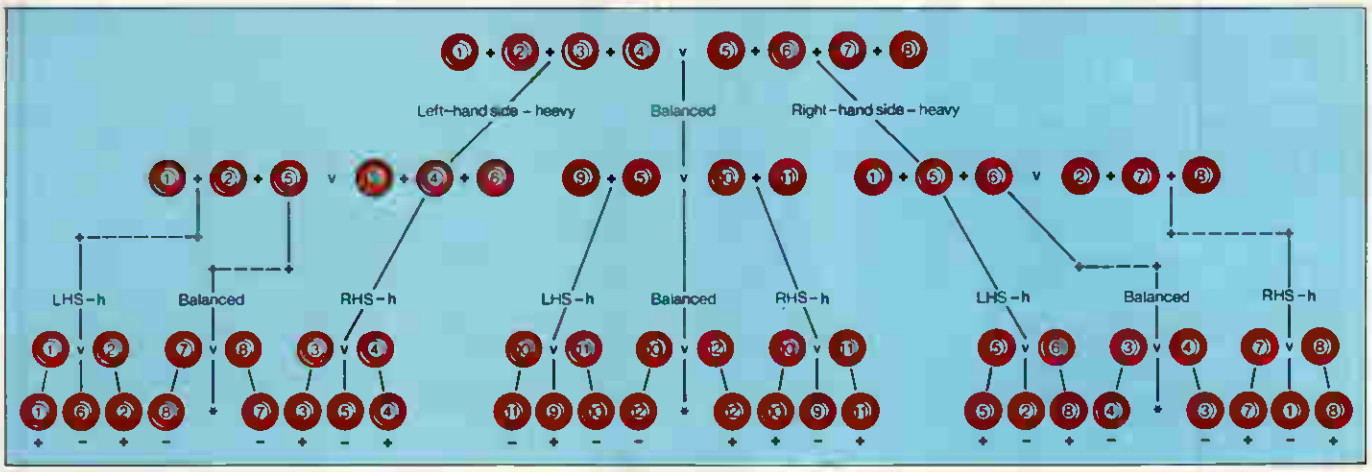

Fig 3 Decision tree solution to the pool ball problem

dropping the '[' and ']' in both the goals and the fact clauses. Barring any system complaints that the two ditty fact clauses each have different numbers of arguments, the results would be much the same.

Here are some more interesting goals:

```
ditty([yo, ho, ho|Rest]).
ditty([yo|Rest]).
ditty([yo, P, ho, with, a, bottle, of,
  rum|Rest]).
```

Notice the mysterious '|' symbol used in these goals: it is not an exclamation mark, but a vertical bar. It is only used in lists, and it is highly unusual for it to be followed by anything other than a single variable name.

When Prolog matches a '|'ed list with another list, everything to the left of the '|' must match, element by element, with the other list. But the variable to the right of the vertical bar is simply matched with the remainder of the other list. The list expression '[X|Y]' is very commonly used. When such a list is matched with another list, it prises apart the first element of the other list (the 'head') from the rest of it (the 'tail'). It will always match with any list, except for the empty list. Try the goals:

```
ditty([X|Y]).
empty([X|Y]).
```

to see what this means.

The '|' list notation is indispensable for creating list processing procedures which can handle general lists of any length. The utilities for solving the pool ball problem (Fig 7) contain some general-purpose list processing facilities, and I'll describe some of them here. The reader can try them out in isolation if he or she wishes. They do not require the presence of any other clauses, only the relevant 'domain' and 'predicate' declarations of Fig 5.

- 'member' determines whether or not an element is in a list. The first clause states that an element, X, is a member of a list if it is at the head of the list. The second clause states that X is a member of the list if it is (recursively) a member of the list without its head.
- 'append' joins the first two list arguments together, returning the result as the third argument. The first clause states that appending any list to the empty list just results in that list. The second clause states that to append any list to a non-empty list, it is necessary to recursively append the list to the non-empty list without its head and then add the head (X) onto the result.
- 'length' calculates the length of a list. The first clause gives the length of the empty list as zero. The second clause calculates the length of a non-empty list as 1 + (recursively) the length of the list without its head.

Try these predicates with the following goals:

```
length([1,2,3],Ans).
member(99,[1,2,3,99,4,5,6])
append([1,2,3],[4,5,6],Ans)
```

As with many predicates in Prolog, all three of these list processing facilities can also be used in other ways, even though they may not have been conceived with alternative uses in mind. Try:

```
length(Ans,5).
member(X,[1,2,3,4]).
append([1,2,3|X],Y,[1,2,Z,4,5]).
```

The 'length' goal constructs a list of five elements (if working in Turbo Prolog ignore the warning message), and then tries to find alternative solutions *ad infinitum*. The 'member' goal finds the four values of X which are members of the list: and the 'append' goal finds various combinations of values for X, Y and Z which satisfy that 'append' relationship.

```
node([1,2,3,4],[5,6,7,8],
     node([1,2,5],[3,4,6],
          node([1],[2],heavy(1),light(6),heavy(2))
          ...)
     ...
     node([5,6,1],[7,8,2],
          ...
          node([7],[8],heavy(7),light(1),heavy(8))))
```

Fig 4 Formatted printout of part of the data structure

```
domains
        maxwings, count = integer
        balls = count*
        tree = node(balls,balls,tree,tree,tree);
               heavy(count);light(count);impossible
predicates
        solve(balls,maxwings,tree).
        gentree(count,balls,balls,balls,balls,maxwings,tree).
        genleftheavy(count,balls,balls,balls,balls,maxwings,
                     balls,balls,balls,tree).
        genrightheavy(count,balls,balls,balls,balls,maxwings,
                     balls,balls,balls,tree).
        genbalance(count,balls,balls,balls,balls,maxwings,
                     balls,balls,balls,tree).
        enough_weighings(balls,balls,balls,maxwings).
        select(balls,balls,count,balls,count,balls).
        try_weighing(count,balls,balls,balls,balls,balls,balls,balls).
        eachside(count,count).
        unheavy(balls,balls,balls,balls,balls,balls,balls,balls,balls).
        unlight(balls,balls,balls,balls,balls,balls,balls,balls,balls).
        unboth(balls,balls,balls,balls,balls,balls,balls,balls,balls).
        shift(balls,balls,balls,balls,balls).
        member(count,balls).
        length(balls,count).
        expo(count,maxwings,count).
        append(balls,balls,balls).
        print_tree(tree,integer).
        spa(integer).
        use(tree).
        action(char,tree,tree,tree).
```

Fig 5 Declarations for the pool ball program

Solving the pool ball problem

In this section I'll first describe the methodology for solving the pool ball problem, then define a data structure for representing the problem solution, and then describe how the accompanying Prolog program actually works to produce this solution. This program is more complicated than the average beginner's program so it may be necessary to expend some effort to fully understand it. A useful tip is to try out lower-level predicates, on their own, as goals on the command line. This can be very useful in comprehending how they work.

There are many ways in which the Prolog program can be enhanced, and at the end of this section I'll present some suggestions for improving it. Since the program works extensively with lists and structures, implementing these suggestions should provide ample opportunity for programming practice with both these types of Prolog data structure. At the same time, attempting some of these improvements should give the reader the opportunity to grapple with some real artificial intelligence issues.

Before reading any further, the reader may care to attempt to solve the problem manually. There are many possible solutions, but they are by no means obvious.

Having solved the pool ball problem manually, it is fairly natural to write the solution in the form of a 'decision tree'. Fig 3 shows one solution (equivalent to the one generated by the program), with the decision tree represented graphically. At the top of the tree is the instruction for the first weighing: weigh balls 1–4 in the left-hand pan of the scales against 5–8 in the right. The three branches immediately below this instruction represent the three possible outcomes of this weighing — left-hand pan heavy, scales perfectly balanced, or right-hand pan heavy.

Depending upon the outcome of the first weighing, different weighings are specified at the end of the three branches. For example, if the result of the first weighing were that the balls in the left-hand pan were found to be heavy, then the second weighing must weigh balls 1, 2, 5 against 3, 4, 6. Depending upon the result of this weighing, one of the three weighings below it should be attempted, and the outcome of this final third weighing will determine the incorrect ball. For example, if 1, 2, 5 and 3, 4, 6 balance and then 8 is found to be heavier than 7, then 7 is the odd ball and it is light. This is written as '7 –' in the diagram

```
clauses

/* solve(Balls,Max_num_of_weighings,Tree) */
solve(PLH,Maxwings,Tree):-
        length(PLH,Nballs),
        gentree(Nballs,[],[],[],PLH,Maxwings,Tree).

/* gentree(Number_of_balls,P,PL,PH,PLH,Max_num_of_weighings,Tree) */
gentree(_,_,[],[],[],_,impossible).
gentree(_,_,[Wrongun],[],[],_,light(Wrongun)).
gentree(_,_,[],[Wrongun],[],_,heavy(Wrongun)).
gentree(Nballs,P,PL,PH,PLH,Maxwings,
                node(Left,Rght,ifheavy,ifbalance,ifrheavy)):-
        enough_weighings(PL,PH,PLH,Maxwings),
        try_weighing(Nballs,P,PL,PH,PLH,Left,Rght,Rest),
        Maxwings1 = Maxwings - 1,
        genleftheavy(Nballs,P,PL,PH,PLH,Maxwings1,Left,Rght,Rest,Ifheavy),
        genbalance  (Nballs,P,PL,PH,PLH,Maxwings1,Left,Rght,Rest,Ifbalance),
        genrightheavy(Nballs,P,PL,PH,PLH,Maxwings1,Left,Rght,Rest,Ifrheavy).
        genbalance(Nballs,P,PL,PH,PLH,Maxwings,Left,Rght,_,Tree):-
                unboth(Left,P ,PL ,PH ,PLH, P1,PL1,PH1,PLH1),
                unboth(Rght,P1,PL1,PH1,PLH1,P2,PL2,PH2,PLH2),
                gentree(Nballs,P2,PL2,PH2,PLH2,Maxwings,Tree).
        genleftheavy(Nballs,P,PL,PH,PLH,Maxwings,Left,Rght,Rest,Tree):-
                unlight(Left,P ,PL ,PH ,PLH, P1,PL1,PH1,PLH1),
                unheavy(Rght,P1,PL1,PH1,PLH1,P2,PL2,PH2,PLH2),
                unboth(Rest, P2,PL2,PH2,PLH2,P3,PL3,PH3,PLH3),
                gentree(Nballs,P3,PL3,PH3,PLH3,Maxwings,Tree).
        genrightheavy(Nballs,P,PL,PH,PLH,Maxwings,Left,Rght,Rest,Tree):-
                unheavy(Left,P ,PL ,PH ,PLH, P1,PL1,PH1,PLH1),
                unlight(Rght,P1,PL1,PH1,PLH1,P2,PL2,PH2,PLH2),
                unboth(Rest, P2,PL2,PH2,PLH2,P3,PL3,PH3,PLH3),
                gentree(Nballs,P3,PL3,PH3,PLH3,Maxwings,Tree).

        try_weighing(Nballs,P,PL,PH,PLH,Left,Rght,Rest):-
                eachside(Nballs,Ceqac),
                select(P,       [],   Ceqac,  Left1,Lceqac1,Prest),
                select(PL,      Left1,Lceqac1,Left2,Lceqac2,PLrest),
                select(PH,      Left2,Lceqac2,Left3,Lceqac3,PHrest),
                select(PLH,     Left3,Lceqac3,Left ,0       ,PLHrest),
                select(PLrest, [],   Ceqac,  Rght2,Rceqac2,PLrest1),
                select(PHrest, Rght2,RCeqac2,Rght3,Rceqac3,PHrest1),
                select(PLHrest,Rght3,RCeqac3,Rght, 0,      PLHrest1),
                append(PHrest1,PLHrest1,Rest1),
                append(PLrest1,Rest1,Rest2),
                append(Prest,Rest2,Rest).

        enough_weighings(PL,PH,PLH,Maxwings):-
                Maxwings >= 1,
                length(PL,PLlen),
                length(PH,PHlen),
                length(PLH,PLHlen),
                expo(3,Maxwings,E),
                PLlen + PHlen + 2 * PLHlen <= E.

        /* select(Balls,List,Max,Listnew,Maxnew,Remaining) */
        select(Balls,List,Max,List,Max,Balls).
        select([Ball|Balls1],List,Max,[Ball|List1],Maxnew,Remaining) :-
                Max >= 1,
                Max1 = Max - 1,
                select(Balls1,List,Max1,List1,Maxnew,Remaining).

        unheavy(Allthese,P,PL,PH,PLH,Pnew,PLnew,PHnew,PLHnew):-
                shift(Allthese,P,PH,Pnew,PHnew),
                shift(Allthese,PL,PLH,PLnew,PLHnew).
        unlight(Allthese,P,PL,PH,PLH,Pnew,PLnew,PHnew,PLHnew):-
                shift(Allthese,P,PL,Pnew,PLnew),
                shift(Allthese,PH,PLH,PHnew,PLHnew).
        unboth(Allthese,P,PL,PH,PLH,Pnew,PLnew,PHnew,PLHnew):-
                shift(Allthese,P,PL,P1,PLnew),
                shift(Allthese,P1,PH,P2,PHnew),
                shift(Allthese,P2,PLH,Pnew,PLHnew).
```

Fig 6 Main predicates for the pool ball program

```
        /* shift(Allthese,Tothis,Fromthis,Tothisresult,Fromthisresult) */
        shift(_,Tothis,[],Tothis,[]).
        shift(Allthese,Tothis,[X|MoreXs],[X|Tothisresult],Fromthisresult):-
                member(X,Allthese),
                shift(Allthese,Tothis,MoreXs,Tothisresult,Fromthisresult).
        shift(Allthese,Tothis,[X|MoreXs],Tothisresult,[X|Fromthisresult]):-
                not(member(X,Allthese)),
                shift(Allthese,Tothis,MoreXs,Tothisresult,Fromthisresult).

        /* eachside(Nballs,N) */
        eachside(Nballs,1):-
                2<=Nballs.
        eachside(Nballs,N):-
                4<=Nballs,
                Nballs = Nballs - 2,
                eachside(Nballs,M),
                N = M + 1.

        /* member(X,List) Is X a member of List? */
        member(X,[X|_]).
        member(X,[_|MoreXs]):-
                member(X,MoreXs).

        /* append(List1,List2,Listboth) */
        append([],List,List).
        append([X|Xs],List,[X|XsList]):-
                append(Xs,List,XsList).

        /* length(List,N) length of list */
        length([],0).
        length([_|Xs],N1):-
                length(Xs,N),
                N1 = N + 1.
        /* Exponentiation M**N = P */
        expo(M,N,P) :- exp(N*ln(M)) = P.
```

Fig 7 Utilities for the pool ball program

(similarly the notion 'x +' means the ball x is found to be heavy). Notice that 8 and 7 should never balance at this point — this is a logical impossibility represented by '*' in the diagram.

Finding a solution to the pool ball problem involves some logical deduction and some guess work, and Prolog is uniquely suited to doing both. A typical approach, used by the program and in manual solutions, is to guess at the weighing instructions at the start/top 'node' in the decision tree, and for each of the three possible outcomes, derive what new information will then be known about the balls. For each of these outcomes another guess at a weighing is made, followed by further deductions, and so on.

Finally, if the result of all the outcomes of all the third weighings is that a definite odd ball can be identified, then a solution to the problem has been found. Otherwise, one or more of the weighing instructions must be changed. Of course, the program is very systematic about 'guessing' and changing the weighing instructions. Human solvers tend to work more erratically but with greater intuition.

The deductions that can be made following a weighing are as follows:

(1) If the scales balance then all the balls in the scales must be perfect, and there are no further conclusions to be reached about any of these balls.

(2) If the balls in the left-hand pan are heavier than those in the right, then none of the left-hand balls can be light, none of the right-hand balls can be heavy, and all the other balls must be perfect.

(3) If the balls in the right-hand pan are heavier than those in the left, then none of the right-hand balls can be light, none of the left-hand balls can be heavy, and all the other balls must be perfect.

(4) If all but one ball is known to be perfect, and that one ball cannot be heavy/light, then it is the odd ball and it is light/heavy.

(5) If all the balls are found to be perfect, then an impossible situation has arisen — the scales are lying!

To see how these deductions work, consider the decision tree in Fig 3 and the deductions that would be made for one possible sequence of weighings. Before the first weighing, all the balls can be considered to be perfect, light or heavy (PLH for short). Suppose the result of the first weighing is that the scales balance. Using rule (1) above, this means that balls 1–8 are perfect (P) and 9–12 are still PLH. If the result of the second weighing, 9 and 5 against 10 and 11, is that the 9 and 5 appear heavier, then using rule 2, 9 and 5 cannot be light, 10 and 11 cannot be heavy and all the other balls must be perfect. Consolidating all this new information, we have 1–8 and 12 are P, 9 is perfect or heavy (PH), and 10 and 11 are perfect or light (PL). Following this, if the result of weighing 10 against 11 is that 11 appears heavier, then using rule (3), ball 10 is PL and all the rest are perfect. Then, by rule 5, ball 10 must be the odd ball and it is light. This is the outcome recorded in the decision tree of Fig 3.

The objective here is to create a Prolog program that will find a solution to the problem and create a data structure equivalent to the graphical decision tree of Fig 3. This data structure will involve both Prolog lists and structures, and a partial printout of it is shown in Fig 4. The solution is represented by a Prolog 'node' structure which specifies the action to be taken for the first weighing, and then the further actions to be taken, depending on the outcome of this weighing. The node structure has five components: a list of the balls to be placed in the left-hand pan; a list of the balls for the right-hand pan; and the three actions to be taken for the three possible outcomes of the first weighing. These three actions are themselves node structures, specifying further weighings, and so on. Ultimately this nesting of nodes is terminated by a conclusion, either a structure of the form 'light(N)' or 'heavy(N)', indicating which ball is heavy or light, or the symbol 'impossible'.

```
/* use(Tree) - dialogue with user */
use(light(N)):-
        write("Ball ",N," is light."),nl.
use(heavy(N)):-
        write("Ball ",N," is heavy."),nl.
use(impossible):-
        write("That's impossible."),nl.
use(node(Left,Right,Ifheavy,Ifbalanced,Ifrheavy)):-
        write("Left  = ",Left),nl,
        write("Right = ",Right),nl,
        write("Result? (L)eft heavy, (B)alanced, (R)ight heavy:"),
        readchar(C),
        action(C,Ifheavy,Ifbalanced,Ifrheavy).
action('L',Ifheavy,_,_):-
        write("Left heavy"),nl,
        use(Ifheavy).
action('R',_,_,Ifrheavy):-
        write("Right heavy"),nl,
        use(Ifrheavy).
action(_,_,Ifbalanced,_):-
        write("Balanced"),nl,
        use(Ifbalanced).

/* print_tree(Tree,Indent) */
print_tree(light(N),Indent):-
        spa(Indent),write("Ball ",N," is light."),nl.
print_tree(heavy(N),Indent):-
        spa(Indent),write("Ball ",N," is heavy."),nl.
print_tree(impossible,Indent):-
        spa(Indent),write("Impossible."),nl.
print_tree(node(Left,Right,Ifheavy,Ifbalanced,Ifrheavy),Indent):-
        spa(Indent),write("Left  = ",Left),nl,
        spa(Indent),write("Right = ",Right),nl,
        Ind8 = Indent + 8,
        print_tree(Ifheavy,Ind8),
        print_tree(Ifbalanced,Ind8),
        print_tree(Ifrheavy,Ind8).

spa(0).
spa(N):- N > 0,write(" "),N1 = N - 1,spa(N1).
```

Fig 8 Printout and test predicates for the pool ball program

The Prolog program (Figs 5–8) has been slightly generalised to attempt to solve the problem for any number of balls, with a maximum number of weighings specified. It can also print out the solution and test it by running an interactive weighing session to identify the odd ball. Fig 5 contains the declarations, needed only by Turbo Prolog users. Fig 6 contains the main predicates involved in the generation of the solution. Fig 7 contains some simple utilities needed by the main predicates while Fig 8 contains the solution printer and tester. Turbo Prologers should combine the code in the four figures into one file; non-Turbo Prologers can omit Fig 5, but may possibly need to modify some of the code to fit their Prolog. To test the program, run it with a simpler problem such as:

```
solve([1,2,3],2,Tree),print_tree(Tree,
  0),use(Tree).
```

This three-ball problem in two weighings should be solved almost instantaneously. When this is working, try the real problem:

```
solve([1,2,3,4,5,6,7,8,9,10,11,12],3,Tree),
  print_tree(Tree,0),use(Tree).
```

In Turbo Prolog 'solve' can take up to three minutes, depending on the hardware running it. It may take considerably longer for interpreted Prologs, so be patient.

It is also possible to replace 'use(Tree)' in the above goals with 'fail' to force backtracking and thus generate multiple solutions to the problem. The first solution is the one represented in the decision tree of Fig 3,

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but there are many, many others, as you will see for yourself if you try it.

When responding to the 'test' part of the program, make sure that any 'l' and 'r' responses are in lower case. The software treats any other characters, including 'L' and 'R', as a 'b' for 'balanced'.

I'll now give an overview of each of the predicates defined in Fig 6. This is the core of the program, and the rest of it should be easy to follow when this part has been understood.

- 'solve' calculates the number of balls in the problem and hands over the task of problem solution to 'gentree', putting all the balls in the PLH category, with P, PL and PH categories empty (that is, empty lists, written as '[]').
- The first three clauses of 'gentree' check to see if the problem can be solved immediately, implementing rules (4) and (5) above. The fourth clause checks that a solution is possible with the number of weighings left; generates a possible weighing; reduces the number of weighings left; and then generates a decision tree for each of the three possible outcomes, using 'genleftheavy', and so on. These last three calls recursively call on 'gentree' which can fail on the 'enough_weighings' test, or run out of alternative weighings. This will cause backtracking so that an alternative possible weighing will be sought by 'try_weigh'.
- 'genbalance', 'genleftheavy' and 'genrghtheavy' implement the rules (1) to (3) above, and create new P, PL, PH and PLH categories for the recursive call to 'gentree'. For example, 'genleftheavy' uses 'unlight' to move any balls in the left-hand pan from the PL category to P, and from the PLH category to PH. The 'unheavy' and 'unboth' calls cause further category movements to be made for balls in the right-hand pans, and for balls not in the scales. 'gentree' is then called with the new category arrangement (but with one less weighing available from before).
- 'tryweighing' generates possible weighing configurations, with all the balls allocated between the left and right pans, or not on the scales (the 'Rest'). Used with backtracking it can repeatedly produce alternative weighing possibilities. But, in order to allow the program to reach a solution in reasonable time, it avoids regenerating some of the trivial variations of weighings that have already been rejected. For example, for the first weighing (when all the balls are PLH) it only generates the six fundamentally different possibilities — one per side up to six per side (there are actually several million possibilities that could be generated). Firstly, it decides how many balls can be used each side, and then uses 'select' to fill up the left-hand pan with balls from each of the four categories. Then it fills up the right-hand pan with balls from three categories, ignoring perfect balls. (There is never a need to place perfect balls on both sides of the scales as they cancel each other out, so arbitrarily they are excluded from the right-hand pan.) All the balls left over after both the pans have been filled are then grouped together into 'Rest' by the calls to'append'.
- 'enough_weighings' is used by 'gentree' to calculate whether there are enough weighings left to solve the problem. Observe that if there is one weighing left, then there will be three outcomes from it. If there are two there will be 3**2=9, if there are three then it's 3**3=27, and so on. However, the number of balls in the PL, PH and PLH categories determines the number of possibilities still to be dealt with, and this cannot exceed the number of outcomes available. Notice that there are always two possibilities still to be dealt with for each ball in the PLH category, but only one for PL and PH.
- 'select' is used by 'try_weighing' to add balls from one category into a scale pan. It can choose to put no balls into the scale pan, or any number right up to filling the scale pan to the maximum, previously determined by 'eachside'.
- 'unheavy', 'unlight' and 'unboth' are used to remove the possibility of specified balls being heavy or light, by moving them as appropriate between the four categories. 'unboth' is used to specify that certain balls are neither light nor heavy — that is, they must all be moved to the 'perfect' category.

Conclusion

There are many ways in which the Prolog program here can be enhanced. One way is to further reduce the number of combinations of weighings that are attempted so that, optimally, the system only considers relevant weighings and not weighings that are trivial variations of weighings it has already considered. It is also possible to improve the efficiency of the program.

Next month: built-in predicates END

Homework

Write a program to sort a list of numbers into ascending order. Use any sorting algorithm you like, or experiment with different ones. The program should transform the list:

[3, 7, 1, 12, 5, 3, 19]

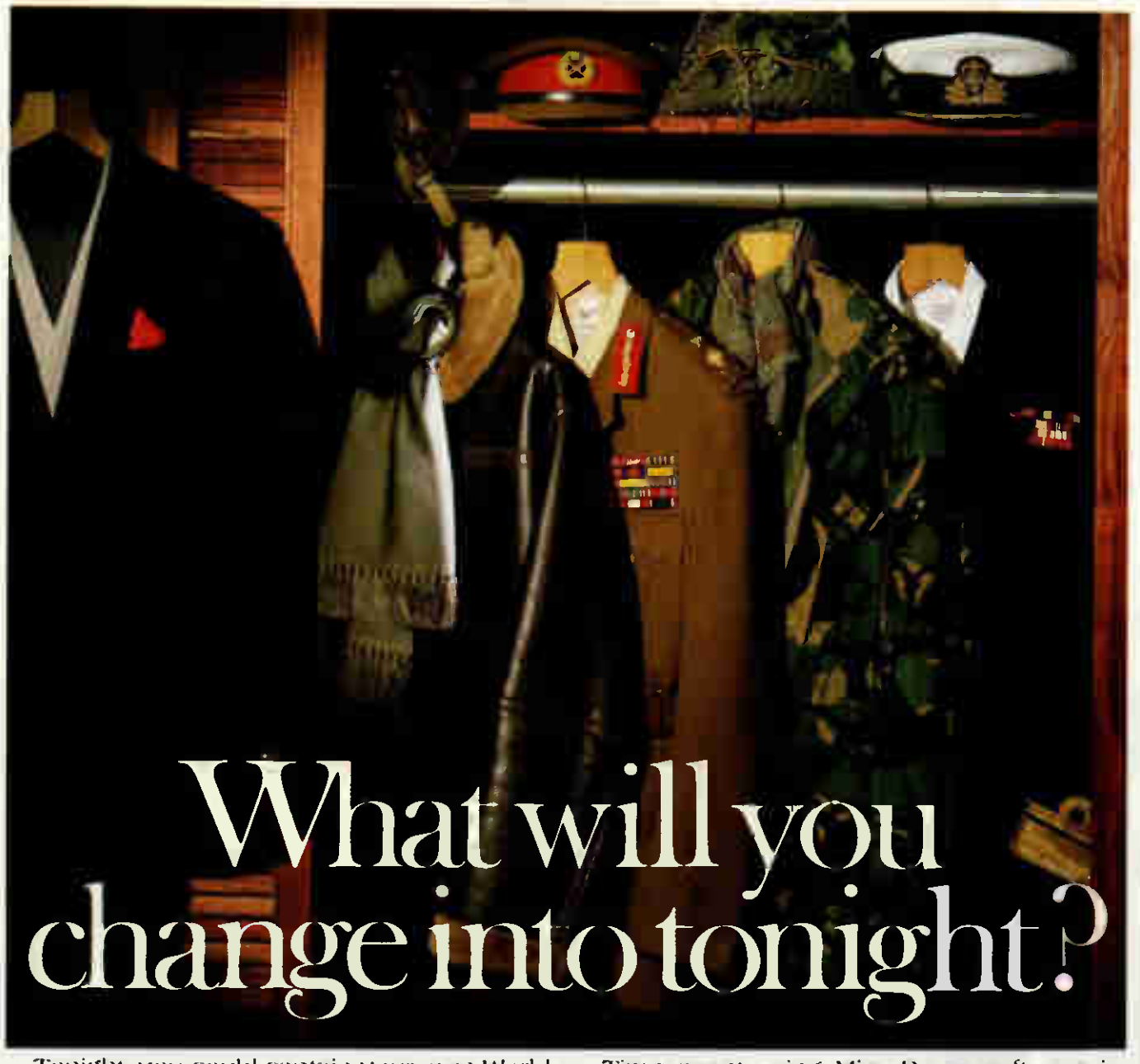
into:

[1, 3, 3, 5, 7, 12, 19]

Solution to last month's homework: tabulating cosines and square roots

The program below solves last month's homework problem. Run it with the goal 'go' to generate the required output. The problem could easily have been solved in a conventional language by using FOR loops, and so on. In the solution here, the 'iterate' clauses fulfil the same function as a FOR loop, with 'doline' being the 'contents' of the FOR loop.

```
predicates
  go
  iterate(integer,integer)
  doline(integer)
clauses
go:—
  write("  I          COS(I)                SQRT(COS(I))"),nl,
  iterate(0,12).
iterate(First,Last):—
  First > Last.
iterate(First,Last):—
  First <= Last,
  doline(First),
  First1 = First + 1,
  iterate(First1,Last).
doline(I):—
  Cos_I = cos(I),
  Cos_I >= 0,
  Sqr_Cos_I = sqrt(Cos_I),
  writef("%4.0              %5.2              %4.2",I,Cos_I,Sqr_Cos_I),n1.
doline(I):—
  Cos_I = cos(I),
  Cos_I < 0,
  writef("%4.0              %5.2              ****",I,Cos_I),n1.
```



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IT MEASURES LESS THAN AN A4 PAD.
IT WEIGHS LESS THAN 2 lb.
IT COSTS JUST

SPECIAL INTRODUCTORY PRICE

£199.95 +VAT, p&p

- ☐ *RAM expandable to 3 Mbytes...*
- ☐ *Word-processing and spreadsheet built in, plus time- and data-management systems...*
- ☐ *Revolutionary supertwist LCD display...*
- ☐ *Completely self-contained – yet talks and listens to your IBM...*

There has never been a computer like the Z88.

It's an extraordinarily powerful machine which offers word processing, spreadsheet, and a set of time and data management tools in a single, highly portable package.

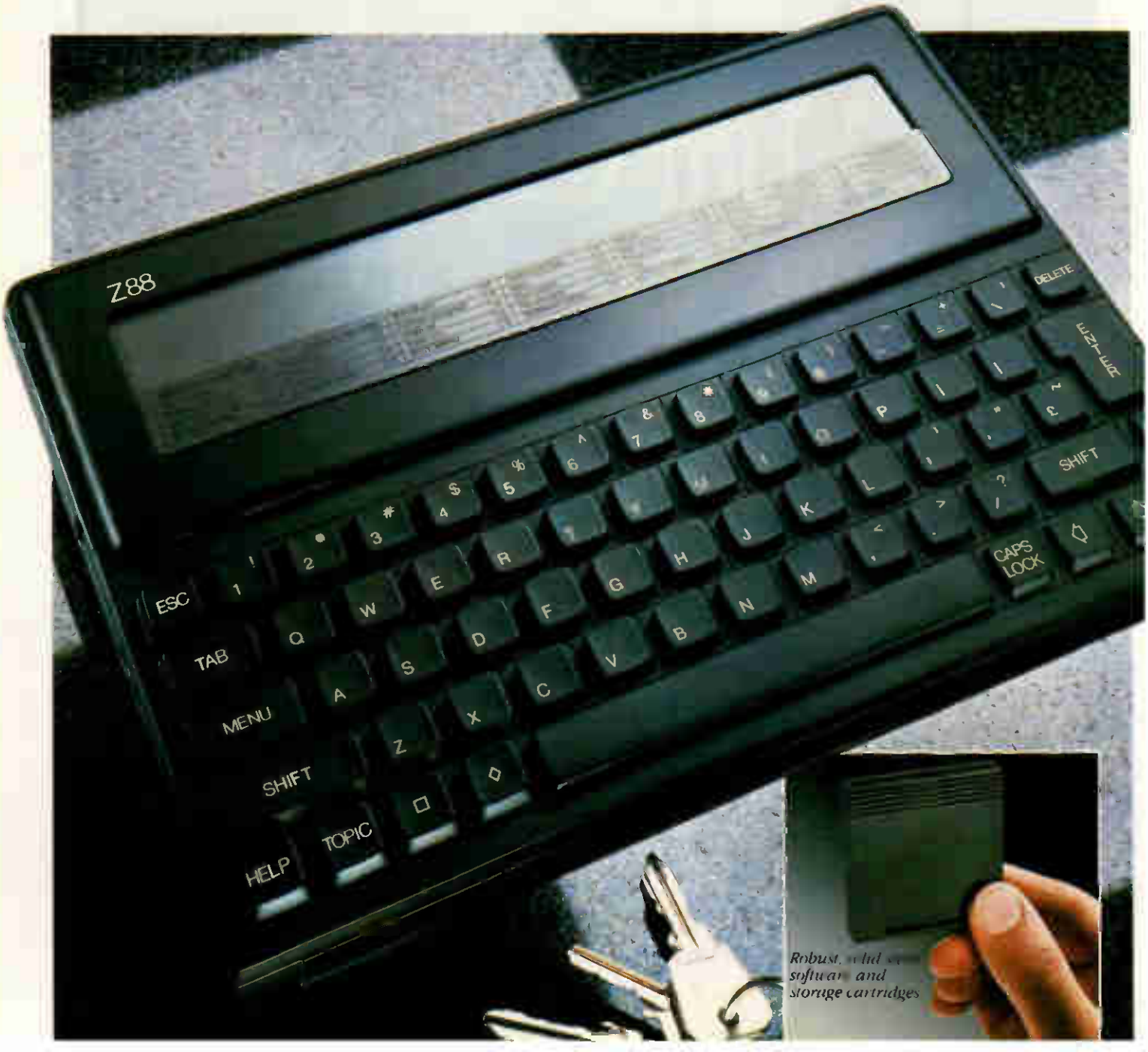
At £199.95, the Z88 is supplied with 32K resident RAM. Extra 32K costs under £20 – extra 128K under £50!

And heavy users will be able to expand the RAM to an astonishing 3 Mbytes, using plug in RAM cartridges.

For printing text or data, the Z88 connects directly to most popular RS232 compatible printers, while for permanent storage the Z88 employs removable solid state EPROM cartridges – no tape to break, no delicate disc to damage.

Though the Z88 is a powerful, full facility, self contained computer, it also acts as an extension of an office micro, connecting directly to allow exchange of text or data.

For every personal computer user, the Z88 offers a comprehensive specification in a package of unparalleled portability.



☐ THE FACILITIES OF THE Z88

RAM Resident 32K, around 15K available (enough for around 2,000 words). Extra RAM available in 32K or 128K cartridges, up to three of which can be plugged into the Z88 to give a total of 416K (enough for a 200 page novel). 1 Mbyte cartridges available shortly. A built-in capacitor or the mains adapter preserves data in RAM while batteries are changed.

Permanent storage Where other machines rely on cassette recorders or disc drives, the Z88 uses solid-state EPROM - Erasable Programmable Read-Only Memory - cartridges, with very rapid electronic access and absolute reliability. Up to three EPROM cartridges can be plugged in: 32K and 128K cartridges and ultra violet eraser are available now. 1 Mbyte cartridges available shortly.

RS232-compatible port offers:
Printing RS232 cable connects the Z88 to popular printers. Cables can also be made up for virtually any RS232-compatible printer.
Text- and data-interchange Resident software formats data for IBM-compatible micros with 5¼" or 3½" disc-drives. If your micro can run such popular programs as Wordstar, Lotus 1-2-3 or WordPerfect, you can exchange text and data between it and the Z88. Cable and software available now.
Modem allows text and data transmission by telephone.

Power supply Optional mains adapter, or 4 AA batteries. (CMOS technology allows about 20 hours active computing - or about a year of life for RAM if machine is switched off).

Dimensions 11½" x 8¼" x ⅞"; weight: under 2 lb.

Full QWERTY keyboard offers 'silent', moving short-travel keys. Foldaway foot raises the Z88 12½° for comfortable viewing and typing.

☐ ADVANCED INTEGRATED SOFTWARE PACKAGE

The operating system of the Z88 is unique to Cambridge Computer Ltd, supporting as its main in-built software an advanced software package, adapted by Protechnic Ltd for the Z88.

The Z88 automatically preserves data in RAM when switched off.

The software is a set of spreadsheet and word processing applications, with a sophisticated help function, designed from the first as an integrated package which allows text to be run within a spreadsheet, or a spreadsheet to be run within text.

Word processing facilities include multi-column layout, global search and replace, and embedded calculations, as well as all the normal word-processing activities. The display shows such commands as bold, italics, underlining, and page breaks. Spreadsheet includes text-handling and sorting.

Other built-in software includes **database selection; calculator; free-form diary, calendar, real-time clock and alarm.**

An outstanding feature of the Z88 is its ability to switch between tasks within an application, and between applications, without the need to save, exit the package, or restart on return.

While computing a spreadsheet, for example, it is easy to switch directly to the diary, and then go straight back to the spreadsheet - which immediately carries on from the point it had reached.

☐ STATE-OF-THE-ART SUPERTWIST LCD DISPLAY

Supertwist technology represents the state of the art in liquid crystal display. Its massive increase in contrast ratio and viewing angle give a dark blue on grey display that surpasses CRT screens.

1 'Topic bar' - seven general menu options, each supported by function menus
2 Work area displays 8 lines by a full 80 characters
3 Unique screen map shows complete page layout, updated automatically as work goes on.
4. Section displays machine status (e.g. battery strength.)

☐ HOW TO ORDER

The Z88 is available only by mail order. The FREEPOST coupon lists the components of the Z88 system currently available.

The Z88 itself comes supplied with 32K RAM built in, a comprehensive manual, sectionalised to suit both novices and computer experts, and a carrying case.

Your order will be acknowledged with information on the likely despatch date.

If you're not happy with any item you receive, return it in original condition within 10 days of receipt for an immediate refund.

Every item is covered by a one-year guarantee, and will be repaired or replaced free of charge if faulty and returned with proof of purchase date.

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WordPerfect TM of WordPerfect

☐ ORDER

To: Cambridge Computer Ltd, FREEPOST, Cambridge, CB4 1BR.
Please supply Z88 system components as shown below.

ITEM	QTY	PRICE EACH £	TOTAL £
Z88 COMPUTER		229.95	
MAINS ADAPTER		9.95	
RS232 PRINTER CABLE (Cable supplied with 25 way D connector. Making up other cables is simple: full dealer instructions in the manual.)		9.95	
I/O SOFTWARE/CABLE for IBM transfer. Software to be supplied on tick as applicable			
☐ 5¼" disc (Full instructions included)		14.95	
☐ 3½" disc (Full instructions included)		14.95	
MODEM		99.95	
32K RAM CARTRIDGE		19.95	
128K RAM CARTRIDGE		49.95	
32K EPROM		12.95	
128K EPROM CARTRIDGE		49.95	
U/V ERASER FOR EPROM CARTRIDGE		29.95	
POSTAGE, PACKING AND INSURANCE			7.50
All prices include VAT @ 15%		Total	£

I enclose cheque/money order for £_____ payable to Cambridge Computer Ltd.
☐ Tick box if VAT receipt required

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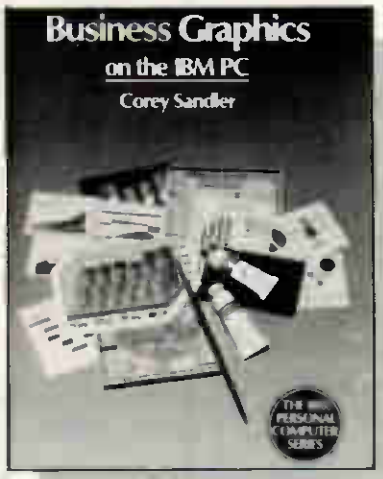
BIBLIOFILE

Computer art and graphics books come under scrutiny this month, and we take you on a celestial journey and back down to earth again for a look at how children are coping with computers.

Business Graphics on the IBM PC



Author: Corey Sandler
Publisher: Addison-Wesley Publishing Company
Price: £9.95

If I were to give just one piece of advice to Amstrad PC owners it would be: stay away from products marked 'especially for the Amstrad PC'. Far too many manufacturers have used the Amstrad PC as an excuse to release sub-standard products at reduced prices, and this seems to apply as much to books as it does to software. *Business Graphics on the IBM PC* is a general IMB-compatible guide and a far better introduction to business graphics than the Amstrad-specific offering reviewed alongside.

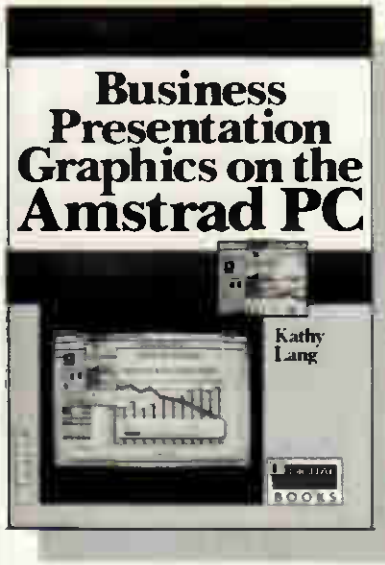
The book begins with a brief, non-specialist introduction to the statistics and mathematics of graph creation. This is very well written and a useful guide to the appropriate time to use some of the more esoteric graphs: for example, this is the first book to clearly explain when you should use a logarithmic scale on an axis. It then describes the hardware required to create business graphics, starting with the choice of machine but concentrating on the vast range of output devices available. Printers, laser printers, Polaroid cameras, plotters and video displays are all described in detail before the author moves on to consider actual products available.

The largest portion of the book is dedicated to a discussion of currently available software. Although Corey Sandler does concentrate on his particular favourites (Graphwriter and BPS Business Graphics), he does consider most of the popular packages (including GEM) and admits his own bias towards the more statistically capable packages.

On the whole *Business Graphics on the IBM PC* is an excellent read, although the rapidly moving nature of the software market means that the product reviews will soon be out of date. This book, used in conjunction with the latest magazine reviews, would act as a good starting point for anyone wanting to use their machine for the creation of business graphics.

Graham Wood

Business Presentation Graphics on the Amstrad PC



Author: Kathy Lang
Publisher: Digital Research and Glentop Publishers Limited
Price: £8.95

The Amstrad PC1512 brings IBM-compatible business computing to a whole new group of users, and among these users there may be some who will want to use the machine to create business graphics. *Business Presentation Graphics on the Amstrad PC* is aimed at potential and existing PC1512 users who want to use their machine for this purpose.

The book is published by Digital Research, creator of GEM, the friendly graphics interface bundled with the PC1512. It is divided roughly into three sections: the first deals with general advice on producing good graphics for presentations; the second covers applications which might be useful; and the third gives a general overview of GEM and its operation.

Kathy Lang does a good job of describing the general principles of producing graphics. Most of her advice seems fairly obvious, such as the effective (minimal) use of capital letters, but it is surprising how easy it is to get carried away. With 16 colours, eight fonts and 12 font sizes, it's all too easy to create a psychedelic masterpiece that diverts attention away from the facts.

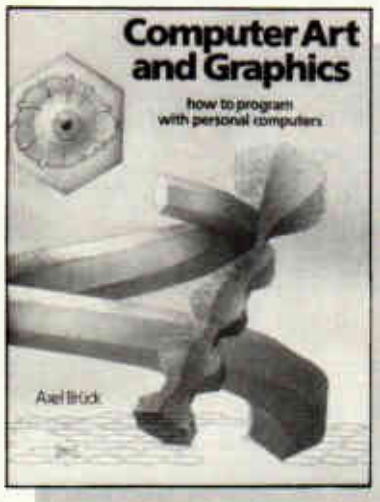
The first section is by far the best — albeit rather too short — but it could act as a reminder list whenever you are creating graphics. But from here on, things go rapidly downhill. Digital Research's influence is so strong that only GEM products are mentioned, despite the large number of more capable packages that will also run on the PC1512. The four GEM packages covered (GEM Paint, GEM Graph, GEM Draw and GEM Wordchart) read like an uncomfortable mix of favourably biased product reviews, advertisements and user manuals. The book ends with an introduction to GEM which is far too long and adds little to the *Amstrad User Manual*.

I was disappointed with this book; it is misleading to give such a general title to a book and then consider only GEM products, especially as it is clearly aimed at new users.

I would also resent paying £8.95 when only two thirds of the book is what it claims, the other third being nothing more than an alternative *GEM User Manual*.

Graham Wood

Computer Art and Graphics



Author: Axel Brück
Publisher: Element (Paul Petzold)
Price: £14.95

My initial reaction upon opening this book was total dismay. Pages and pages of Basic program listings usually inspire me to put a book back on the shelf and look elsewhere. Obviously the author was aware of this, as the first few paragraphs state quite clearly that the idea is not to type in *all* the programs and stand back and gasp (the examples are supposed to fire your artistic imagination and give you the ability to turn your micro into a highly personal electronic canvas). The snag is that your results might turn out to be disappointing compared with the impressive surrealist colour plates which Axel Brück includes to illustrate his own talent.

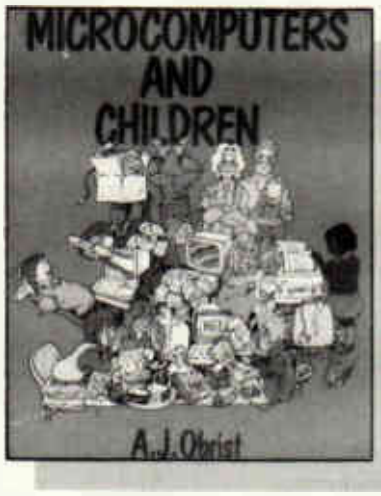
The unfortunate fact is that without sophisticated (and expensive) gadgetry — such as very high-resolution monitors, decent CAD software and fancy plotters — achieving computer graphics from Basic is hard work. The Apple II used for the Basic program examples would achieve very modest results.

The standard of arcade game graphics is given a sound put-down: the object here is create three-dimensional models of a good enough quality to hang on the living room wall. Given time and a lot of patience you do get there by way of simple shapes, more sinuously complex ones, multi-dimensional techniques and controlled perspective.

It's hard work made harder by the frequent need to tinker with the listings to make them match your particular Basic. Too difficult for me (I gave up at the third listing), but perhaps if you're dedicated it could be a rewarding book to work through. One thing in its favour is the author's unadulterated enthusiasm, which convinces you that a graphic masterpiece is just one more Basic program away.

Graham Wood

Microcomputers and children



Author: AJ Obrist
Publisher: Hodder & Stoughton
Price: £5.95 (paperback)

Here is a sensible and straightforward guide to microcomputers for parents and teachers alike. As the author points out, the micro is here to stay — 'its influence and importance will grow and grow' — and the sooner that schools are able to utilise it and all its encompassing advantages, the better.

Microcomputers and children is not a massive tome — only 100-odd pages — but it covers a basic introduction to micros, what they are, how they work (we're not talking complex issues here, just simple cassettes and television screens), how to set about buying a micro, selecting programs and choosing software. A strong emphasis is placed on micro games and how children learn through play, explaining certain popular games and illustrating how they help develop reasoning power and decision-making abilities. The author describes the games available for young children which help to teach colours, shapes, numbers and reading, while for older children he describes the more specialised games ('content-free' programs) which enable the development of games and simulation themselves. Any game or program mentioned is included in the appendix where it is also classified under subject and age group.

A very interesting chapter is included on how the micro can be used by children of different capabilities, ranging from the gifted through to those with physical handicaps or learning difficulties. There is also a short section on flow-charts and programming which mentions Logo and the turtle, Prolog and Basic.

But don't expect this book to give you anything more advanced than that. *Microcomputers and children* is geared towards pre-school and primary education; it won't help you solve the finer details of your spreadsheet package, but then perhaps your seven-year-old may already know the answer to that one.

Lorna Kyle

Flight Simulator Co-Pilot

Author: Charles Gulick
Publisher: Microsoft Press
Price: £7.95 (paperback)

Charles Gulick is an expert flying instructor for the Microsoft and Sub-Logic flight simulators. He has been flying both of them regularly ever since they were available and his enthusiasm for them is infectious. Even the easiest, most mundane flights become adventures inside and outside the aircraft.

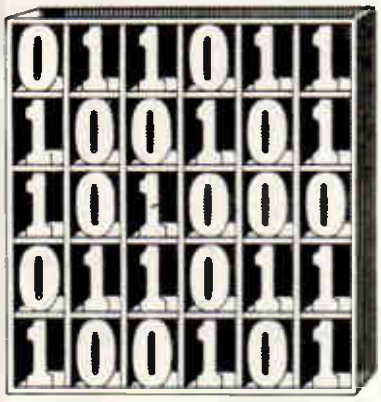
This book is designed to be as much as possible like having a real instructor or co-pilot by your side. You should read it while you fly.

Flight Simulator Co-pilot is divided into three sections. The first section is basic flying training, learning to fly steady, climb, bank, descend and land. The second section takes you on trips around the interesting locations in Flight Simulator and teaches instrument-controlled flying at the same time. The final section gives some of the most interesting trips to be found in the Flight Simulator world and shows you a few interesting manoeuvres. All the locations are described as they are in real life and Charles Gulick gives details of local history and points of interest.

Before I read this book, I had always found Flight Simulator boring: too slow, too hard to control accurately and no fun. Charles Gulick has taken away all the drudgery. He teaches you to fly quickly and painlessly and then proceeds to make it all fun.

Helen Brew

SUBSET



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, PCW, 32-34 Broadwick Street, London W1A 2HG.

6809 Soundex

Datasheet 1 is a 6809 version of the Soundex name-encoding routine from Roger Fine of Edgware. Z80 and 8086 versions of Soundex were published in Subset, April 1986.

Soundex was developed by Margaret Odell and Robert Russell, just after The Great War, to reduce name variants, misspellings or heard names to a simple, short and easily recorded phonetic code. The *sound* of each name is transformed into a four-character sequence beginning with an initial upper-case letter and followed by three decimal digits corresponding to groups of phonetically similar letters. Vowels are ignored, as are repeated consonants in the same letter group.

One problem that can occur only occasionally in names is that of repeated initial letters — as in LLOYD and FFOULKES — where the repeat should be ignored. This problem had been missed in earlier versions of Soundex and only resolved in the 8086 version NAMEX.

Roger decided to check up on the rules for Soundex-encoding and found them on page 392 of Knuth's *Sorting and Searching (The Art of Computer Programming, volume 3)*. These are shown in Fig 1.

According to these rules, the Z80 version SOUNDX not only wrongly encodes a repeated initial but also erroneously ignores similar consonants separated by one or more vowels.

Knuth also gives examples which clarify the use of the rules and can be used to test any new Soundex routine. The two name sequences, *Euler, Gauss, Hilbert, Knuth, Lloyd, Lukasiewicz* and *Ellery, Ghosh, Heilbronn, Kant, Ladd, Lissajous* should both give the Soundex code sequence, E460, G200, H416, K530, L300, L222.

Fig 1

1. Retain the first letter of the name, and drop all occurrences of a, e, h, i, o, u, w, y in other positions.

2. Assign the following numbers to the remaining letters after the first:

b, f, p, v → 1	l → 4
c, g, j, k, q, s, x, z → 2	m, n → 5
d, t → 3	r → 6

3. If two or more letters with the same code were adjacent in the original name (before step 1), omit all but the first.

4. Convert to the form "letter, digit, digit, digit" by adding trailing zeros (if there are less than three digits), or by dropping rightmost digits (if there are more than three).

DATASHEET 1

```
;
;SNDX6809          Convert a name into Soundex code.
;
;STRUCTURAL CONCEPTS
;DATA              NAME:          Type:       ASCII string.
;                                 Length:     indefinite.
;                                 Header:     none.
;                                 Terminator: appended null (00).
;                  SOUNDEX CODE:  Type:   ASCII alphanumeric string.
;                                 Length: 4 bytes.
;                                 Fields: byte 1:    u.c. letter,
;                                         bytes 2-4: digit range 0-6.
;PROGRAM
;
;SYSTEM REQUIREMENTS
;PROCESSOR         6809
;HARDWARE          Memory for name and for Soundex buffer.
;SOFTWARE          None.
;
```

```
;PROGRAM DETAILS
;INPUT             X addresses 1st byte of name.
;                  Y addresses 1st byte of 4-byte Soundex code buffer.
;OUTPUT            Soundex buffer contains Soundex code of name.
;STATE CHANGES     CC changed. All registers preserved.
;I/O ERRORS        None.
;OPTIMISATION      The look-up table base pointer (U) is offset by -65 to
;                  remove the need to adjust the ASCII letter value in A
;                  before use as table index.
;                  Soundex "0" digits are stored in the look-up table as
;                  nulls ($00) to remove the need to test for $30.
;INTERRUPT EFFECT  May be interrupted and re-entered.
;LOCATION NEEDS    Not specific. Relocatable. PROMable.
;PROGRAM BYTES     87 (code: 61, appended look-up table: 26).
;STACK BYTES       9 (S).
;CLOCK CYCLES      Not given.
;
;
SNDX6809 PSHS  D,U,Y,X        ;Save registers used.              3476
         LEAS  -1,S           ;Clear 1 byte stack workspace.     327F
         LEAU  SNDTAB-"A",PCR;Index letter code table.           338C   F7
         LDB   #4             ;Set Soundex buffer byte count.    C6     04
;
ITSZERO  CLR   ,S             ;Clear stored copy character.      6FE4
;
NEXT     LDA   ,X+            ;Get next name char & bump point.  A680
         BEQ   PADTOEND       ;If term., pad buffer with "0"s.   27     23
;
         ANDA  #$DF           ;Ensure upper case.                84     DF
         CMPA  #"A"           ;Check if in range A to Z          81     41
         BLO   NEXT           ;and if not ignore                 25     F8
         CMPA  #"Z"           ;and go get next                   81     5A
         BHI   NEXT           ;character of name.                22     F2
;
         CMPB  #3             ;If 1st letter, write to buffer    C1     03
         BHI   STOREIT        ;and store for later comparison.   22     0C
;
         CMPA  ,S             ;Compare with possible 1st letter  A1E4
         BEQ   NEXT           ;in store and ignore if same.      27     EA
;
         LDA   A,U            ;Convert to letter code and if     A6C6
         BEQ   ITSZERO        ;a 0, ignore it, clearing store.   27     E4
;
         CMPA  ,S             ;Compare with last letter code     A1E4
         BEQ   NEXT           ;in store and ignore if same.      27     E2
;
STOREIT  STA   ,S             ;Save letter or code to store      A7E4
         STA   ,Y+            ;write to buffer, bumping point.   A7A0
         DECB                 ;count one letter or digit done    5A
         BNE   NEXT           ;and repeat if buffer not full,    26     DB
         BRA   EXIT           ;else exit with Soundex code.      20     07
;
PADTOEND LDA   #"0"           ;Write digit "0" to buffer         86     30
         STA   ,Y+            ;for all remaining bytes.          A7A0
         DECB                 ;                                  5A
         BNE   PADTOEND       ;                                  26     F9
;
EXIT     LEAS  1,S            ;Clear workspace off stack,        3281
         PULS  D,Y,X,U,PC     ;restore registers and exit.       35F6
;
;...Table of Soundex values ("0" stored as null for quick testing).
;
SNDTAB   FCB   0              ; A                                00
         FCC   '123'          ; B C D                            3132 33
         FCB   0              ; E                                00
         FCC   '12'           ; F G                              3132
         FDB   0              ; H I                              0000
         FCC   '22455'        ; J K L M N                        3232 3435
                                                                 35
         FCB   0              ; O                                00
         FCC   '126236'       ; P Q R S T                        3132 3632
                                                                 33
         FCB   0              ; U                                00
         FCC   '1'            ; V                                31
         FCB   0              ; W                                00
         FCC   '2'            ; X                                32
         FCB   0              ; Y                                00
         FCC   '2'            ; Z                                32
```

Sharp 700 expand

Referring to the Z80 routines COMPACT and EXPAND (*PCW*, December 1985), Geoffrey Childs of Winchcombe writes:

'I found the article interesting as I had been

working on a similar screen compression program for the Sharp 700. I had used a different algorithm for compressing text and picture but virtually the same one for the colours. Hence the only comparable part of our programs is the colour expansion.

'The Sharp is peculiar in that it uses non-ASCII display codes and the screen is banked out by Basic. The screen banking meant using an intermediate area for the expansion. I chose the area OC800H to OCFFFH since it is accessible in banked and unbanked form. It is the expansion of the compressed colours into this area which is relevant.

'The fact that the Sharp expansion takes only 15 bytes rather than the 34 bytes of EXPAND is an interesting illustration that, while a general routine may be coded in an optimum way, it is still sometimes better to recode for a specific situation.'

Geoffrey's colour expansion program is shown in Fig 2.

It is short and fast but could be improved one byte by substituting 'BIT 4,D' for 'LD A,D: CP ODOH'.

Fig 2

```
;
COLXPAND LD   A,(HL)          ;Get colour code in A.          7E
         INC  HL              ;Bump compact pointer and       23
         LD   B,(HL)          ;get repeat count.              46
REPEAT   LD   (DE),A          ;Store colour code to           12
         INC  DE              ;expansion area, bumping point, 13
         DJNZ REPEAT          ;and repeat for count.          10 FC
         INC  HL              ;Address next colour code.      23
         LD   A,D             ;Get expansion area address     7A
         CP   ODOH            ;hi-byte and test for area end  FE 00
         JR   NZ,COLXPAND     ;repeating until past OCFFFH.   20 F3
;
```

Memory wipeout challenge

The problem posed in Puzzle Dazzle No 1 (*PCW*, January 1979) was to write the shortest and/or quickest program that would clear all 64k of the 8080's memory. Five solutions were published and the (equal) best two of these, by Eric Baddiley of Congleton and David Parkinson of Ipswich, are shown in Fig 3, along with Z80 versions.

Both methods rely on memory wraparound and work by setting the stack pointer to the top of memory, then pushing zeros down through memory, until the program itself is overwritten.

Note that both programs take only 16 clock cycles (15 cycles in Z80 code) to clear two bytes. LDIR, which is not implemented on the 8080, would take 21 clock cycles to clear a single byte.

Fig 3

```
;
;... 8080 versions.
;                                                    clock cycles
FFFC  21 00 00  CLEAR1  LXI  H,0000  ;Clear HL and set          10
FFFF  F9                SPHL        ;Stack Pointer above memory  5
0000  E5                PUSH H      ;Loop, pushing HL=0 to memory 11
0001  E9                PCHL        ;until E5 E9 overwritten.    5
;
FFFB  21 FF FF  CLEAR2  LXI  H,OFFFFH;Address RST instr, and set  10
FFFE  F9                SPHL        ;SP to clear from below RST. 5
FFFF  C7                RST  0      ;Loop pushing return address 0 11
0000  E9                PCHL        ;until C7 E9 overwritten,    5
;
;...Time (CLEAR1 & CLEAR2) 10 + 5 + 11*32768 + 5=32767 = 524298 cycles.
;
;... Z80 versions.
;                                                    clock cycles
FFFC  21 00 00  CLEAR1  LD   HL,HPLP ;Same comments             10
FFFF  F9                LD   SP,HL  ;as 8080 version.           5
0000  E5        HPLP    PUSH HL     ;                          11
0001  E9                JP   (HL)   ;JP (HL) is quicker than PCHL. 4
;
FFFB  21 FF FF  CLEAR2  LD   HL,RSLP ;Same comments             10
FFFE  F9                LD   SP,HL  ;as 8080 version.           5
FFFF  C7        RSLP    RST  0      ;                          11
0000  E9                JP   (HL)   ;JP (HL) is quicker than PCHL. 4
;
;...Time (CLEAR1 & CLEAR2) 10 + 5 + 11*32768 + 4*32767 = 491531 cycles.
;
```

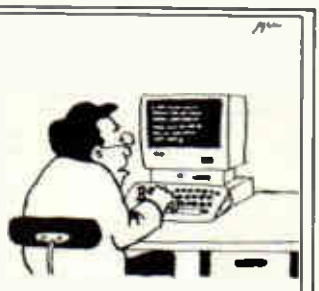
Z80 Hexout

Datasheet 2 contains a set of five connected utilities dealing with the output of hexadecimal data and addresses, along with a separate routine which outputs a data byte read from memory.

Although written by John Kerr of Glasgow as a set of local subroutines for his compact disassembler, the code from ADRSP onwards is a discrete entity. It has minimal input requirements, of fairly standard register usage (A, DE), and could be used unaltered by almost any application that needs to print out hexadecimal values. You might even find a similar sequence in your system software.

FETCH is a different kettle of fish. After reading one byte of data from a memory file, it updates the file index DE and a count of bytes fetched at (IX+0) and then outputs the value before returning to the calling program. I don't see much chance of using this 11-byte routine in many other types of program. Incidentally, John could have saved one program byte, two stack bytes and 14 clock cycles by re-fetching the value after output rather than saving it on stack.

Most of HEXOP is taken up by the short 4-bit to ASCII hex conversion sequence, CP 10: SBC A,69H: DAA, which John also used in CONVHL (Subset, February). At only five bytes it is not worth writing as a separate subroutine. However, with the preceding AND 0FH, which masks out unwanted bits in the high-order nibble but has no effect on already validated 4-bit data, it could be an extremely useful 7-byte systems subroutine.



'I'm sorry, boss, but my cursor's not moving until you guarantee me 50 per cent of the royalties.'

CHROP, at the end of the five-routine fallthrough sequence, could be the only external link in John's entire disassembler although the program actually uses "CHROUT" several times. It makes sense to keep external reference to a minimum; except where speed really is paramount, the ten clock cycles added to all external calls by making them indirectly through a jump instruction is negligible.

To alter the location of the external routines, you will find it far easier to change a few addresses in a jump table than have several dozen call addresses scattered throughout a long program.

DATASHEET 2

```
;
;FETCH          Fetch a byte from memory and output it as two ASCII
;                hex digits, followed by a space.
;ADRSP          Output 16-bit value in hex, followed by a space.
;BYTSP          Output 8-bit value in hex, followed by a space.
;BYTOP          Output 8-bit value as two ASCII hex digits.
;HEXOP          Output 4-bit value as one ASCII hex digit.
;CHROP          Output ASCII character.
;
;STRUCTURAL CONCEPTS
;PROGRAM        See line Comments.
;
;SYSTEM REQUIREMENTS
;PROCESSOR      Z80
;HARDWARE       ALL ROUTINES: Output device or file.
;               FETCH only:   Source memory.
;SOFTWARE       Written as local subroutines for a Z80 disassembler..
;               Local dependance.
;               "CHROUT" - System specific routine to output ASCII
;                 character in A. Must preserve registers.
;
;PROGRAM DETAILS
;INPUT          FETCH: DE = source pointer.
;                      (IX+0) = fetch count.
;               ADRSP: DE = value to output.
;               BYTSP: A = value to output.
;               BYTOP: A = value to output.
;               HEXOP; lo-nibble A = value to output.
;               CHROP: A = value to output.
;OUTPUT         FETCH: A = byte fetched.
;               All:   1 to 5 bytes output to device or file.
;STATE CHANGES  FETCH: DE updated to address next byte.
;                      (IX+0) incremented for byte fetched.
;               All:   AF may be changed.
;I/O ERRORS     None.
;OPTIMISATION   Short, quick 4-bit to ASCII hex digit conversion by
;               flag manipulation and decimal adjustment of
;               accumulator after subtraction.
;               CHROP is the only system link address, making all
;               calls, jumps and other direct memory reference within
;               the disassembler internal to the disassembler.
;INTERRUPT EFFECT May be interrupted and re-entered.
;LOCATION NEEDS Not specific. Not relocatable. PROMable.
;PROGRAM BYTES  42 (FETCH: 11,  Others: 31).
;STACK BYTES    FETCH: 10 + c.  ADRSP:  6 + c.  BYTSP:  6 + c.
;               BYTOP:  4 + c.  HEXOP.  0 + c.  CHROP:  0 + c.
;                 (c = CHROUT stack use.)
;CLOCK CYCLES   FETCH: 237 + 3c.  ADRSP: 302 + 5c.  BYTSP: 153 + 3c,
;               BYTOP: 124 + 2c.  HEXOP:  35 + 1c.  CHROP:  10 + 1c.
;                 (c = CHROUT clock cycles.)
;
;...FETCH is distinct from the other routines in the Datasheet and has
;...its own exit point.
;
FETCH    LD   A,(DE)          ;Read a byte, then point to     1A
```

```
        INC  DE             ;next source byte and add 1     13
        INC  (IX+00)        ;to number of bytes fetched.    DD 34 00
;
        PUSH AF             ;Save byte while outputting     F5
        CALL BYTSP          ;it followed by a space.        CD lo hi
        POP  AF             ;Restore fetched byte to A      F1
        RET                 ;and exit from FETCH.           C9
;-------------------------------------------------------------------
;
;...ADRSP, BYTSP, BYTOP, HEXOP and CHROP form a multiple entry,
;...fallthrough sequence which exits via a system specific character
;...output routine.
;
ADRSP   LD   A,D            ;Output address high order      7A
        CALL BYTOP          ;byte followed by low order     CD lo hi
        LD   A,E            ;byte followed by a space.      7B
;
BYTSP   CALL BYTOP          ;Output 2-digit hex in A,       CD lo hi
        LD   A,20H          ;then ASCII space.              3E 20
        JR   CHROP          ;                               18 10
;
BYTOP   PUSH AF             ;Save low order digit.          F5
        RRA                 ;Shift high order digit         1F
        RRA                 ;down into low nibble A.        1F
        RRA                 ;                               1F
        RRA                 ;                               1F
        CALL HEXOP          ;Output shifted hi-digit.       CD lo hi
        POP  AF             ;Restore & output lo-digit.     F1
;
HEXOP   AND  0FH            ;Mask out hi-digit.             E6 0F
        CP   10             ;Set Cy if 0-9, reset if A-F.   FE 0A
        SBC  A,69H          ;Convert to ASCII hex using     DE 69
        DAA                 ;Cy for decimal adjustment.     27
;
CHROP   JP   CHROUT         ;Go output ASCII A.             C3 lo hi
;-------------------------------------------------------------------
```

Z80 Range test

Datasheets 3 and 4 are a couple of short and straightforward byte-testing utilities by Bob Andersson of Windsor.

Bob has not implemented BYTRANGE and BYTSET as distinct subroutines but has included them in two definitions in his macro library. Using conditional assembly flags, the full code is assembled only at the first occurrence of the macro. Thereafter, each one-line macro call in the source program assembles a subroutine call instruction followed by the range values or set address.

Although you might think the two-comparison operation performed by BYTRANGE simple enough to not bother writing as a subroutine, it does take five source lines and nine bytes of code at each occurrence. As a subroutine it takes up only two lines of source program and five bytes of object code for each call.

I am frankly surprised that Bob has used the null terminator technique of determining the end of a set in BYTSET, since many of the applications that I can think of do include zero as a value and that is excluded from being an element in the list. The alternative technique of preceding the list by one or two bytes containing the number of elements to be used as a counter in the routine might be more appropriate in this case.

The byte misers among you might spot that the two instructions, LD A,D: CP (HL), inside BSLOOP, could be replaced by CP D. And any speed freaks will observe that this change would save seven clock cycles on each test.

DATASHEET 3

```
;-------------------------------------------------------------------
;BYTRANGE            Test if unsigned data byte is in given range.
;-------------------------------------------------------------------
;STRUCTURAL CONCEPTS
;PROGRAM             lowvalue = (returnaddress).
;                    returnaddress = returnaddress + 1.
;                    highvalue = (returnaddress).
;                    returnaddress = returnaddress + 1.
;                    IF testbyte < lowvalue
;                    (
;                     inrangeflag = FALSE.
;                    ;
;                     IF testbyte > highvalue
;                     [
;                      inrangeflag = FALSE.
;                     ;
;                      inrangeflag = TRUE.
;                     ]
;                    ]
;-------------------------------------------------------------------
;SYSTEM REQUIREMENTS
;PROCESSOR           Z80
;HARDWARE            None.
;SOFTWARE            None.
;-------------------------------------------------------------------
;PROGRAM DETAILS
;INPUT               A = test value (unsigned, 0 to 255).
;                    Unsigned range values (lowest, highest) must follow
;                    immediately after CALL BYTRANGE (CD ?? ?? lv hv).
;OUTPUT              Cy = 0: A is within given range.
;                    Cy = 1: A is below or above given range.
;STATE CHANGES       F changed.
;                    Return to location following range values.
;                    Other registers unchanged.
;I/O ERRORS          If 1st range value > 2nd range value then only a test
;                    value equal to the 1st range value will return Cy=0.
;OPTIMISATION        None.
;INTERRUPT EFFECT    May be interrupted and re-entered.
;LOCATION NEEDS      Not specific, Relocatable, PROMable.
;PROGRAM BYTES       16
;STACK BYTES         2
;CLOCK CYCLES        Minimum; 111. Maximum: 122.
;-------------------------------------------------------------------
;
BYTRANGE EX   (SP),HL       ;Save HL & address range bytes. E3
         PUSH BC            ;Save BC for range registers.   C5
         LD   B,(HL)        ;Pick up lowest range value     46
         INC  HL            ;and point to next.             23
         LD   C,(HL)        ;Pick up highest value and      4E
         INC  HL            ;point to new return address.   23
         CP   B             ;If A is below lowest value     B8
         JR   C,BREXIT      ;then exit with Cy=1, else...   38 04
         CP   C,            ;if A equals highest value      B9
         JR   Z,BREXIT      ;then exit with Cy=0, else      28 01
         CCF                ;Cy=0 if in range, else Cy=1.   3F
;
BREXIT   POP  BC            ;Restore BC and HL, putting     C1
         EX   (SP),HL       ;new return address on stack    E3
         RET                ;and exit past range values.    C9
;-------------------------------------------------------------------
```

DATASHEET 4

```
;-------------------------------------------------------------------
;BYTSET              Test if unsigned data byte is in addressed value set.
;-------------------------------------------------------------------
;STRUCTURAL CONCEPTS
;DATA                SET:  Type:       simple list.
;                          Element:    byte (value 01H to 0FFH).
;                          Length:     unlimited.
;                          Header:     none.
;                          Terminator: null byte (00H).
;PROGRAM             setpointer = (returnaddress).
;                    returnaddress = returnaddress + 2.
;                    insetflag = FALSE.
;                    WHILE (setpointer) > 0 AND insetflag = FALSE
;                    (
;                     IF testbyte = (setpointer)
;                     [
;                      insetflag = TRUE.
;                     ]
;                    )
;-------------------------------------------------------------------
;SYSTEM REQUIREMENTS
;PROCESSOR           Z80
;HARDWARE            Memory for SET.
;SOFTWARE            None.
;-------------------------------------------------------------------
;PROGRAM DETAILS
;INPUT               A = test value (unsigned, 1 to 255).
;                    Set address (low order byte first) must follow
;                    immediately after CALL BYTSET (CD ?? ?? 11 1h).
;OUTPUT              Cy = 0: A is in addressed set.
;                    Cy = 1: A is not in addressed set.
;STATE CHANGES       F changed.
;                    Return to location following set address.
;                    Other registers unchanged.
;I/O ERRORS          None.
;OPTIMISATION        None.
;INTERRUPT EFFECT    May be interrupted and re-entered.
;LOCATION NEEDS      Not specific, Relocatable, PROMable.
;
;PROGRAM BYTES       24
;STACK BYTES         4
;CLOCK CYCLES        128 + (51 * no-match tests)
;                    + (27 AND Cy=1) + (46 AND Cy=0).
;-------------------------------------------------------------------
;
BYTSET   EX   (SP),HL       ;Save HL & address set address. E3
         PUSH DE            ;Save DE for set address.       D5
         LD   E,(HL)        ;Pick up address low byte       5E
         INC  HL            ;and point to high byte.        23
         LD   D,(HL)        ;Pick up address high byte and  56
         INC  HL            ;point to new return address.   23
;
         PUSH HL            ;Save new return address and    E5
         EX   DE,HL         ;get set address in HL.         EB
         LD   D,A           ;Save test byte in D.           57
;
BSLOOP   LD   A,(HL)        ;Read next byte and             7E
         AND  A             ;check for set terminator.      A7
         SCF                ;Set Cy=1 and exit if end       37
         JR   Z,BSEXIT      ;of set, test byte not in set.  28 05
;
         LD   A,D           ;Else get test byte, compare    7A
         CP   (HL)          ;with set element setting Z=1   BE
         INC  HL            ;and Cy=0 if equal. Index next  23
         JR   NZ,BSLOOP     ;element, repeat if not equal.  20 F6
;
BSEXIT   LD   A,D           ;Restore test byte to A.        7A
         POP  HL            ;Hl = new return address.       E1
         POP  DE            ;Restore DE and HL, putting     D1
         EX   (SP),HL       ;new return address on stack    E3
         RET                ;and exit past set address.     C9
;-------------------------------------------------------------------
```

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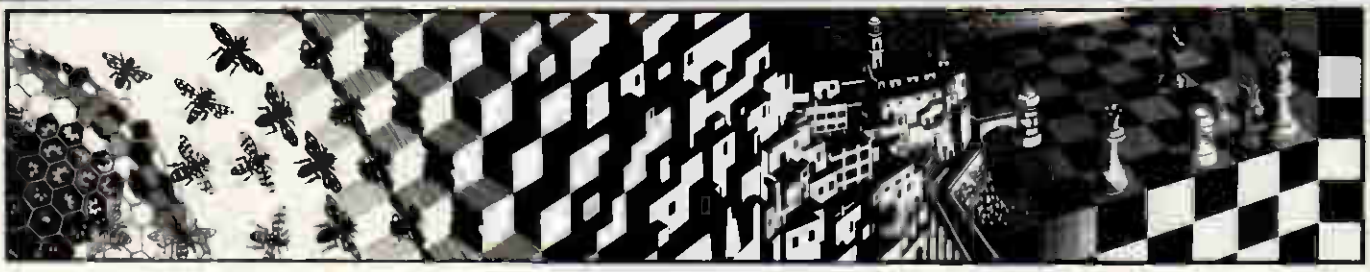

See how far you get as a futuristic detective with no clues at all, or, as Sherlock Holmes, solve as many as thirty dastardly crimes. Stephen Applebaum reviews the best of this month's games.

Just your imagination

Title: Portal
Computer: Commodore 64/128
Supplier: Activision
Format: Disk
Price: £24.95

Of all the games I have played over the past few years, none has posed such a challenge to my imagination as Activision's apocalyptic Portal; an eclectic detective yarn awash with savage and symbolic imagery that takes its subject matter from genres as diverse as science fiction, Greek Mythology, psychology and philosophy.

On a superficial level, Portal is a kind of Hacker for grown-ups. But to look at it in such a simplistic fashion would be to do both the game and its creators a great injustice.

It is difficult to make any hard and fast judgement about what exactly Portal's writers are trying to say, as the game's plot throws up so many different ideas. At times its characters appear to yearn for an escape from the technology with which they have surrounded themselves, hence the allusions to Greek Mythology; but at other times they revel in it. Whatever the meaning, Portal certainly provides food for thought.

In a way, Portal's construction is reminiscent of Kubrick's *2001: A Space Odyssey*. The analogy is given, not to throw light on the plot, but to indicate the awe in which the program's authors hold the technology they have created in their highly stylised vision of the Earth, some 30 years from now.

Where Kubrick used slow pan shots and Strauss waltzes to enhance his fantastic models and communicate his sense of wonder at the future, so Portal's writers have, at the risk of being accused of self-indulgence, employed long descriptive passages to breathe life into their creations. Science-fiction buffs will enjoy these prosaics, although I doubt whether Portal will appeal to the shoot-'em-up contingent.

Portal is a futuristic detective story. And, being such, it would be careless of me to give too much away since that would preclude any pleasure readers might derive from unravelling its mysteries for themselves. What follows should not be looked upon as a source of clues, but only as an indication of the nature of the game's workings.

When Portal has been loaded, the computer becomes a nominal Worldnet terminal. (You won't have heard of Worldnet: it's a fictitious network that is supposed to have entry points dotted all over the globe). Displayed on the terminal screen is a window containing a number of squares marked with different motifs; these are data-gathering agents called AIs. By scrolling the window's contents either vertically or horizontally, each AI can be accessed in turn to reveal the files stored in its database.

Like Hacker (which I hate to mention in connection with Portal but it's the closest thing of its kind), the player enters the scene not knowing what to do or even what the aim of the game is. The only way to learn is to extract data from the various AIs.

Inside an AI called Central Processing are a number of messages left by Ezekial Fortune. He, it would appear, was one of the first people to notice that all was not well with the world, and that strange and inexplicable phenomena were occurring in Antarctica. Although others must have harboured fears similar to Fortune's, he was the only one to couch them via Worldnet.

Fortune's first message tells of the discovery of a new viral disease in Christchurch; his later ones are filled with cryptic references to a Field and a Migration. He knew next to nothing about what these terms meant, but he had uncovered the name Peter Devore with whom he felt they were connected in some way. And most sinister of all, people were disappearing: even Fortune's last message ends in mid-sentence, implying that he, too, has suffered the fate he was trying to warn others about.

Using the facilities of Worldnet, the player, who picks up the story years after Fortune and the rest of mankind vanished, must discover why everyone suddenly left the Earth and where, if anywhere, they went. Although apparently alone in this seemingly impossible search for knowledge, the player actually has a helper in the form of HOMER, Worldnet's leading AI.

HOMER is an acronym derived from Heuristic Overview of Matrix Expansion and Reconstruction. Like its human namesake, HOMER's function is to teach. It does this by

accepting data from the other AIs and consolidating it to form a story. As HOMER receives more information, the story becomes less patchy and the player can slowly build up a picture of what has happened.

As the game proceeds, the AIs churn out more information about specific characters and historical events. It becomes clear that Peter Devore played a prominent role in instigating the Migration; for it was his accidental discovery of the Portal, the doorway to the Realm, that allowed the Migration to take place. But what exactly are the Portal and the Realm in the first place?

Questions such as these can only be answered after a great deal of investigation. The amount of data making up the program is immense and almost fills all six sides of three 5¼in disks, so there are many more questions that have to be satisfied first.

Portal is one of the most inventive games available for any home micro; it is also a program for the brain, not the trigger finger, which is certainly a refreshing thought.

A lot of work has gone into characterising Portal's major figures, which in itself brings the game to life. HOMER, the star of the show, is like a friendly old teacher who is always offering counsel to his young pupil. His character, in particular, is so well constructed that I was reluctant to switch off the computer after play, as it seemed like I was saying goodbye to an old friend who I would never see again.

Portal is a brilliant odyssey of the imagination, presided over by one of the most believable characters to inhabit a computer game. It would be madness for anyone owning a Commodore 64 or a 128 to overlook this exciting program.

Elementary, my dear micro

Title: 221b Baker Street
Computer: Commodore 64/128;
Apple II; Atari
Supplier: Activision
Format: Disk
Price: £14.95

Sherlock Holmes, the fictitious deerstalkered sleuth who proved to be such a money-spinner for Sir Arthur Conan Doyle, his creator, recently embarked on his greatest adventure — to see if his inscrutable character and uncanny powers of detection can be as attractive to games players as they have been to countless numbers of readers for the past century.

The UK launch of Datasoft's 221b Baker Street could not have happened at a more auspicious time. Nineteen-eighty-seven marks the 100th anniversary of the first appearance of Sherlock Holmes in the book *A Study In Scarlet*.

And it isn't only Datasoft's timing that is perfect — so, too, is its game design. Even if you are not drawn by the implied presence of Sherlock Holmes, 221b Baker Street also has its attractions for those people who like Cluedo, the old board game of murder and detection. To be quite frank, 221b Baker Street is a virtual rip-off of Cluedo. But who's complaining? Cluedo always was, and still is, a good game.

It is worth noting that the game's manual credits Jay Moriarty's board game, 221b Baker Street, as the basis for the computer program, which presumably means that any blame for its similarity to Cluedo should be imputed to him and not Datasoft. However . . .

221b Baker Street is, in a sense, an expanded version of Cluedo. The environment in which it is played has been eked out and the original house interior of the table-top game replaced with a whole town. This is not to say that the gameplay is very much different, though; for rooms read buildings.

Before a game can start, the usual routine of selecting the number of players, a joystick, and, more uncommonly, the provision or otherwise of coded clues, must be gone through.

Coded clues are for players who take their game-playing very seriously. They have been provided so that when clues are revealed onscreen, they can only be deciphered and hence understood by a player using a specific code group. There are four groups, one for each player.

However, since it is possible for the codes to be broken by outside infiltrators — that is, opposing players — each code group has been designed around four sub-groups made up of different codes. So, when players feel their security being threatened, all they have to do is tell the computer to give them their coded messages using code from one of the other sub-groups.

Unlike the rather colourless characters in Cluedo, such as Colonel Mustard, 221b Baker Street allows players to take on one of the four names that over the years have become synonymous with fictional crime detection: Sherlock Holmes, Dr Watson, Irene Adler and Inspector Lestrade.

All four characters are represented in graphic form, both in the selection sequence and throughout the entire game. During the latter they are displayed as small, animated figures which potter about the town under the direction of the player's joystick movements.

221b Baker Street comes complete with 30 individual crimes, each one with a title as fantastic as anything devised by Doyle himself. For instance, someone can't talk his way out of trouble in The Adventure of the Gluttonous Gossip, while The Adventure of the Musical Murder could very well be a statement on all that Sigue Sigue Sputnik has done for the recording industry.

The backgrounds of all 30 cases are described in some depth in a casebook provided with the game. Here can be found lots of little clues and details about who was doing what to whom at the time of the murder, theft, or whatever the crime that is being investigated.

In play, the top half of the display contains a three-dimensional view of the 'board'; this features a number of buildings connected by a path made up of squares. At the bottom of the screen is a die and a small inventory window.

Pressing the joystick's fire button causes the number on the die to change continuously from 1 to 6. When it stops, the number shown indicates the amount of squares the player's character can move along the path.

On entering a building, players are rewarded with a nice graphical repre-

sentation of the interior, and, more importantly, a clue. If the building happens to be the local police station, the player whose go it is can elect to take a badge rather than receive a clue. Badges are quite handy as they allow players to lock up locations, preventing others from getting at the clues hidden in them. Buildings can be unlocked but only with a key elicited from the town locksmith.

Clues collected from the various sites can be recorded on printed slips provided with the game. These list all the locations along with a small space next to each so that players have room to write down any relevant information.

When a player has enough information to solve the crime, he or she must return to 221b Baker Street and answer a series of pertinent questions. If these are met with satisfactory replies, the game finishes and the computer explains the full story.

I don't really know why anyone should want to play computerised 221b Baker Street, seeing as there's a perfectly good version of the same thing available in board format. But if they must, Datasoft's conversion is an excellent alternative.

Brave, macho and stupid

Title: Dragon's Lair Part II: Escape From Singe's Castle
Computer: Commodore 64/128
Supplier: Software Projects
Format: Disk, cassette
Price: £14.95 (disk), £9.95 (cassette)

Dragon's Lair, one of the first laser disk-based 'interactive' cartoons, proved an instant hit when it was introduced into arcades all over the UK. Although frustratingly difficult and notoriously expensive, the game still attracted hordes of enthusiastic punters; all of them eager to put their 50 pence pieces into the slot just to look at the marvellous graphics that brought to life the adventures of Dirk the Daring.

Noting the unprecedented success of Dragon's Lair, Software Projects set about writing conversions for all the popular home micros. After a long wait and a lot of debugging, the game finally arrived.

It was, as expected, a mere shadow of the original. Not only were its graphics a poor representation of those which people were flocking into the arcades to see, but the gameplay, too, was quite appalling.

Undeterred by the critical panning of Dragon's Lair, Software Projects has bounced back with Escape from Singe's Castle, a continuation of the Dirk the Daring saga.

I am pleased to say that this time the company has got it spot on. Of course, the graphics are still not comparable with those of the arcade original although they do evoke a similar atmosphere, unlike those of the previous debacle.

To say that Escape from Singe's Castle picks up the story from where Dragon's Lair left off is both right *and* wrong. True, it continues from where Software Projects' version ended, but that's only because it did not reproduce all the screens contained in the coin-operated game. What we're being offered now are those screens that were not programmed into the first conversion.

Dragon's Lair II begins soon after Dirk has returned Princess Daphne to her father, King Aethelred, having wrenched her from the clammy clasp of Singe, the Lizard King, by whom she had been abducted.

Dirk, being brave, macho and incredibly stupid, decides that rescuing Daphne is not a manly enough gesture to allow him to ask the Princess for her hand in marriage. To prove himself worthy, he returns to Singe's castle once more, this time in search of a pot of gold coins. Obviously Dirk doesn't want Daphne to get the impression that he is marrying her for her money. Poor, misguided fool.

Death lurks around every corner of Singe's castle, even underneath it. For before Dirk can enter the inner confines of the castle proper, he must tackle the fast-flowing rivers that run beneath it.

The subterranean rivers hold danger for Dirk. Rocks loom up and threaten to smash the keel of his flimsy wherry; waterfalls rise up to toss him into the icy flow; and when all seems calm, whirlpools suddenly form and agitate the still waters.

Of course, Dirk need not die. He can negotiate all these obstacles, though it requires a steady hand and a great deal of patience to make him do so. Overcoming the waterfalls, for example, should be quite easy, as the computer indicates with an arrow the correct spot to go over its brow.

However, as is the case with all easy-sounding things, there's a catch — you can only move the joystick once per obstacle. In a sense this makes play much more difficult than if you were actually guiding Dirk all the way, because just touching the joystick once at the wrong moment is enough to send him to a watery grave.

The second phase of Dragon's Lair II would be enough to make most people think that they had made the wrong decision in infiltrating Singe's castle. But not Dirk. He is too busy looking good — or, he is until a massive ball, rather like the one in *Raiders Of The Lost Ark*, flattens him under a rolling pin.

The screens I have described are only two of eight superbly animated and actually quite funny sequences. In the scene with the giant ball, for example, Dirk is shown as if he is about to run out of the screen with the ball behind him. Every so often, holes which he must jump over appear in the floor, while smaller balls roll across his path. Here, once again, the joystick can only be moved once, else Dirk either falls down a hole or trips, only to be caught by the assailing ball.

Dragon's Lair Part II: Escape From Singe's Castle is a respectable comeback for Software Projects. It is fun, good humoured and very, very difficult. I hope that there's a part III to follow, though I think all the screens from the arcade game have now been exhausted. END

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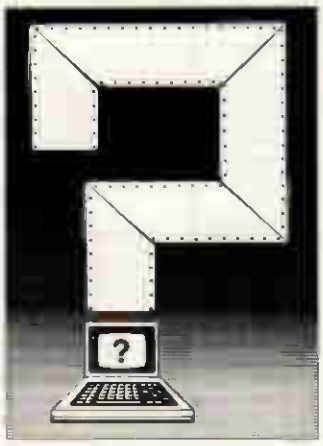


Computer Answers is PCW's help column. We offer advice about all kinds of specific hardware and software problems through the pages of the magazine. We also welcome further information in response to published queries.

Fault-finding by numbers

I own an Atari STF and a Star NL-10 printer, with a parallel interface cartridge. When I print a simple statement: 'THE RAIN IN SPAIN . . .' the printer produces a garbled message: 'WKG£SCKO£KO£SSCKO . . .' What am I doing wrong, if anything? Is the computer or the interface faulty? Please bear in mind that I'm a relative novice.
SA Westerdale, BFPO 16

I'm glad you sent detailed examples of this problem, including a hex dump — a printout of the character codes received by the printer.

The exact problem becomes apparent if you write each character code to binary notation and compare the codes transmitted by the computer with those received by the printer. The binary codes for 'T' and 'H' are 01010100 and 01001000, whereas your printer acts as if it receives 'W' and 'K': 01010111 and 01001011. The difference should be obvious — the printer is assuming that the last two digits of each code are 1. If you work your way through the rest of the message, you should be able to prove to yourself that this happens regardless of the transmitted value of those digits.

The parallel interface is so named because it expects all eight binary digits of a character code to be transmitted synchronously down eight wires. Somewhere in your system, two of these digits are 'getting lost'. Under such circumstances computers usually assume a specific value for such unconnected or wrongly connected signals — in this case, the assumed value is '1'.

Information is sent in parallel from the computer to the interface; if the computer were losing two signals it would not run any programs at all, so it is safe to assume that the problem is somewhere between the computer circuit board and the printer. The only way to track down such a fault is to systematically examine and, if need be, replace links in the chain between the computer and the printer until the culprit is identified.

I would suspect the printer cable first, then the connectors at either end of it. The interface would be my next suspect: check that it is properly plugged in and works with other parallel printers. Alternatively, try the printer with other computers and see if the garbling of characters still occurs — in which case the printer must be at fault.

You can narrow down the cause of any consistent fault very quickly by replacing components in a system. It is wise to check the cheap mechanical components, such as connectors, first of all. Keep notes and work in a logical sequence — don't jump to conclusions.

MT80+ memory

I have a Mannesman Tally MT80+ printer, and would like to know the type number of the 2k RAM buffer chips mentioned in the pathetic user manual.
C Smith, Shipley, West Yorkshire

The MT80+ accepts the 6116 chips which are used in most low-cost printers. You must open up the printer and remove the interface board to reveal two sockets, labelled RAM1 and RAM2. Each expects one 6116, so you can expand the internal buffer by up to 4k.

You'll need to adjust some of the configuration DIP switches inside the printer, to tell it that the extra RAM is fitted. I suggest you enquire about this when you order the components, unless you can find advice in the manual.

Mannesman Tally charges £10 plus VAT for each chip; its Sales Office is in Molly Miller's Lane, Wokingham, Berks RG11 HUT, tel: (0734) 791868. You should be able to get the chips — but probably not technical advice — from many other component suppliers.

Terminal emulation

I periodically use an Acorn BBC Model B and a Miracle Technology WS2000 modem to demonstrate computer communications to my college classes. I would now like to use this configuration to access an account on a DEC minicomputer at a nearby polytechnic, and need a software package to make the BBC Micro emulate a DEC VT52 or VT100 terminal. Are similar applications packages available for the Sinclair Spectrum?
SF Tyler, Ketley, Telford

The BBC Micro's built-in software comes quite close to emulating a DEC VT-52 — many of the control codes are identical. The VT-100 is a more sophisticated beast. It offers reverse video, various character sizes, smooth scrolling and many other features which you can probably live without, especially if you're using a slow dial-up link. Computer Concepts sells a package called Termi 2 for £33.35; this offers VT-52 emulation, with an option to customise its response to emulate other simple terminals.

If you need VT-100 emulation you have a choice between Computer Concepts' Communicator package at £69, and Dial-up from PMS Communications. Dial-up is normally sold bundled with a WS4000 modem, but you'll want the version that consists of software and a cable; personal and educational variants are available, both at prices around £80. PMS can be contacted on (021) 643 7688; Computer Concepts is on (0442) 63933.

The Spectrum display can't cope with the 80 characters per line of a VT-52 or VT-100, so there's no chance of it emulating a DEC terminal properly. However, simple terminal emulation software is available for the Spectrum with a WS2000, and that will probably allow a limited degree of communication. Forms-entry and screen editing programs are unlikely to work, but you should be able to pass commands and messages back and forth.

You'll need a proper RS232 interface for the Spectrum — Sinclair's Interface 1 works quite well with printers but can't cope with all the demands of a modem. Miracle Technology, tel: (0473) 216141, sells an appropriate interface, with simple bundled software, for £39.95.

Amstrad PC Basic

Over the years my company has built up an extensive library of software designed to run on our IBM micros using Microsoft Basic or BasicA.

We are attracted towards the Amstrad PC1512, but are rather dismayed to discover that we cannot load IBM BasicA into the Amstrad in order to run our software. Can this problem be overcome?
MJ Fort, Peterborough, Cambridgeshire

Most of the code for BasicA is stored in 32k of ROM memory on the IBM PC system board. The file you load from disk is actually only a bunch of corrections and 'extra' features which work in conjunction with the ROM routines.

In its economy drive Amstrad decided to do without the ROMs, which is

why you can't run BasicA. However, you *can* run Microsoft's stand-alone MS-Basic, and this is so similar to BasicA that you are unlikely to run into compatibility problems.

The most cost-effective scheme is to buy a copy of Microsoft's £85 QuickBASIC compiler, which translates interpreted Basic programs into machine code. It gives a hefty speed advantage and adds several much-needed features to the language.

Microsoft says that QuickBASIC code will run without change, with no need for an interpreter, on any PC-compatible — Amstrads and IBMs included. You'd be wise to continue developing software on real IBMs so that you can use their interpreters for interactive testing. Microsoft is on (0734) 500741.

Pet ports

I use a Commodore Pet 2001 for amateur-radio teletype work. The input/output port is located at address 59459, but I can't understand how this is related to the edge connector on the board, which has 12 pins. Could you explain the connection?
James McNab, Glasgow

The 'user port' you refer to actually has 24 tags — 12 at the top and another 12 underneath. The eight lines you can control are at the bottom — the third through tenth tags, reading from left to right, looking up at the underside of the connector. All four pins at either end of the connector, top and bottom, are connected to 'ground'.

The value you POKE to address 59459 does not cause any information to be transmitted in itself, but it indicates that certain lines are to be used for output and the others for input. To encode and decode these values, you must convert the number to binary.

Fifteen in binary is 00001111, and Commodore — like most micro firms — uses the silly convention that a 1 means an output and a 0 means an input. Since the digit 1 looks more like an 'I' than an 'O', and a '0' looks more like 'O' than 'I', you *may* be able to remember this by observing that micro manufacturers always make things as confusing as possible!

You read and write the port, when you have set the direction for each line, by PEEKing and POKEing address 56577. Thus, if you wanted to use the first seven lines for output, and the last for input, you would set up the port with POKE 59459,127 (01111111 in binary).

The most significant bit of the 8-bit value returned by PEEK(56577) indicates the logic level of the input line. If this particular line is at a 'high' logic level the value will be over 127, otherwise it will be 127 or less. The total of all the other bit values, which you should ignore as they aren't inputs, can't exceed 64 + 32 + 16 + 8 + 4 + 2 + 1 = 127.

You can write a value to the port with POKE 56577, VALUE (in this case VALUE should be between 0 and 127, as we are using the seven least significant bits for output). Their values total 127 if all seven bits are set, as shown above.

The port works at TTL logic levels, so you shouldn't connect anything providing more than five volts to it. You can take up to 100mA of 5-volt power from the second pin from the left, on the top of the connector.

At last — the ITV micro!

In the November 1986 Computer Answers section, I read of boxes 'to turn a monitor into a television' and I would very much like to know more. Is a separate aerial needed? Do I have to disconnect disks, printers, and so on? Will they work with any monitor, such as mine for the Tandy Model 1?
Parig Digan, Dalgan Park, Ireland

There must be many situations where it is desirable to take output from a composite video source and feed it into an RGB monitor. Is this feasible (and cheap)?
Alfred W Pauson, Thornliebank, Glasgow

Last year Display Electronics obtained a large number of 'TV tuners' — devices capable of splitting a broadcast TV signal into standard, unmodulated sound and video. I suspect that these gadgets were originally made, at considerable cost, for cable TV applications. Display Electronics realised that they could be used to feed television signals from a conventional TV aerial into a computer monitor, and a market was born.

Incidentally, this is not a way to avoid payment of a TV licence. UK licensing law covers the use of 'receiving equipment', not just television sets. You must buy a licence unless the premises where the monitor is used to display broadcast television pictures are covered by an existing licence.

The original 'Telebox' produced a composite video signal compatible with colour or monochrome monitors that accept input through a single, screened cable. The term 'composite video' indicates that all of the information needed to produce a picture — intensity, colour, vertical and horizontal timing pulses — is encoded into one signal.

The TV sound is *not* encoded with the video information, although tuners for monitors receive that as well. Two sockets on the Telebox allow you to connect an external loudspeaker or amplifier. The first socket provides up to about four watts of power, which should be louder than most TVs if you supply an efficient 'speaker'; the second output is at 'line' level. The basic Telebox has seven push-button tuning controls, and sells for about £30.

Not all micro monitors accept composite video input. Some require you to supply separate timing signals, or 'synchs'. Colour monitors often need separate signals to control the three colour 'guns' which work in combination to generate any colour.

A few computer displays gain elegant circuitry and crisper boundaries by only allowing a gun to be on or off, with no intermediate levels. These RGB TTL models *cannot* display a TV picture properly, as they can only display eight colours including black and white. RGB stands for Red, Green, Blue — the three primary colours — and TTL stands for Transistor Transistor Logic, which is the generic name of the type of switching circuit used.

RGB monitors which allow smooth, graduated control of the intensity of each primary colour are termed 'linear'. These can produce a full range of colours, so they're capable of reproducing the detailed colour in a TV broadcast; indeed, most monitors seem to work at least as well as TVs of the same price.

Three firms make tuners for RGB linear monitors, all at prices around £70. The first of these is the Screenvision from Screens' Microcomputers and Electronics (SME). This is a souped-up version of the Telebox, with RGB linear output and a built-in 'speaker', as well as a phono output. SME has developed PAL A/B and SECAM versions of its tuner, which can decode signals broadcast outside the United Kingdom.

Display Electronics replied with Telebox 2, building a composite-to-RGB signal converter into the first Telebox and adding a loudspeaker and front-panel controls. Then champion box-shifters Dk'Tronics joined the fray, with its own RGB linear tuner.

The basic Telebox is much the cheapest unit, but it has no speaker and only works with composite video monitors. All the RGB linear models have distinct selling points. The Telebox 2 is probably the most flexible, as it allows composite-to-RGB conversion and abounds with front-panel controls. The Screenvision is slightly cheaper and available in 'export' versions. The Dk'Tronics tuner is available through retailers at marginally the lowest UK price, but it has continuous rather than push-button tuning, and lacks composite video and lin-level sound outputs.

The RGB linear tuners generally need specially made leads to join them to your monitor, although Amstrad users should be able to use their computer lead. SME can make leads to order, given the details of your monitor.

A tuner is unlikely to work if your monitor must have separate horizontal and vertical synch signals, or if it uses an American-style 60Hz screen refresh rate. UK broadcasts redraw the screen only 50 times a second, and few US monitors can lock on to this slower rate. Most such monitors come with imported IBM PCs and work-alikes.

Commodore's 1910 monitor is stranger than its specification suggests: it will accept composite video, but not RGB.

I'm pleased to say I found all three companies very helpful. Display Electronics can be reached on (01) 679 4414, Dk'Tronics on (0493) 602926, and SME on (09274) 20527. END

Clearing the line

This month Peter Tootill tackles the subject of error-free data transmission.

Transferring information of some sort between computers is a very popular pastime these days — or should I say it is very common. It can be very unpopular with those who have to move significant amounts regularly, who are often faced with a choice between slow data rates (for example, V21 300 bits/sec) and reasonable freedom from retransmissions due to errors, or higher speeds, but a much higher incidence of errors. Even at 300 bits/sec there is a good chance of noise on the phone line affecting the information being transferred. So, if it is important to avoid errors, some sort of error detection and correcting system is required.

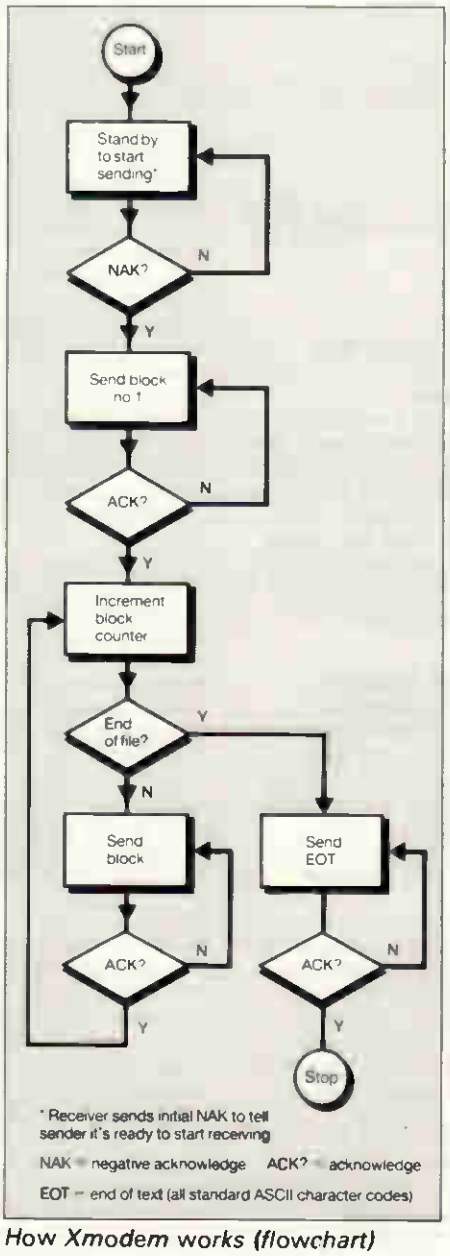
Error correction can be achieved in a number of ways, the most common of which is to send information in blocks and to check each block for errors after it has been sent. If an error has occurred during transmission, the block is repeatedly sent until a good copy is received. Of course, if too many errors occur, most systems will abort.

The way that the block is checked for errors varies. The most common methods treat the string of ASCII codes that represent the characters like numbers and perform an arithmetic calculation on them.

The simplest way is to calculate the checksum of the data by adding up the numbers. The total is then transmitted along with the data itself. When the receiving computer gets the data, it adds the numbers again and checks that the total agrees with the total sent with the data. If the numbers don't agree, an error has occurred.

Another more complex method uses something called a CRC (cyclic redundancy check). CRC is a more accurate test for data errors.

So far so good; we have covered the basic principles involved in achieving error-free file transfer — they are simple. The complications arise in how the data is sent (what size of block, for example), how the calculations are performed and what happens in various circumstances during the transfer: the software at both ends must obviously be in harmony if the process is to work.



How Xmodem works (flowchart)

The description of the above process is called a 'protocol' and the protocol standard for transferring, say, a file between two computers will have to cover such things as block size, calculation of check data, methods of acknowledging a correctly received block, what to do to request retransmission if an error is detected, whether the file name should be included in the transmission, and so on. The description of a protocol can be quite extensive — the one I have for Zmodem is nearly forty pages long!

You will probably come across the letters ARQ in connection with error-checking data transfer. ARQ stands for Automatic Repeat on reQuest and is usually associated with error-correcting modems, rather than file-transfer software. The advantage of ARQ is that everything passing between the two systems is checked, including, for example, logging on and entering a password, which means you should not notice the effects of line noise at all.

The main problem with ARQ modems is the lack of an internationally accepted standard protocol at present. There are at least three systems available in the UK and others in the US. The CCITT — the international body controlling this area — is presently considering the topic, but the whole area has become much more important with the higher speed modems that are now in regular use, especially if long-distance phone calls are involved. Using ARQ modems can be a bit disconcerting as the data tends to move in fits and starts as the blocks of data are sent and checked. On a bad line the process can be very intrusive — but it's still

better than coping with the line noise were ARQ not being used.

ARQ in modems in the UK is still relatively new and only a few are available. The three systems that you may come across are Epad, Tulse and a proprietary system in Dacom modems. Epad is the most widely available and Epad access to British Telecom's PSS service is available in most areas, but only at V23 (1200/75 rates). The Tulse system was developed by a company called Tulse Data Systems and is incorporated in modems available from BT and Steebek, including the Quattro. Others will probably follow. You can also buy a standalone box to add on to non-ARQ modems (but this is expensive at around £300).

Why BT should use both Epad and the Tulse system is a bit of a mystery to me, but it has been suggested that the latter doesn't suit V23 data rates very well. As far as I can gather the Tulse system is the favourite for widescale adoption in the UK. In the US, MNP seems to be the clear leader at present.

Which way the CCITT will go, I don't know. Hayes, which has set the standard in modem control languages, is pushing for a variant of the X25 protocols used in packet networks. This is on the basis that it is widely understood by manufacturers and software houses and could be adapted to dial-up modems relatively easily. I understand that the CCITT is not likely to decide before 1988 and even then it will take a while before products start to appear based on whatever standard it produces.

When it comes to file transfer, the field is much larger. There are a number of protocols in regular use. The 'original' file-transfer protocol (and still the most common), Xmodem, was developed by Ward Christensen in the US in 1977. It was very simple and he made it available in the 'public domain'. Now it is included in just about every commercial and public domain terminal package and bulletin board system. Other protocols you will come across are listed on page 176 with an explanation of their basic vital statistics, together with some indication of where you are likely to come across them.

There have been a number of enhancements to the Xmodem protocols over the years: the first was to replace the simple checksum on data blocks with a CRC protocol. As mentioned above, this is a more complex and accurate test for data errors. It is claimed that the CRC protocol will detect virtually all short data errors and over 99.99 per cent of longer errors.

Other improvements to Xmodem include Ymodem, windowed Xmodem and Zmodem; more about these shortly.

Protocol:	Xmodem	YM-k	YM-g	Zmodem	SKermit	WXmodem
Protocol Round Trips	804	104	5	5	5	4
Trip Time at 40ms	32s	4s	0	0	0	0
Trip Time at 5s	4020s	520s	25s	25s	25s	20s
Overhead Characters	4803	603	503	3600	38280	8000
Transfer Time at 0s	893s	858s	857s	883s	1172s	916s
Transfer Time at 5s	925s	862s	857s	883s	1172s	916s
Transfer Time at 5s	5766s	1378s	882s	918s	1197s	936s

For comparison: a straight 'dump' of the file contents with no file management or error-checking takes 853 seconds.

Table 1 Theoretical timings for file transfer using several common protocols (assumes no errors, and is based on 102,400byte binary file of random 8-bit characters. Sent at 1200 bits/sec. Ignores I/O overheads)

Protocol	Time/HD	Time/FD	Throughput	Efficiency
Kermit	1:49	2:03	327	34%
Xmodem	1:20	1:44	343	36%
Zmodem	:39	:48	915	95%

Times were measured downloading a 35721-character text file at 9600bps, from Santa Cruz SysV2.1.2 Xenix on a 9MHz IBM PC/AT to DOS 2.1 on an IBM PC. Xenix was in multi-user mode but otherwise idle. Transfer times to PC hard disk and floppy disk destinations are shown.

Source
The ZMODEM Asynchronous Inter Application File Transfer Protocol by Chuck Forsberg (Nov 1986). Published electronically on several systems.

Table 2 Real example of file downloaded from a timesharing system

There are a number of other transfer protocols that you will come across. Most terminal programs have a proprietary transfer protocol included (Crosstalk and Hayes' Smartcom are examples), but I won't cover these here as the details are usually not published. Normally you need to have the same software at both ends of a transfer if you want to use them.

An added complication is that most file-transfer protocols require the full eight bits of each byte of data (so that program files can be transferred). Some online systems such as Prestel and normal PSS only allow seven bits for data, the eighth being reserved for a parity bit (a crude error-checking device). All the Xmodem family and most proprietary file-transfer protocols need eight bits with no parity bit. Some protocols, like Kermit and the CET Telesoftware format, use special methods to send programs over 7-bit links.

One of the variables in file-transfer protocols is the size of the block of data that is being transmitted. This is a compromise as larger blocks make for a more efficient transfer because the overheads of checking the data and acknowledging the receipt need to be carried out less often. However, the larger the block, the more chance there is of its being corrupted in transit. I have found that, on even a moderately noisy line, it can be virtually impossible to transfer a 1k block without it being affected. I believe that Ymodem, which uses 1k blocks, is supposed to fall back to 128byte blocks if this proves to be a problem, but it certainly didn't happen with the implementation I tried. (I had to revert, manually, to Xmodem to upload a short file to a bulletin board.)

The other factor which governs the efficiency of the transfer process is the fact that many protocols are half-duplex: that is, they send a block, wait for it to be acknowledged and then send the next block. There is obviously a short delay while this happens: the minimum has been quoted as 40 milliseconds. This is enough for the delays in the modems and time for the respective computers to calculate the checksums, and so on. It isn't a lot if you are sending a 100k file in 18byte blocks where the total delay will be of the order of half a minute.

The problems begin when you are using a timesharing system, packet networks or a long-distance tele-

phone link that travels via a satellite. A satellite link can add half a second to the round trip time needed to acknowledge each block. The total overhead then increases to around 200 seconds. Packet-switched networks can increase the delay to around a second, and a busy timesharing system can easily generate a total of five seconds or more as you wait for the mainframe to get around to dealing with your particular task. You can imagine the result in an Xmodem transfer!

In an attempt to improve the efficiency of file transfer protocols when using slower mediums, full-duplex protocols such as Super-Kermit, WXmodem and Zmodem have been devised. In these, the sending system doesn't wait for the block to be acknowledged, but carries on to the next one without delay. If an error arises then the receiving system will tell the sender. By this time it will probably be a block or two ahead, but it either re-sends the bad block and continues where it left off (Super-Kermit) or goes back to the block where the error occurred and starts again (WXmodem and Zmodem).

The latter system is less efficient but much easier to handle from a programming point of view. The full-duplex protocols are often referred to as 'windowed' protocols, as they look at the data as if it were through a window covering several blocks.

Table 1 gives the total overheads calculated by the developers of Zmodem for transferring a 100k file at 1200 bits/sec with 0, 40ms and 5second delays for various protocols. The figures assume *no* transmission errors. As you can see, windowing makes a very significant difference when delays in the process are introduced.

Conclusion

The field of file transmission protocols is large and complex, and I haven't been able to do much more than scratch the surface here. I hope that I have at least given you some understanding of what goes on when an error-correcting file transfer system is in use and also what some of the commoner systems are.

Some bulletin boards carry downloadable text files that contain the full specification of Xmodem and other protocols. Look through *PCW*'s list of numbers in End Zone and leave a message on your local board if you want to get hold of this information.

The revised list of UK bulletin boards (BBSs) has a permanent spot in 'End Zone'.

Common file transfer protocols

Xmodem: often called Christensen or CP/M modem protocols. This uses 128byte blocks and a checksum for error-checking. Uses eight data bits to transfer binary files. Supported by just about every terminal program and bulletin board system; also by American commercial online systems such as The Source and CompuServe.

Xmodem-CRC: identical to the checksum system but uses a CRC method of error-checking. Also widely supported.

Xmodem-1k: as Xmodem but supports 1kbyte as well as 128byte blocks. Rarely used.

Modem-7: a variation of Xmodem that transfers a CP/M-style file name with the file. Can be used for batch file transfers. In some CP/M public domain programs such as MODEM7xx.COM itself.

Ymodem: based on Xmodem. Supports 1k and 128byte blocks, CRC error-checking. Includes filename for batch transfers. Gaining wider support in software of American origin; for example, Procomm, Mirror (MS-DOS), YAM and IMP (for CP/M systems), also BBS systems such as TBBS and Fido.

Ymodem-g: a variant of Ymodem designed for use with hard-wired systems, or systems where no errors are likely to arise (using ARQ modems, for example). No checking of block is performed.

WXmodem: Windowed Xmodem — a full-duplex version of Xmodem. It allows blocks to be sent in a continuous stream with no delays for acknowledging them. Not very common as yet (included in Procomm, the US online system called PeopleLink and reported to be coming on CompuServe).

Zmodem: a more sophisticated variant of Xmodem. It supports longer blocks (typically 256bytes at up to 2400 bits/sec, 1024bytes above). It also supports batch file transfers, allowing pathnames, including file-creation dates. Includes sophisticated protection against errors interfering with the file-transfer process itself. Looks very promising but very recent and not yet widely used — Zcomm, Pro-YAM are examples of implementations.

Kermit: designed to allow transfer of files of any type between mainframe systems. It uses a 'quoting' system to allow transfer of binary files on systems that only allow seven data bits. Mainly found on mainframe systems but also some micro-based bulletin boards and terminal packages. Latest version uses windowing to speed up transfer. Widely available in specific micro and mainframe packages, usually public domain. Also in commercial packages such as Crosstalk, Mirror, Procomm, also Fido BBSs. Again not supported by online systems in the UK such as Telecom Gold, Microlink, and so on.

Super Kermit: a windowed version of Kermit. Still very new. Available in Procomm and on The Source. Terminal packages should be available from usual sources.

CET Telesoftware: a special protocol for transferring program files to and from viewdata systems such as Prestel. Produced by Council for Educational Technology. Supported by most British viewdata terminal programs and viewdata systems, including Prestel.

All the above protocols are public domain — that is, the descriptions are publicly available and anyone can use them without the need to enter into agreements or pay any licence fees. Many other protocols exist, but are usually specific to some manufacturer's product. Some are available in a number of products where they have been licensed by others. The following are ones that are available in more than one product:

MNP: ARQ system found in a number of error-correcting modems in the USA. Devised by Microcom Networking Products. Available in modems from a number of US manufacturers such as US Robotics, Microcom, Racal-Vadic, Micom.

Tulse: ARQ system found in some British error-correcting modems. Devised by Tulse Data Systems. Available in modems from BT, Steebek, DaCom and probably others. Also available as a hardware add-on for other modems. Supported by some UK online systems such as Istel. There are rumours that BT will adopt it for Prestel and PSS access in the near future.

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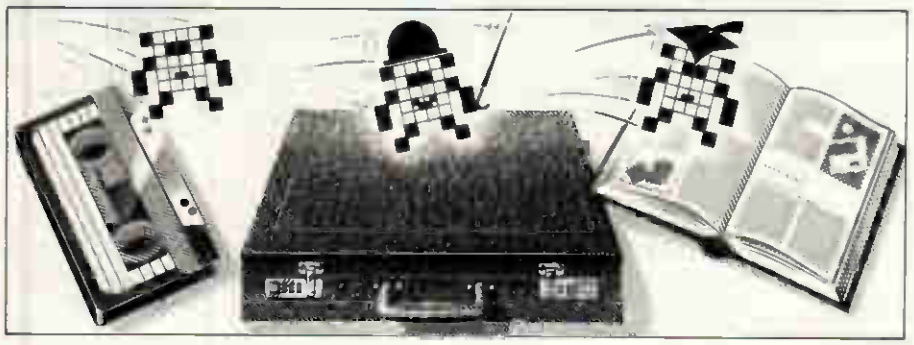
PROGRAM FILE



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PCW 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 £50 per page of published listing, plus a £50 bonus for the Program of the Month. Send your contributions to Owen Linderholm, Program File, PCW, 32-34 Broadwick Street, London W1A 2HG.

This month's programming technique is clean input and validation, which deals with such topics as careful entry of strings and numbers, and checking that values entered by the user fall within the desired range. It is fairly easy to write a standard set of routines that can subsequently be used in all your programs as standard input routines.

Text input essentially falls into two categories — numerical and string. Longer text input in the form of files shouldn't really be done in this way, but entered into a text editor. The file can then be loaded by the program.

The technique used here is to read all input as character strings. If the input is intended to be numerical it is then converted to a number; this allows the program to check that each entered character is numeric as it is typed in. Letters and punctuation marks are simply not accepted; the purpose of which is to prevent novice users or erratic typists making mistakes, as well as discourage malicious users from entering bad data.

Another advantage of this method is that it allows the programmer to include routines which help the user easily edit invalid entries. For example, if a typing mistake has been made, then the program could redisplay the previous entry with the mistake and allow the user to just correct the error rather than retyping it.

Commercial programs use this

Fig 1

```
140 IF (GET AND 95)=89 PRINT "Y":start=3 ELSE PRINT "N":start=1
255 osbyte=&FFF4
312             LDA #&B4
313             LDX #&00
314             LDY #&FF
315             JSR osbyte          \find start of text
316             TXA
317             CLC
318             ADC #start
319             STA addhi
390             LDA #&7A
400             SEC
405             SBC addhi           \set no of 256-byte pages
410             TAX
```

type of technique all the time, but user programs often don't do any checking. When a mistake is made, the interpreter or compiler issues an unfriendly standard error message such as 'Redo from start'.

I have written a simple set of routines to provide basic input validation. They can check that input is longer or shorter than specified lengths; they can check that numbers are not too high or too low, and print error messages; they can also do minimal editing. Their major advantage is that they are easy to modify and expand.

The routines are all very short, and have been written in a modular way so that they can easily be re-written and only the relevant parts in a particular program need be used.

A full MBasic listing is given for a program to repeatedly read in names and telephone numbers. The names must be between 3 and 20 characters long and the numbers between 7 and 15. I had intended to include Modula-2 routines as well but this proved to be a mammoth task, so from now on I shall concentrate on Basic but try to include information to help in translating the programs.

Possible extensions to this kind of routine include displaying the possible field size as underlined characters or blobs, or full editing of input strings including deletion from the centre, and so on. Other changes could allow for better presentation, up to and including pop-up windows or menus.

Blunders

There is a correction to the BBC Wordwise Recovery program (February issue) to allow it to work with the BBC Master. The lines given in Fig 1 should be typed over the previous program.

This month's programs

Part of Program File this month is given over to a section of programs from Robert Schifreen's article on how to access CMOS RAM on AT clones (page 148, this issue). The Program of the Month is for the Amstrad CPC range of computers. It is called Multi-Column Formatter and is by Rudi Way (regular readers will remember him as the man who is handy with a meat grinder). The program takes an input file of text and reproduces it as a multi-column listing on screen, printer or file.

I receive a large number of programs every month for Program File and almost always have too many good ones. This month these include a logic circuit design and testing program in Turbo Pascal which requires the Turbo Graphics workshop.

```
1000 REM/This is an example program for entering names and
1010 REM/telephone numbers.
     REM/Variables used in the program:
     REM/SPX,SPY - start position x and y, screen co-ords of the
     REM/          start of the input field
     REM/NM$ - name string
     REM/NR$ - number string
     REM/IC$ - input character
     REM/MNL,MXL - minimum and maximum string length
     REM/DS$ - display string
     REM/DL - display string length
     REM/FAIL - failure flag for numeric check
     REM/DONE - flag to check for enter key
     REM/DEL - flag to check for delete key
     REM/LONG - flag to check for string too long
     REM/SHORT - flag to check for string too short
     REM/EPX,EPY - start co-ords for error message
     REM/EM$ - error message
     REM/MXV,MNV - maximum and minimum values for numeric entries
     REM/RT$,DL$,NL$ - string constants for the enter and delete
     REM/            keys and an empty string
1020 GOSUB 3300
1030 GOSUB 1100:GOTO 1030

     REM/Main control routine. Clear screen and print message.
     REM/Get name and repeat for number. Then print out what was
     REM/entered and wait for the space bar to be pressed.
1100 CLS:PRINT:PRINT
1110 PRINT"Enter name:";
1120 SPX=3:SPY=13:LOCATE SPX,SPY
1130 GOSUB 1200
1140 PRINT:PRINT:PRINT"Enter no. ";
1150 SPX=5:SPY=12:LOCATE SPX,SPY
1160 GOSUB 1300
1170 PRINT:PRINT:PRINT"Name is ";NM$:PRINT"Number is ";NR$
1180 PRINT"Press SPACE":IC$=INPUT$(1)
1190 RETURN

     REM/Input name routine. Set min and max length and call
     REM/overall input routine. Set name string to input string
     REM/and return.
1200 MNL=3:MXL=20:DS$="":DL=0:GOSUB 3400
1210 NM$=DS$:RETURN

     REM/Input number routine. As for input name except set
     REM/number string to input string.
1300 MNL=7:MXL=15:DS$="":DL=0:GOSUB 3400
1310 NR$=DS$:RETURN

     REM/Input character routine. Read character from keyboard
     REM/(waits for first key to be pressed and returns this as
     REM/a one character string).
2000 IC$=INPUT$(1):RETURN
     REM/Check numeric routine. Check that input character is a
     REM/number. If not set FAIL flag.
2100 FAIL=0:IF (IC$<"0" OR IC$>"9")THEN IC$="":FAIL=1
2110 RETURN

     REM/Check done routine. If input char was RETURN key then set
     REM/DONE flag.
2200 DONE=0:IF IC$=RT$ THEN DONE=1
2210 RETURN

     REM/Check delete routine. If input char was backspace key then
     REM/set DEL flag.
2300 DEL=0:IF IC$=DL$ THEN IC$="":DEL=1
2310 RETURN

     REM/Display input routine. Move cursor to start of input field
     REM/and print enough spaces to blank the field. Then move back
     REM/to start and print input string so far.
2400 LOCATE SPX,SPY
2410 FOR X=1 TO DL+1:PRINT" ";:NEXT X
2420 LOCATE SPX,SPY:PRINT DS$;:RETURN

     REM/Delete char routine. If there is anything to delete then
     REM/remove the last character from the input string and adjust
     REM/the length to be correct.
2500 IF DL>0 THEN DS$=LEFT$(DS$,DL-1):DL=DL-1
2510 RETURN

     REM/Add char routine. Add the input char to the end of the input
     REM/string
2600 DS$=DS$+IC$:DL=DL+1:RETURN

     REM/Check long routine. If string is too long then delete last
     REM/character, redisplay it, display error message and set
     REM/LONG flag.
2700 LONG=1:IF DL>MXL THEN GOSUB 2500:GOSUB 2400:
     EM$="Entry too long":GOSUB 2900:LONG=1
2710 RETURN

     REM/Check short routine. If string too short then display error
     REM/message and set SHORT flag.
2800 SHORT=0:IF DL<MNL THEN EM$="Entry too short":GOSUB 2900:SHORT=1
2810 RETURN

     REM/Display error routine. Move cursor to error message field
     REM/and display error string.
2900 LOCATE EPX,EPY:GOSUB 3100:PRINT EM$;:RETURN

     REM/Check high routine. If input value too high, then display
     REM/error message. Only here as an example - unused.
3000 IF IV>MXV THEN EM$="Entry too high":GOSUB 2900:RETURN
     REM/Check low routine. If input value too low, then display
     REM/error message. Only here as an example - unused.
3100 IF IV<MNV THEN EM$="Entry too low":GOSUB 2900:RETURN

     REM/Beep routine. Beeps twice.
3200 BEEP:BEEP:RETURN

     REM/Initialisation. Set constant values to the correct ones.
     REM/EPX,EPY are the co-ordinates for the start of the error
     REM/message field;RT$ represents a carriage return;DL$ the
     REM/backspace key and NL$ a null string.
3300 EPX=20:EPY=2:RT$=CHR$(13):DL$=CHR$(8):NL$="":RETURN

     REM/Standard input routine. It reads a character. Checks it
     REM/it is delete and deals with it if it is. Otherwise it
     REM/checks if it is a RETURN. If not it adds the character
     REM/to the string, checks length, displays and repeats.
     REM/Otherwise it checks if it is short and returns.
3400 GOSUB 2000
3410 GOSUB 2300:IF DEL=1 THEN GOSUB 2500:GOTO 3440
3420 GOSUB 2200:IF DONE=1 THEN 3450
3430 GOSUB 2600
3440 GOSUB 2400:GOSUB 2700:GOTO 3400
3450 GOSUB 2800:IF SHORT=1 THEN 3400
3460 RETURN
```

Program of the Month
CPC Multi-Column Formatter

by Rudi Way

As Rudi Way cheekily mentioned in his covering letter, this program could be used to produce a computer magazine since it allows text to be printed in columns. The program is operated by a long menu which is used to set a wide range of options. Each option has a default value which can be selected by pressing Return.

There is an initialisation section which includes the printer control codes. These will have to be changed to fit in with your printer.

One problem the program has to deal with is what to do if the output doesn't fill the last page. In this case you are given the choice of having all the columns finish level with each other halfway down the page, or fill the first columns and leave the latter ones empty.

The program allows for front and back pages. This switches page numbers and headings from side to side so that if they were organised in book form, the numbers and headings would always be on the edge.

The program is also capable of controlling fonts on different printers. It is set up to use standard Epson controls and can print in pica, elite, condensed, NLQ or condensed subscript. It has been carefully written and is modular, so it should be easy to understand and adapt.

```
200  ----------MAIN PROGRAM----------
210 DEFINT a-z
220 ON ERROR GOTO 4170
230 ON BREAK GOSUB 340
240 GOSUB 5870  defaults
250 GOSUB 5220  initialisations
260 ag$=n-1
270 WHILE again
280    GOSUB 4810  set up screen
290    GOSUB 1800  user input
300    GOSUB 540   multi column output
310
320    GOSUB 2210  again ?
330 WEND
340
350 PEN 1 PAPER 0 MODE 2
360 LOCATE ( 80-LEN(message1$)
370 INK 1,pencolour papercolour
380 CLOSEIN CLOSEOUT
390 dummy =FREE
400 INK 1 pencolour
410 CLEAR
420 CLS
430 END
440  --------------------------------
450
460
470  ---------ERROR ROUTINE----------
480 PEN 1 PAPER 0
490 MODE 2
500 PRINT "ERROR ";ERR " in line ";ERL
510 END
520  --------------------------------
530
540  ---------MAKE COLUMNS-----------
550 OPENIN infile$
560 IF (outfile$<>SCR$) AND (outfile$<>PRN$) THEN OPENOUT outfile$ ELSE
570 IF outfile$=SCR$ THEN str=2
580 IF outfile$=PRN$ THEN str=8
590
600 IF frobac=-1 THEN 630
610    storedlm=lm
620    storedrm=rm
630  FI
640
650 IF pagnum<>0 THEN page=pagnum
660
670 WHILE NOT EOF
680   read a page
690    DIM lain$(nc,lpp)  lains(columns,lines per page
700
710    FOR n=1 TO nc
720       FOR m=1 TO lpp
730          IF EOF THEN MID
740          LINE INPUT#9, lain$(n,m)
750          PRINT      erase loading
760          lain$(n,m)=MID$(la
770          lains(n,m)=lain$(n,m)+CHR$(13)+CHR$(10)
780       NEXT
790    NEXT
800
810    write a page
820    IF str=2 THEN CLS=2
830
840    IF frobac=0 THEN lm=stored
850    IF frobac=1 THEN lm=storedrm
860
870    IF head=0 THEN 950  no header
880
890       IF frobac<>0 THEN heds=LEFT$(PAGE$(page),lm-1)+CHR$(13)+CHR$(10)
900          heds=LEFT$( SPACE$ (MAX( 0,pw-LEN(header$)-1)/2)+header$
910       FI
920
930       IF str<>2 THEN 950
940          PRINT#2,MID$(heds$,1,80)
950          IF LEN(heds$)<80 THEN PRINT#2
960       FI
970
980       IF str<>2 THEN PRINT#str,heds$;CHR$(13);CHR$(10)
990    FI
1000
1010   IF equ AND EOF THEN GOSUB 1690  adjust sofar lines on last page
1020
1030   FOR n=1 TO lpp
1040      IF lain$(1,n)="" THEN LS=LS+CHR$(13)+CHR$(10) empty line
1050         LS=SPACE$(lm)
1060
1070         FOR m=1 TO nc-1
1080            IF lain$(m,n)<>"" THEN LS=LS+lain$(m,n)+SPACE$(cp
1090         NEXT
1100
1110         LS=LS+lain$(nc,n)
1120      FI
1130
1140      IF str<>2 THEN 1170
1150         PRINT#2,MID$(LS,1,80);
1160         IF LEN(LS)<80 THEN PRINT#2
1170      FI
1180
1190      IF str<>2 THEN PRINT#str,LS;CHR$(13);CHR$(10)
1200   NEXT
1210
1220   ERASE lains
1230
1240   IF pagnum=0 THEN 1480  no page number
1250      PRINT#str
1260
1270      IF frobac<>1 THEN 1300
1280         pages=SPACE$(MAX( 0  pw-4 LEN(STR$(page)) ) / 2)
1290         pages=LEFT$(pages$+STR$(page),pw)
1300      FI
1310
1320      IF frobac<>0 THEN 1350
1330         pages=SPACE$(MAX( 0,pw-re LEN(STR$(page)) ) / 2)
1340         pages=LEFT$(pages$+STR$(page)+SPACE$(pw)
1350      FI
1360
1370      IF frobac=1 THEN pages=LEFT$(SPACE$(pw/2)+STR$(page),pw)
1380
1390      IF str<>2 THEN 1420
1400         PRINT#2,MID$(pages$,1,80);
1410         IF LEN(pages$)<80 THEN PRINT#2
1420      FI
1430
1440      IF str<>2 THEN PRINT#str,pages$
1450
1460      page=page+1
1470
1480   FI
1490
1500   IF frobac<>-1 THEN frobac=-(frobac=1)  200 2
1510   IF str=2 THEN PRINT messages$ GOSUB 4690 CLS=2
1520   IF str=8 THEN GOSUB 1590  send formfeed
1530   IF str=9 THEN FOR m=lpp+1 TO pll-head+(pagnum<>0)*2 PRINT#8 NEXT
1540
1550 WEND
1560 CLOSEIN CLOSEOUT
1570 RETURN
1580
1590 '---formfeed handling---
1600 FOR m=lpp+1 TO pll-head-(pagnum<>0)*2 PRINT#8 NEXT
1610 IF single AND NOT EOF THEN PRINT message$ GOSUB 4690  wait for key press
1620 RETURN
1630
1640  ---move lines if equal height columns requ.red---
1650 IF m=lpp+1 THEN n=n-1 m=lpp ELSE m=m-1
1660 lyncntr=(n-1)*lpp+m
1670 FOR col=nc TO 1 STEP -1
1680    ll=lyncntr-col
1690    lyncntr=lyncntr-ll
1700    FOR row=ll TO 1 STEP -1
1710       lain$(col,row)=lains(n,m)
1720       IF (col<>n) OR (row<>m) THEN lains(n,m)=""
1730       m=m-1
1740       IF m=0 THEN n=n-1 m=lpp
1750    NEXT
1760 NEXT
1770 RETURN
1780 '------END OF MAKE COLUMNS------
1790 '
1800 '----------- INPUT ----------
1810 again=1
1820 WHILE again
1830    GOSUB 3480 'input file
1840    GOSUB 3800 'output file
1850    GOSUB 2290  number of columns
1860    GOSUB 2380 'column width
1870    GOSUB 2470 'left margin
1880    GOSUB 2560  central margins
1890    GOSUB 2650  right margin
1900    GOSUB 2740  head ( y/n)
1910    GOSUB 2830  header ( enter
1920    GOSUB 3010  page control
1930    GOSUB 3100  print both pages
1940    GOSUB 3190  page length
1950    GOSUB 3280  lpp per page
1960    GOSUB 3460  centertext
1970    GOSUB 3870  single sheet
1980
1990    GOSUB 2030  again ?
2000 WEND
2010 RETURN
2020
2030 '----rerun input ?----
2040 WHILE INKEY$<>"" WEND
2050 pw = lm + nc*cw + (nc-1)*cp + rm   page width
2060 IF pw<256 THEN 2130
2070    SOUND 129,20
2080    PRINT message$
2090    again=1
2100    GOSUB 4690  keypress
2110    PRINT
2120    RETURN
2130 'fi
2140 pw=pw'
```

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"Don't these stupid bears ever eat anything else?"

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One day, a bright young thing by the name of Goldilocks came by, just as the three bears had decided to stroll down to their local for a swift tincture before breakfast (bears rise very late in the day). Goldilocks spotted the door was open and thus she wandered in. There upon the table were three bowls of porridge. A great big bowl, a medium sized bowl, and a teeny-weeny little bowl.

"Porridge *again*," groaned Goldilocks, "don't those stupid bears ever eat anything else? It's little wonder they all suffer from the crabs...." So Goldilocks raised the limp cloth from her wicker basket..... and whipped out her portable PC to set about creating a more adventurous and nutritious diet with an advisory system she'd created earlier using PaperBack Software's *VP Expert*. A rule-based expert system that *anyone* can use to create knowledge-based systems.

Her fingers flew across the keys, the printer whirled and spat out a list of alternatives that might tempt the ursine palate. She put the list on the table and left, just as the bears were returning.

"What's this ? Who's been computing in *my* chair ?" enquired baby bear.

Daddy bear grabbed the list from the table and read it aloud: "Wild antelope...fresh honey...pic-a-nic baskets...? Now *that's* what I call decent grub..... forget the porridge Ma, this looks far more suitable to keep the body and soul of a hungry bear together....." And so they lived happily ever after. So can *you* for only £99, with ***VP Expert***, from New Star Software.

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PROGRAM FILE

```
2150 PRINT message10$ ;"
2160 set$=yesno$:GOSUB 4150 'yes or no
2170 IF ndf=0 THEN text$=LEFT$(yesno$,1)
2180 again= ( text$=LEFT$(yesno$,1) )
2190 RETURN
2200 '
2210 '---rerun program---
2220 WHILE INKEY$<>"":WEND
2230 PRINT message14$ ;
2240 set$=yesno$:GOSUB 4150 'yes or no
2250 IF ndf=0 THEN text$=LEFT$(yesno$,1)
2260 again= ( text$=LEFT$(yesno$,1) )
2270 RETURN
2280 '
2290 '---number of columns---
2300 WINDOW#1,20,60,8,8:CLS#1:PRINT#1,s3$;nc ;
2310 PRINT input$ ; :posi=POS(#0):GOSUB 4000
2320 WHILE ndf AND (textc=0 OR text>255):SOUND 129,20:GOSUB 4000:WEND:PRINT
2330 IF ndf THEN nc=text 'ndf= not default (number entered)
2340 LOCATE#2,2,8:PRINT#2,SPACE$(78)
2350 LOCATE#2,20,8:PRINT#2,s3$;nc
2360 RETURN
2370 '
2380 '---column width---
2390 WINDOW#1,20,60,9,9:CLS#1:PRINT#1,s4$;cw ;
2400 PRINT" 0 < ";input$;" < 256 : " ; :posi=POS(#0):GOSUB 4000
2410 WHILE ndf AND (textc=0 OR text>255):SOUND 129,20:GOSUB 4000:WEND:PRINT
2420 IF ndf THEN cw=text
2430 LOCATE#2,2,9:PRINT#2,SPACE$(78)
2440 LOCATE#2,20,9:PRINT#2,s4$;cw
2450 RETURN
2460 '
2470 '---left margin---
2480 WINDOW#1,20,60,10,10:CLS#1:PRINT#1,s5$;lm ;
2490 PRINT input$ ; :posi=POS(#0):GOSUB 4000
2500 WHILE ndf AND (text>255):SOUND 129,20:GOSUB 4000:WEND:PRINT
2510 IF ndf THEN lm=text
2520 LOCATE#2,2,10:PRINT#2,SPACE$(78)
2530 LOCATE#2,20,10:PRINT#2,s5$;lm
2540 RETURN
2550 '
2560 '---central margin (between columns)---
2570 IF nc=1 THEN RETURN
2580 WINDOW#1,20,60,11,11:CLS#1:PRINT#1,s6$;cm ;
2590 PRINT input$ ; :posi=POS(#0):GOSUB 4000
2600 WHILE ndf AND (text>255):SOUND 129,20:GOSUB 4000:WEND:PRINT
2610 IF ndf THEN cm=text
2620 LOCATE#2,2,11:PRINT#2,SPACE$(78)
2630 LOCATE#2,20,11:PRINT#2,s6$;cm
2640 RETURN
2650 '
2660 '---right margin---
2670 WINDOW#1,20,60,12,12:CLS#1:PRINT#1,s9$;rm ;
2680 PRINT input$ ; :posi=POS(#0):GOSUB 4000
2690 WHILE ndf AND (text>255):SOUND 129,20:GOSUB 4000:WEND:PRINT
2700 IF ndf THEN rm=text
2710 LOCATE#2,2,12:PRINT#2,SPACE$(78)
2720 LOCATE#2,20,12:PRINT#2,s9$;rm
2730 RETURN
2740 '
2750 '---equal height columns ?---
2760 IF nc=1 THEN RETURN
2770 WINDOW#1,20,60,13,13:CLS#1:PRINT#1,s7$;equ$ ;
2780 PRINT message7$ ;
2790 set$=yesno$:GOSUB 4150 'yes or no
2800 IF ndf THEN equ$=text$
2810 equ=(equ$=LEFT$(yesno$,1))
2820 LOCATE#2,2,13:PRINT#2,SPACE$(78)
2830 LOCATE#2,20,13:PRINT#2,s7$;equ$
2840 RETURN
2850 '
2860 '---header---
2870 WINDOW#1,20,60,14,14:CLS#1:PRINT#1,s10$;head$ ;
2880 set$=yesno$
2890 PRINT message8$ ;
2900 GOSUB 4150 'header ?
2910 IF ndf THEN head$=text$
2920 LOCATE#2,2,14:PRINT#2,SPACE$(78)
2930 LOCATE#2,20,14:PRINT#2,s10$;head$
2940 IF head$=LEFT$(yesno$,1) THEN head=2 ELSE head=0:CLS#3:RETURN
2950 PEN#3,0:PAPER#3,1:CLS#3:PRINT#3,header$ ;
2960 PRINT  'eresa message8
2970 LOCATE#3,1,1:LINE INPUT#3,"",text$
2980 IF text$<>"" THEN header$=text$
2990 PEN#3,1:PAPER#3,0:CLS#3:PRINT#3,header$ ;
3000 RETURN
3010 '
3020 '---page numbers---
3030 WINDOW#1,20,60,15,15:CLS#1:PRINT#1,s14$;pagnum
3040 PRINT message9$ ; :posi=POS(#0):GOSUB 4000:PRINT
3050 IF ndf THEN pagnum=text
3060 LOCATE#2,2,15:PRINT#2,SPACE$(78)
3070 LOCATE#2,20,15:PRINT#2,s14$;pagnum
3080 RETURN
3090 '
3100 '---front/back pages---
3110 WINDOW#1,20,60,16,16:CLS#1:PRINT#1,s15$;frobac$
3120 PRINT message12$ ;
3130 set$=frobacset$:GOSUB 4150
3140 IF ndf THEN frobac$=text$
3150 frobac=INSTR(frobacset$,frobac$)-2
3160 LOCATE#2,2,16:PRINT#2,SPACE$(78)
3170 LOCATE#2,20,16:PRINT#2,s15$;frobac$
3180 RETURN
3190 '
3200 '---lines per page---
3210 WINDOW#1,20,60,18,18:CLS#1:PRINT#1,s8$;lpp ;
3220 effpll=pll - head + 2*(pagnum<>0)
3230 PRINT"0 < ";input$;" <=";effpll;" : " ; :posi=POS(#0):GOSUB 4000
3240 WHILE (lpp>effpll AND NOT ndf) OR (ndf AND (text<=0 OR text>effpll))
3250     SOUND 129,20
3260     GOSUB 4000
3270 WEND
3280 PRINT
3290 IF ndf THEN lpp=text
3300 LOCATE#2,2,18:PRINT#2,SPACE$(78)
3310 LOCATE#2,20,18:PRINT#2,s8$;lpp
3320 RETURN
3330 '
3340 '---pagelength in lines---
```

PROGRAM FILE

```
3350 WINDOW#1,20,60,17,17:CLS#1:PRINT#1,s11$;p11 ;
3360 minp11-head-(pagnum<>0) * 2
3370 PRINT input$;" >"; minp11;" : " ; :posi=POS(#0):GOSUB 4000
3380 WHILE (p11<-minp11 AND NOT ndf) OR (ndf AND text<-minp11)
3390    SOUND 129,20
3400    GOSUB 4000
3410 WEND
3420 PRINT
3430 IF ndf THEN p11-text
3440 LOCATE#2,2,17:PRINT#2,SPACE$(78)
3450 LOCATE#2,20,17:PRINT#2,s11$;p11
3460 RETURN
3470 '
3480 '---input file---
3490 WINDOW#1,20,60,5,5:CLS#1:PRINT#1,s1$ ;
3500 IF infile$<>"" THEN PRINT#1,infile$ ; ELSE PRINT#1,empty$ ;
3510 PRINT message1$ ; :GOSUB 4320 'get name
3520 IF ndf=0 THEN text$=infile$
3530 IF disc AND text$="" THEN SOUND 129,20:GOTO 3510
3540 IF ndf THEN infile$=text$
3550 LOCATE#2,2,5:PRINT#2,SPACE$(78)
3560 LOCATE#2,20,5 PRINT#2,s1$ ;
3570 IF infile$<>"" THEN PRINT#2,infile$ ELSE PRINT#2,empty$
3580 RETURN
3590 '
3600 '---output file---
3610 WINDOW#1,20,60,6,6:CLS#1:PRINT#1,s2$ ;
3620 IF outfile$<>"" THEN PRINT#1,outfile$ ; ELSE PRINT#1, empty$ ;
3630 PRINT message2$ ; :GOSUB 4320 'get name
3640 IF ndf THEN t$=text$ ELSE t$=outfile$
3650 IF disc AND t$="" THEN SOUND 129,20.GOTO 3630
3660 LOCATE#2,2,6:PRINT#2,SPACE$(78)
3670 LOCATE#2,20,6:PRINT#2,s2$ ;
3680 IF t$<>"" THEN PRINT#2,t$ ELSE PRINT#2,empty$
3690 IF disc=0 THEN outfile$=t$:RETURN
3700 IF (infile$<>text$) THEN outfile$=t$:RETURN
3710 IF text$=SCR$ OR text$=PRI$ THEN outfile$=t$.RETURN
3720 PRINT warning1$ , 'equal filenames
3730 set$=yesno$.GOSUB 4150
3740 IF ndf=0 OR text$=RIGHT$(yesno$,1) THEN 3600 ELSE outfile$=t$:RETURN
3750 '
3760 '---choice of characterfont---
3770 IF outfile$<>PRI$ THEN RETURN
3780 WINDOW#1,20,60,19,19:CLS#1:PRINT#1,s12$;font
3790 PRINT message3$ ,  posi=POS(#0):GOSUB 4000
3800 WHILE ndf AND (text>maxfon) SOUND 129,20.GOSUB 4000 WEND PRINT
3810 IF ndf THEN font=text
3820 IF font>0 THEN PRINT#8,pcode$(0);pcode$(font) ;
3830 LOCATE#2,2,19 PRINT#2,SPACE$(78)
3840 LOCATE#2,20,19 PRINT#2,s12$;font
3850 RETURN
3860 '
3870 '---single sheet---
3880 IF outfile$<>PRI$ THEN RETURN
3890 WINDOW#1,20,60,20,20:CLS#1:PRINT#1,s13$,single$
3900 PRINT message5$ ,
3910 set$=yesno$:GOSUB 4150
3920 IF ndf THEN single$=text$
3930 single=(single$=LEFT$(yesno$,1))
3940 LOCATE#2,2,20 PRINT#2,SPACE$(78)
3950 LOCATE#2,20,20:PRINT#2,s13$;single$
3960 RETURN
3970 '
3980 '---subroutines---  call  --subroutines--  call  *subroutines*
3990 '
4000 '--get number or reset not-default flag ndf--
4010 set$=NO9$+com$
4020 n=0
4030 text$=STRING$(3,nil$)
4040 i$=""
4050 WHILE i$<>cr$
4060    LOCATE posi,1.PRINT text$;SPACE$(3);
4070    GOSUB 4690 'i$=getchar
4080    IF ( INSTR(NO9$,i$) AND (n>=3) ) OR (i$=nil$) THEN SOUND 129,20
4090    IF INSTR(NO9$,i$) AND (n<3) THEN n=n+1:MID$(text$,n)=i$
4100    IF INSTR(clr$+del$,i$) THEN GOSUB 4760 'erase char
4110    IF i$=cr$ THEN ndf= ( text$<>STRING$(3,nil$) ):text= VAL(text$)
4120 WEND
4130 RETURN
4140 '
4150 '--get char from set + <cr> or reset not-default flag ndf--
4160 posi=POS(#0)
4170 i$=""
4180 text$=nil$
4190 set$=set$+com$
4200 WHILE i$<>cr$
4210    GOSUB 4690 'getchar
4220    IF i$=cr$ THEN 4270
4230    IF INSTR(com$,i$) OR i$=nil$ THEN text$=nil$
4240    IF i$=nil$ THEN SOUND 129,20
4250    IF INSTR(set$,i$) AND (INSTR(com$,i$)=0) THEN text$=i$
4260    LOCATE posi,1:PRINT text$;SPACE$(1) ;
4270 WEND
4280 ndf= (text$<>nil$)
4290 PRINT
4300 RETURN
4310 '
4320 '--get name--
4330 posi=POS(#0)
4340 good=0
4350 WHILE good=0
4360    n=0
4370    text$=STRING$(namelen,nil$)
4380    i$=nil$
4390    WHILE i$<>cr$
4400       IF slow THEN WHILE INKEY$<>"" WEND
4410       i$=nil$
4420       IF disc THEN LL=32 ELSE LL=31 'no spaces allowed , if disc
4430       WHILE NOT (INSTR(com$+tabb$,i$)<>0 OR (ASC(i$)>LL AND ASC(i$)<127))
4440          i$=INKEY$:WHILE i$="":i$=INKEY$:WEND
4450       WEND
4460       IF i$=tabb$ THEN text$="":ndf=-1:PRINT:RETURN 'empty name
4470       MID$(i$,1)=UPPER$(i$)
4480       IF INSTR(clr$+del$,i$) THEN GOSUB 4760:GOTO 4510
4490          IF n>=namelen AND i$<>cr$ THEN SOUND 129,20
4500          IF n<namelen AND i$<>cr$ THEN n=n+1:MID$(text$,n)=i$
```

PROGRAM FILE

```
4510       LOCATE posi,1:PRINT tezt$;SPACE$(namelen) ;
4520    WEND
4530    ndf= ( tezt$<>STRING$(namelen,nil$) )
4540    tezt$=LEFT$(tezt$,n)  'remove right side chr$(0)'s
4550    GOSUB 4600 'good = ( disc file name ok )
4560 WEND
4570 PRINT
4580 RETURN
4590 '
4600 '-check disc file name-
4610 IF disc = 0 THEN good = 1 : RETURN
4620 dot = INSTR(tezt$,".")
4630 IF INSTR(dot+1,tezt$,".") THEN 4660   'more than one dot
4640 IF dot = 0 THEN tezt$ = LEFT$(tezt$,8) : good = 1 : RETURN
4650 IF  (dot > 1) AND (LEN(tezt$)-dot <=3)  THEN good = 1 : RETURN
4660 LOCATE posi,1:PRINT SPACE$(namelen) ; :SOUND 129,20:good=0
4670 RETURN
4680 '
4690 '-get char from set$ or return nil-
4700 IF slow THEN WHILE INKEY$<>"":WEND
4710 i$=INKEY$: WHILE i$="": i$=INKEY$ :WEND
4720 MID$(i$,1)=UPPER$(i$)
4730 IF INSTR(set$,i$)=0 THEN i$=nil$
4740 RETURN
4750 '
4760 '-erase char-
4770 IF n>0 THEN MID$(tezt$,n)=nil$:n=n-1
4780 RETURN
4790 '----------END OF INPUT---------
4800 '
4810 '---------SET UP SCREEN----------
4820 MODE 2:BORDER papercolour:INK 0,papercolour:INK 1,papercolour
4830 WINDOW#1,1,80,2,2:PEN#1,0:PAPER#1,1:CLS#1
4840 WINDOW#1,20,60,1,3:CLS#1
4850 LOCATE#1,8,2:PRINT#1,"- MULTI COLUMN  FORMATTER -" ,
4860 WINDOW#1,1,1,2,25:CLS#1
4870 WINDOW#1,80,80,2,25:CLS#1
4880 WINDOW#1,1,80,25,25:CLS#1
4890 PEN 1:PAPER 0
4900 LOCATE 20,8: PRINT s3$ ;nc
4910 LOCATE 20,9: PRINT s4$ ;cw
4920 LOCATE 20,10:PRINT s5$ ;lm
4930 LOCATE 20,11:PRINT s6$ ;cm
4940 LOCATE 20,12:PRINT s9$ ;rm
4950 LOCATE 20,13:PRINT s7$ ;equ$
4960 LOCATE 20,14:PRINT s10$;head$
4970 LOCATE 20,15:PRINT s14$;pagnum
4980 LOCATE 20,16:PRINT s15$;frobac$
4990 LOCATE 20,17:PRINT s11$;pll
5000 LOCATE 20,18:PRINT s8$ ;lpp
5010 LOCATE 20,19:PRINT s12$;font
5020 LOCATE 20,20:PRINT s13$;single$
5030 LOCATE 20,5 :PRINT s1$ ;infile$
5040 LOCATE 20,6 :PRINT s2$ ;outfile$
5050 WINDOW#0,2,80,25,25:PEN 0:PAPER 1            'command line
5060 WINDOW#2,1,80,1,24:PEN#2,1:PAPER#2,0         'menu
5070 WINDOW#3,4,77,22,23:PEN#3,1.PAPER#3,0        'header
5080 MOVE  16,24
5090 DRAW 624,24,1
5100 DRAW 624,72
5110 DRAW  16,72
5120 DRAW  16,24
5130 MOVE  15,24
5140 DRAW  15,72
5150 MOVE 625,24
5160 DRAW 625,72
5170 IF head$=LEFT$(yesno$,1) THEN PRINT#3,header$ ;
5180 INK 1,pencolour
5190 RETURN
5200 '--------------------------------
5210 '
5220 '--------INITIALISATIONS---------
5230 AZ$="ABCDEFGHIJKLMNOPQRSTUVWXYZ"
5240 NO9$="0123456789"
5250 bb$=CHR$(7)  'bell
5260 cr$=CHR$(13):tabb$=CHR$(9) 'carriage return, tab
5270 clr$=CHR$(16):del$=CHR$(127) 'clear, delete
5280 nil$=CHR$(0):esc$=CHR$(27)
5290 com$=clr$+del$+cr$
5300 IF disc THEN namelen=12 ELSE namelen=16
5310 '
5320 'printer control codes
5330 maxfon=5  'available number of fonts
5340 DIM pcode$[maxfon]
5350 pcode$[0]=esc$+"@"            'printer reset
5360 pcode$[1]=esc$+"B"+CHR$(1) 'pica
5370 pcode$[2]=esc$+"B"+CHR$(2) 'elite
5380 pcode$[3]=esc$+"B"+CHR$(3) 'condensed
5390 pcode$[4]=esc$+"B"+CHR$(4) 'NLQ
5400 pcode$[5]=esc$+"S"+CHR$(1)+esc$+"A"+CHR$(6)+pcode$[3] 'condensed subscript
5410 '
5420 'translate these strings to your local language/dialect
5430 empty$="< no name >"
5440 SCR$="SCREEN"
5450 PRI$="PRINT"
5460 yesno$="YN"
5470 frobaset$="-FB" 'equal/front/back page
5480 inp$="input"
5490 inp1$="0 < input < 256 : "
5500 inp2$="0 <= input < 256 : "
5510 s1$=" input file name: ":s1$=s1$+SPACE$(21-LEN(s1$))
5520 s2$=" output file name: ":s2$=s2$+SPACE$(21-LEN(s2$))
5530 s3$=" number of columns: ":s3$=s3$+SPACE$(20-LEN(s3$))
5540 s4$=" columnwidth: ":s4$=s4$+SPACE$(20-LEN(s4$))
5550 s5$=" left margin: ":s5$=s5$+SPACE$(20-LEN(s5$))
5560 s6$=" centre margin: ":s6$=s6$+SPACE$(20-LEN(s6$))
5570 s7$=" equal columns: ":s7$=s7$+SPACE$(21-LEN(s7$))
5580 s8$=" lines per page: ":s8$=s8$+SPACE$(20-LEN(s8$))
5590 s9$=" right margin: ":s9$=s9$+SPACE$(20-LEN(s9$))
5600 s10$=" header: ":s10$=s10$+SPACE$(21-LEN(s10$))
5610 s11$=" page length. ":s11$=s11$+SPACE$(20-LEN(s11$))
5620 s12$=" font: ":s12$=s12$+SPACE$(20-LEN(s12$))
5630 s13$=" single sheets: ":s13$=s13$+SPACE$(21-LEN(s13$))
```

PROGRAM FILE

```
5640 s14$=" page numbers  " s14$=s14$+SPACE$(20-LEN(s14$))
5650 s15$=" front/back pages  ":s15$=s15$+SPACE$(21-LEN(s15$))
5660 warning1$=b$+"input and output file have equal names. Ok ?  Y / N: "
5670 message1$="filename: "
5680 message2$="'"+SCR$+"', '"+PRI$+"' or filename: "
5690 message3$="0 (no new font) or font number <="+STR$(maxfon)+" : "
5700 message4$=b$+"press key for next page "
5710 message5$="print on single sheets ?  Y / N. "
5720 message6$=b$+"feed fresh sheet, then press a key"
5730 message7$="equal columns on last page ?  Y / N. "
5740 message8$="header ?  Y / N: "
5750 message9$="0 (no page numbers) or first page number : "
5760 message10$=b$+"change input ?  Y / N: "
5770 message11$="line width > 255 characters; re-enter data "
5780 message12$="-= no difference ; start with: F= front , B= back page  . "
5790 message13$="PLEASE WAIT"
5800 message14$=b$+"rerun program ?  Y / N: "
5810 IF disc THEN RETURN  'else adjust messages
5820 message1$="press <TAB> (= no name) or enter "+message1$
5830 message2$="<TAB>, "+message2$
5840 RETURN
5850 '---------------------------------
5860 '
5870 '-------DEFAULT VALUES-----------
5880 'change these as you like
5890 pencolour=13       'white
5900 papercolour=0      'black
5910 disc=0             'no disc drive
5920 slow=1             'no keyboard look ahead
5930 nc=2               'number of columns
5940 cw=40              'column width
5950 lm=8               'left margin
5960 cm=4               'centre margin
5970 rm=4               'right margin
5980 header$="A Risk Analysis: Will The Barking Computer Bite ?"
5990 equ$="N"           'not equal height columns
6000 head$="Y"          'header
6010 infile$=""
6020 outfile$="SCREEN"  'output going to screen
6030 pll=66             'page length in lines (for 11" paper)
6040 lpp=60             'print 'lpp' lines per page (lpp <= pll)
6050 pagnum=1           'pagenumbering starts at 1
6060 font=0             'no change of font
6070 frobac$="-"        'no front/back pages
6080 single$="Y"        'single sheets
6090 RETURN
```

QL Sounds Good

by Rhys Miles

The purpose of this program is to make it easy to calculate values for the BEEP statements. The program displays the values for the parameters as bars; these bars can be easily raised and lowered to test the different sounds.

The values are changed using the Up and Down keys — the longer the keys are held down, the faster the rate of change. This is needed for the duration and grad_y parameters, due to the wide range of possible values. Pressing the space bar moves on to the next parameter to the right, with an asterisk indicating the current parameter. Only the current parameter can be altered. Pressing F5 produces a sound using the values, while F4 cancels the sound.

The program has four main parts: the title screen; bar drawing; keyboard scanning; and the main routine. The bar-drawing procedure accepts two parameters — x as the x coordinate of the bar and y as the height of the bar. The keyboard procedure scans the keyboard to see if Up, Down, Space, F4 or F5 are being pressed. The procedure is only exited if the Up, Down or Space keys are pressed since F4 and F5 are dealt with within the procedure.

The main part of the program starts by setting up the screen and the window size, and drawing the eight boxes for the bars. The main loop of the program repeatedly calls draw_bar and key. The program can only be exited by breaking in.

```
140 MODE 4
150 CSIZE 0,0
160 WINDOW #1,512,256,0,0
170 PAPER 0
180 INK 7
190 CLS
200 title screen
210 CLS
220 REMark Draw eight bo es
230 FOR i=10 TO 178 STEP 136/8
240 LINE i,10 TO i+10,10 TO i+10,100
250 LINE TO i,100 TO i,10
260 NEXT i
270 RESTORE (80)
280 CSIZE 0,0
290 REMark Data for the title$
```

PROGRAM FILE

```
300 DATA "duration","pitch","pitch 2","grad x","grad y","wrap","fuzzy","random"
310 FOR f=7 TO 78 STEP 78/8
320 READ a$
330 a$=a$&CHR$(189):REMark chr$(189)="="
340 REMark Routine to print the titles vertically
350 FOR n=1 TO LEN (a$)
360 AT n,f:PRINT a$(n)
370 NEXT n
380 NEXT f
390 REMark dimension and set arrays
400 DIM param(8)
410 DIM paramsc(8)
420 DIM low_limit(8)
430 DIM high_limit(8)
440 FOR f=1 TO 8
450  READ param(f)
460  READ paramsc(f)
470  READ low_limit(f)
480  READ high_limit(f)
490 NEXT f
500 REMark Initial data for arrays
510 DATA 0,90/32767,0,32767,0,90/255,0,255,0,90/255,0,255,0,90/32767,0,32767,...?
0/15,-8,7,0,90/15,0,15,0,90/15,0,15,0,15,0,90/15,0,15
520 c=1
530 plus=1
540 REPeat loop
550  FOR f=1 TO 8
560   BEEP 500,20
570   AT 21,7+((f-1)*9.75)
580   PRINT "
590   IF f=5 THEN draw_bar 87,8,((param(5)*paramsc(5)/32768)*100 TO 87
600   draw_bar (19.8+(17*(f-1))),((param(f)*paramsc(f))*10)
610   keys=0
620   key
630   IF keys=1 THEN param(f)=param(f)+c
640   IF keys=2 THEN param(f)=param(f)-c
650   IF keys=3 THEN
660    AT 21,7+((f-1)*9.75)
670    PRINT " "
680    GO TO 780
690   END IF
700 REMark Test if the value of the parameter is above the MAX limit
710   IF param(f)>high_limit(f) THEN param(f)=high_limit(f)
720 REMark Test if the value of the parameter is below the MIN limit
730   IF param(f)<low_limit(f) THEN param(f)=low_limit(f)
740   AT 21,7+((f-1)*9.75)
750 REMark Print the new value
760   PRINT param(f)
770   GO TO 590
780  NEXT f
790 END REPeat loop
800 STOP
810 REMark The procedure that draws the bars
820 DEFine PROCedure draw_bar (x,y)
830 INK 7
840 REMark Draw box and fill it in
950 FILL 1
860 LINE x-4,10 TO x,10
870 LINE TO x,y TO x-4,y TO x-4,10
880 FILL 0
890 INK 0
900 FILL 1
910 LINE x-4,y+1 TO x,y+1
920 LINE TO x,100 TO x-4,100
930 LINE TO x-4,y+1
940 FILL 0
950 INK 7
960 OVER 0
970 END DEFine
980 REMark The procedure that scans the keyboard
990 DEFine PROCedure key
1000 LOCal k
1010 k=KEYROW(1)
1020 c=c+plus
1030 IF c>2000 THEN c=2000:plus=plus-1
1040 IF KEYROW(0)=32 THEN BEEP param(1),param(2),param(3),param(4),param(5),para
m(6),param(7),param(8)
1050 IF KEYROW(0)=1 THEN BEEP
1060 IF k<>0 THEN GO TO 1100
1070 c=1
1080 plus=1
1090 GO TO 1010
1100 plus=plus+1
1110 IF k=4 THEN
1120   keys=1
1130   END DEFine
1140 END IF
1150 IF k=128 THEN
1160   keys=2
1170   END DEFine
1180 END IF
1190 IF k=64 THEN
1200   keys=3
1210   END DEFine
1220 END IF
1230 GO TO 1010
1240 END DEFine
1250 STOP
1260 REMark The procedure for the title screen
1270 DEFine PROCedure title_screen
1280 AT 0,35:PRINT "Sounds Good"
1290 AT 1,39:PRINT "by"
1300 AT 22,32:PRINT "Press space bar"
1310 REMark Change to a larger character size
1320 CSIZE 2,1
1330 x=0:y=0:x1=450:y1=0:c=0
1340 OVER 1
1350 REPeat loop
1360 INK c
1370 REMark Move the cursor one pixel
1380 CURSOR x,y
1390 PRINT "Rhys"
1400 CURSOR x1,y1
1410 PRINT "Miles"
1420 x=x+1:y=y+1:x1=x1-1:y1=y1+1:c=c+1
1430 IF x=237 THEN EXIT loop
1440 REMark Make a small beep
1450 BEEP .5,c
1460 IF c>7 THEN c=0
1470 REMark Exit if space is pressed
1480 IF INKEY$(0)=" " THEN INK 7:END DEFine
1490 END REPeat loop
1500 END DEFine
```

PROGRAM FILE

Turbo Pascal Circuit Validation

by Mark Needham

This program allows you to design and test simple logic circuits that comprise AND, NAND, OR, NOR and INVERTER-type gates with up to six different input lines and up to three different output lines. This could be of use in school lessons on logic circuits where the actual components are not available, or where it isn't possible to supply the components as they are easily damaged.

To make option selection easy, an arrow is moved around the screen using the cursor keys up, down, left and right. To select an option, move the arrow just underneath the word and press Return.

The master menu has six options:

EXIT — leave the Circuit Validation Program
LOAD — load a pre-saved circuit
SAVE — save the current circuit
CLEAR — clear the current circuit
EDIT — edit the current circuit
PROCESS — calculate for the current circuit the outputs produced by all combinations of inputs

Editing the circuit

The EDIT menu has five options:

RETURN — returns to the Master menu
GATE ADD — add a gate
GATE REMOVE — remove a gate
TRACK ADD — add a track
TRACK REMOVE — remove a track

To add a gate, select the GATE ADD option by moving the arrow to the word ADD on the left of the screen and press Return. The top line will change to display a list of gate types; move the arrow to the gate type you want and press Return. The RETURN option will get you back to the EDIT menu. Now move the arrow around the middle portion of the screen (the grid) to where you want the gate to be placed. If at any time you want to change the gate type, move the arrow to the top row and re-select the gate. The gate type you have chosen will appear on the bottom line of the screen. If you put a gate on top of another gate, the old gate is removed, thus allowing you to modify the circuit without having to redraw it.

Removing a gate is achieved by selecting the REMOVE option, then moving the arrow on top of the gate to be removed and pressing Return. You will be asked to confirm the removal. Any tracks attached to that gate will also be removed.

Adding tracks is slightly more complex. First, select the ADD TRACK option by moving the arrow to the word ADD and pressing Return. You must now select the gate or input connector (A . . . F) from where the track is to start. Press Return when the arrow is over the required position. Now move the arrow to select the gate or output connector (X . . . Z) to where the track is to go. Again press Return.

If there are no tracks coming from the selected start gate, a line will appear joining the two gates/connectors. You must now straighten the line if it isn't already straight; this is done by using the cursor keys. To put a corner on the line, press the Space key; to finish, press the Return key. The line must be straight before you finish.

If there's a track coming from the start gate or the chosen connector, a circle will appear. This is a track solder blob that must be moved using the cursor right key along the track to where you want the new track to start from. Press Return to fix the blob, or S to start from the beginning again. When you have fixed the blob, a line will appear which must be straightened as described above.

Removing tracks is similar again: simply select the gate or connector from where the track starts, and then select the gate or connector from where the track ends. You will be asked to confirm the removal of the track.

Loading or saving the circuit

Select the LOAD or SAVE option, then enter the name of the file you want to load or save. A normal MS-DOS filename is required. Press Return alone to abort the load or save.

Processing the circuit

When the circuit has been designed, its output can be generated. This is done by selecting the PROCESS option from the Master menu. The output can go to screen (press 'N') or printer (press 'Y'). Firstly, for each output connector that is connected, its definition is displayed. These definitions are not the standard way logic expressions are displayed — that would require too much code. The minus signs would normally be a horizontal bar over the bracketed expression following them. Following the definitions are every combination of input for those input connectors that are connected to a gate, and the output produced by the circuit for each of the output connectors.

PROGRAM FILE

```
const
  MaxBytes = 326; CC = 1; keyUp = #141; Keydown = #142; xeyLeft = #143;
  KeyRight = #144; Ret = #13; Space = #32; ESC = #27; Bell = #7; FFeed = #12;

  AddComp = 3; ResComp = 4; AddTrak = 6; ResTrak = 7; Erase = 5;
  GateType : set of byte = [2,3,4,5,6,7];
  Join : array[0..5] of char = ('-','-','-','+','+','+');
  LowRange = 65; TopRange = 78;
  Con : array[0..6] of integer = (9,13,5,11,7,15,3);

type
  ShapePtr     = ^ShapeDef;                    { Ptr to shapes on heap }
  ShapeDef     = array[1..MaxBytes] of byte;   { Array for shapes on heap }
  SubLinePtr   = ^SubLineDef;
  SubLineDef   = record
                   SX,SY,EX,EY : integer;      { Info for lines on screen }
                   Ptr : SubLinePtr;
                 end;
  LinePtr      = ^LineDef;
  LineDef      = record                        { Info for tracks }
                   SCol,SRow,ECol,ERow : integer;
                   PutBlob : boolean;          { Start with blob ? }
                   SLPtr : SubLinePtr;
                   LPtr : LinePtr;
                 end;
  GateTypes    = (NONE,ANDGATE,NANDGATE,ORGATE,NORGATE,INVERTER);
  CommandTypes = (Option,InputLetter,OutPutLetter,Grid,Zilch);
  Strfield     = string[240];

const MultiInputs : set of GateTypes = [ANDGATE,NANDGATE,ORGATE,NORGATE];
var
  GridFile : Text;
  TempLine,JoinLine,StartLine,WorkLine,LastLine          : LinePtr;
  WSLine,LSLine                                          : SubLinePtr;
  TopHeap,StartData                                      : ^integer;
  Command                                                : CommandTypes;
  Abort,Value,AddBlob,GoBack,ExitProg,Exit               : boolean;
  CX,CY,StartX,StartY,EndX,EndY,ArrowCol,ArrowRow,
  CommandNum,GateNum,StartCol,StartRow,EndCol,EndRow,
  Mem,T,Eptr,i,FirstCol,LastCol,Column,row,NumInputs,
  NumOutputs,loop,OutDev                                 : integer;
  key,c                                                  : char;
  Skip                                                   : set of byte;
  Ex,Stk,Expr,Fname,CurCircuit                           : strfield;
  GateShape    : array [ANDGATE..INVERTER] of ShapePtr;
  Connections : array[1..8,1..6] of byte;
  State        : array[LowRange..TopRange] of char;
  UseInp       : array[LowRange..TopRange] of boolean;
  UseOut       : array[1..3] of boolean;
  DefOut       : array[1..3] of Strfield;
  GridInfo     : array[1..8,1..6] of GateTypes;
  GateDefs     : array[1..8,1..6] of strfield;

FUNCTION ConvGate(c : GateTypes) : Strfield;
begin
  case c of
  NONE     : ConvGate := '    ';   ANDGATE  : ConvGate := 'AND ';
  NANDGATE : ConvGate := 'NAND';   ORGATE   : ConvGate := 'OR  ';
  NORGATE  : ConvGate := 'NOR ';   INVERTER : ConvGate := 'INV ';
  end
end;
PROCEDURE Beep; begin write(Bell) end;
PROCEDURE ExitPos; begin ArrowCol := 8; ArrowRow := 1 end;
PROCEDURE Sp(n : integer); begin for i := 1 to n do write(Space) end;
PROCEDURE Clr8; begin gotoxy(1,1); Sp(79) end;
PROCEDURE Clr25; begin gotoxy(1,25); Sp(79) end;
PROCEDURE InvColour; begin ColorTable(1,0,0,0) end;
PROCEDURE NoreColour; begin ColorTable(0,1,2,3) end;
FUNCTION ColPos(x : integer) : integer; begin ColPos := 64 + (x-1)* 64; end;
FUNCTION RowPos(x : integer) : integer; begin RowPos := 24 + (x-1)* 24; end;
PROCEDURE Blob(x,y,c : integer); begin for i := 1 to 4 do circle(x,y,i,c) end;

PROCEDURE ArrowHome;
begin if ArrowRow = 1 then begin ArrowRow := 4; ArrowCol := 1 end end;

FUNCTION KeyGet: char;
var keyPress: char;
begin
  read(kbd,KeyPress);
  if (KeyPress = ESC) and KeyPressed then begin
    read(kbd,KeyPress);
    case KeyPress of
    #72: KeyPress := keyUp;       #75: KeyPress := keyLeft;
    #80: KeyPress := KeyDown;     #77: KeyPress := KeyRight;
    else KeyPress := #0
    end
  end;
  keyGet := KeyPress
end;

FUNCTION GetYESorNo(S : Strfield) :boolean; { Wait for 'Y' or 'N' }
begin
  Clr25; gotoxy(28-length(S) div 2,25);
  write('Confirm ',S,' (Y)es or (N)o ? ');
  repeat key := upcase(KeyGet) until key in ['Y','N']; Clr25;
  GetYESorNo := key = 'Y'
end;

PROCEDURE Error(ERnum : integer);
begin
  Clr25; gotoxy(15,25); Beep;
  case ERnum of
  1 : write('GATES WITH LESS THAN 2 INPUTS');
  2 : write('NO OUTPUTS SPECIFIED');
  3 : write('FILE ',Fname,' NOT FOUND')
  end;
  write(' - PRESS RETURN TO CONTINUE '); read(kbd,c); Clr25
end;

PROCEDURE DrawBasicOR;       { Draw an OR gate at the top of the screen }
begin
  draw(0,0,15,0,CC); draw(0,19,13,19,CC); draw(13,0,13,19,CC);
  circle(-5,9,11,CC); FillShape(10,9,CC,CC); circle(15,9,10,CC);
  FillShape(10,9,CC,CC)
end;

PROCEDURE DrawBasicAND;      { Draw an AND gate at the top of the screen }
begin
  draw(0,0,13,0,CC); draw(0,0,0,19,CC); draw(0,19,13,19,CC);
  circle(13,9,10,CC); fillshape(13,9,CC,CC); fillshape(1,1,CC,CC)
end;
```

PROGRAM FILE

```
PROCEDURE DrawInverter;      ( Draw an INVERTER )
begin
  draw(5,4,5,15,CC); draw(20,9.5,15,CC); draw(20,9.5,4,CC);
  FillShape(10,9,CC,CC);
  circle(23,9,3,CC); draw(0,9,5,9,CC); draw(27,9,31,9,CC)
end;

PROCEDURE DesignComponents;
begin
  DrawBasicAND; draw(0,9,31,9,CC);
  new(GateShape[ANDGATE]); GetPic(GateShape[ANDGATE]^,0,0,31,19);
  FillScreen(0); DrawBasicAND; circle(27,9,4,CC);
  new(GateShape[NANDGATE]); GetPic(GateShape[NANDGATE]^,0,0,31,19);
  FillScreen(0); DrawBasicOR; draw(10,9,31,9,CC);
  new(GateShape[ORGATE]); GetPic(GateShape[ORGATE]^,0,0,31,19);
  FillScreen(0); DrawBasicOR; circle(27,9,4,CC);
  new(GateShape[NORGATE]); GetPic(GateShape[NORGATE]^,0,0,31,19);
  FillScreen(0); DrawInverter;
  new(GateShape[INVERTER]); GetPic(GateShape[INVERTER]^,0,0,31,19)
end;

PROCEDURE DrawArrow(AtX,AtY : integer);    ( Draw pointer using ColorTable )
begin
  draw(AtX+8,AtY+0,AtX+0,AtY+5,-1);       draw(AtX+0,AtY+5,AtX+4,AtY+5,-1);
  draw(AtX+4,AtY+5,AtX+4,AtY+10,-1);      draw(AtX+4,AtY+10,AtX+12,AtY+10,-1);
  draw(AtX+12,AtY+10,AtX+12,AtY+5,-1);    draw(AtX+12,AtY+5,AtX+16,AtY+5,-1);
  draw(AtX+16,AtY+5,AtX+8,AtY+0,-1)
end;

PROCEDURE DrawMasterOptions;      ( Master Options )
begin
  Clr25; gotoxy(20,25);
  if CurCircuit = '' then write('Circuit Validation Utility by Mark Needham.')
  else write('Current Circuit : ',CurCircuit);
  Clr01; gotoxy(5,1);
  write('Master Options :   PROCESS  SAVE    EDIT    CLEAR    LOAD    EXIT');
  FirstCol := 3; LastCol := 8; Skip := [)
end;

PROCEDURE DrawEditOptions;    ( Editing options )
begin
  Clr25; Clr01; gotoxy(3,1); ExitPos;
  write('Edit Options : GATES  ADD   REMOVE    TRACKS  ADD   REMOVE  RETURN');
  FirstCol := 3; LastCol := 8; Skip := [5]
end;

PROCEDURE DrawGateOptions;
begin
  Clr01; gotoxy(8,1); ExitPos;
  write('Gates :  AND    NAND     OR      NOR    INVERTER        RETURN');
  Clr25; gotoxy(8,25);
  write('Select Gate Type :       Then Select Position on Grid');
  FirstCol := 2; LastCol := 8; Skip := [7]
end;

PROCEDURE DrawRemoveGateOptions;
begin
  ArrowHome; Clr01; gotoxy(63,1); write('RETURN');
  FirstCol := 8; LastCol := 8; Skip := [)
end;

PROCEDURE DrawStartTrackOptions;
begin
  DrawRemoveGateOptions;    ( they are the same )
  Clr25; gotoxy(25,25); write('Select Start Gate or Input Letter')
end;

PROCEDURE DrawEndTrackOptions;
begin
  ArrowHome; gotoxy(40,1); write('ERASE'); Clr25; gotoxy(8,25);
  write('Select End Gate or Output Letter, Select ERASE to Re-select Start');
  FirstCol := 5; LastCol := 8; Skip := [6,7]
end;

PROCEDURE DrawTrackJoinOptions;
begin
  FirstCol := 8; LastCol := 8; Skip := [); Clr01; Clr25; gotoxy(4,25);
  write('RETURN to fix blob   S to restart   Cursor Right to Move'+
        '   ESC to Abort')
end;

PROCEDURE DrawCircuitBoard;   ( Draw the INPUT & OUTPUT letters )
begin
  FillScreen(0);
  for i := 1 to 6 do begin gotoxy(1,2+(i * 3)); write(chr(64+i)) end;
  for i := 1 to 3 do begin gotoxy(78,2+(i * 6)); write(chr(87+i)) end;
  gotoxy(1,22); write('INPUTS'); gotoxy(72,22); write('OUTPUTS')
end;

PROCEDURE ReDrawCircuit;   ( Redraw the whole circuit )
begin
  DrawCircuitBoard;
  for column := 1 to 8 do for row := 1 to 6 do
    if GridInfo[Column,row] <> None then
      PutPic(GateShape[GridInfo[Column,row]]^,ColPos(Column),RowPos(Row+1));
  WorkLine := StartLine^.LPtr;
  while WorkLine <> nil do begin              ( loop for all tracks )
    with WorkLine^ do begin
      if PutBlob then Blob(SLPtr^.SX,SLPtr^.SY,1);
      WSLine := SLPtr;
      while WSLine <> nil do begin
        with WSLine^ do draw(SX,SY,EX,EY,1);
        WSLine := WSLine^.Ptr
      end;
    end;
    WorkLine := WorkLine^.LPtr              ( Get next track in list )
  end
end;

PROCEDURE PosArrow;
begin
  if ArrowRow > 3 then begin
    if ArrowCol = 9 then DrawArrow(624,RowPos(ArrowRow-3)+10)
    else
      if ArrowCol > 0 then DrawArrow(ColPos(ArrowCol),RowPos(ArrowRow-3)+10)
      else DrawArrow(4,RowPos(ArrowRow-3)+10)
  end
  else DrawArrow(ColPos(ArrowCol),8);
end;

PROCEDURE UpToTop;  ( Moving arrow up to the top option row )
```

PROGRAM FILE

```
begin
  ArrowRow := 1;
  if ArrowCol < FirstCol then ArrowCol := FirstCol;
  if ArrowCol > LastCol then ArrowCol := LastCol;
  while ArrowCol in Skip do ArrowCol := succ(ArrowCol);
end;

PROCEDURE CheckLastColUp;  { Moving arrow up at OUTPUT letters }
begin
  if ArrowRow = 5 then UpToTop
  else begin
    if ArrowRow = 7 then ArrowRow := 5;
    if ArrowRow = 9 then ArrowRow := 7;
  end
end;
PROCEDURE CheckLastColDown;
begin if ArrowRow mod 2 = 0 then ArrowRow := succ(ArrowRow) end;

PROCEDURE GetOption;   { Main routine to move arrow pointer around screen }
begin
  InvColour;   { Set inverse colour mode }
  repeat
    PosArrow; key := KeyGet; PosArrow;
    case key of
    Ret       : if ArrowRow = 1 then begin
                  Command := Option; CommandNum := ArrowCol
                end
                else
                  if ArrowCol = 0 then begin
                    Command := InputLetter; CommandNum := ArrowRow;
                  end
                  else
                    if ArrowCol = 9 then begin
                      Command := OutputLetter; CommandNum := ArrowRow;
                    end
                    else Command := Grid;
    KeyUp     : if ArrowCol = 9 then CheckLastColUp
                else
                  if ArrowRow > 4 then ArrowRow := pred(ArrowRow)
                  else UpToTop;
    KeyDown   : if ArrowRow = 1 then ArrowRow := 4
                else begin
                  if ArrowRow < 9 then ArrowRow := succ(ArrowRow);
                  if ArrowCol = 9 then CheckLastColDown;
                end;
    KeyLeft   : if ArrowRow = 1 then begin
                  if ArrowCol > FirstCol then begin
                    ArrowCol := pred(arrowCol);
                    while ArrowCol in Skip do ArrowCol := pred(ArrowCol)
                  end
                end
                else if ArrowCol > 0 then ArrowCol := pred(ArrowCol);
    KeyRight  : if ArrowRow = 1 then begin
                  if ArrowCol < LastCol then begin
                    ArrowCol := succ(ArrowCol);
                    while ArrowCol in Skip do ArrowCol := succ(ArrowCol)
                  end
                end
                else begin
                  if ArrowCol < 9 then ArrowCol := succ(ArrowCol);
                  if ArrowCol = 9 then CheckLastColDown;
                end
    end; { case }
  until key = ret;
  NormColour;
end;

FUNCTION CheckExit : boolean;
begin CheckExit := (Command = Option) and (CommandNum = LastCol) end;

PROCEDURE DoAdd;          { Add a gate to the grid, or overwrite another }
var Comp : GateTypes;
begin
  Exit := true; Comp := GateTypes(GateNum);
  if (Comp = INVERTER) and (Connections[ArrowCol,ArrowRow-3] > 1) then beep
  else begin
    GridInfo[ArrowCol,ArrowRow-3] := Comp;
    PutPic(GateShape[Comp]^,ColPos(ArrowCol),RowPos(ArrowRow-2))
  end
end;
PROCEDURE SetGate;  { Specify gate type }
begin
  GateNum := pred(CommandNum);
  gotoxy(27,25); write(ConvGate(GateTypes(GateNum)))
end;

PROCEDURE AddComponent;   { Main routine to add a gate }
begin
  DrawGateOptions; Exit := false;
  repeat
    GetOption;
    if (Command = Option) and (CommandNum in GateType) then begin
      SetGate;
      repeat
        GetOption;
        if (Command = Option) and (CommandNum in GateType) then SetGate
      until CheckExit or (Command = Grid);
      if Command = Grid then DoAdd
    end
  until CheckExit or Exit;
  CommandNum := 0
end;

PROCEDURE DoAddTrack;      { main routine to add a track }
var Move,First : boolean;

  PROCEDURE NewSubLine;
  begin
    new(WSLine);
    if First then WorkLine^.SLPtr := WSLine else LSLine^.Ptr := WSLine;
    LSLine := WSLine; First := false;
  end;

  FUNCTION CheckStraight : boolean;
  begin CheckStraight := (StartX-CX = 0) or (StartY-CY = 0) end;

  FUNCTION LineNotStraight : boolean;
  begin
    LineNotStraight := Not CheckStraight or
                       Not ((CX-EndX = 0) or (CY-EndY = 0))
  end;
```

PROGRAM FILE

```
begin
  Invcolour; EndX := ColPos(EndCol);
  Clr25; gotoxy(5,25);
  write('Straighten the line. SPACE for corner  RETURN to End  ESC to Abort');
  if EndCol = 9 then EndY := RowPos(EndRow-2)-10
  else
    if GridInfo[EndCol,EndRow-3] <> INVERTER then
      EndY := RowPos(EndRow-2)-19+Con[Connections[EndCol,EndRow-3]]
    else
      EndY := RowPos(EndRow-2)-10;
  new(WorkLine);
  with WorkLine^ do begin
    LPtr := nil; PutBlob := AddBlob;
    SCol := StartCol; SRow := StartRow;
    ECol := EndCol;   ERow := EndRow;
    SLPtr := nil
  end;
  CX := StartX; CY := StartY; First := true; Move := false;
  if AddBlob then Blob(StartX,StartY,1);
  repeat
    draw(StartX,StartY,CX,CY,-1); draw(CX,CY,EndX,EndY,-1);
    key := KeyGet;
    draw(StartX,StartY,CX,CY,-1); draw(CX,CY,EndX,EndY,-1);
    if key in [KeyLeft,KeyRight,KeyUp,KeyDown] then Move := true;
    case key of
    KeyUp    : CY := CY - 2;
    KeyDown  : CY := CY + 2;
    KeyRight : if CX + 2 <= EndX then CX := CX + 2;
    KeyLeft  : if CX - 2 >= StartX then CX := CX - 2;
    Space    : if Move and CheckStraight then begin
                 NewSubLine;
                 with WSLine^ do begin
                   SX := StartX; SY := StartY; EX := CX; EY := CY; Ptr := nil
                 end;
                 draw(StartX,StartY,CX,CY,1); StartX := CX; StartY := CY;
                 Move := false
               end else Beep;
    Ret      : if LineNotStraight then begin Beep; key := #0 end;
    end;
  until (key = ret) or (Key = ESC);
  if Key <> ESC then begin
    if (CX <> StartX) or (CY <> StartY) then begin
      NewSubLine;
      with WSLine^ do begin
        SX := StartX; SY := StartY; EX := CX; EY := CY; Ptr := nil
      end
    end;
    NewSubLine;
    with WSLine^ do begin
      SX := CX; SY := CY; EX := EndX; EY := EndY; Ptr := nil
    end;
    draw(StartX,StartY,CX,CY,1); draw(CX,CY,EndX,EndY,1);
    if EndCol < 9 then
      Connections[EndCol,EndRow-3] := succ(Connections[EndCol,EndRow-3]);
    LastLine^.LPtr := WorkLine; LastLine := WorkLine;
  end else Abort := true;
  NormColour
end;

FUNCTION CheckForTracks : boolean;    { Check for a track to see if a blob }
var found : boolean;                  { is required. }
begin
  Found := false;
  WorkLine := StartLine^.LPtr;
  while WorkLine <> nil do begin
    with WorkLine^ do
      if (SCol = StartCol) and (SRow = StartRow) and Not Found then begin
        Found := true; JoinLine := WorkLine
      end;
    WorkLine := WorkLine^.LPtr
  end;
  CheckForTracks := Found
end;

FUNCTION Sgn(v : integer) : integer;
begin if v = 0 then Sgn := 0 else if v > 0 then Sgn := 2 else Sgn := -2 end;

PROCEDURE MovePointer;                          { Move blob pointer routine }
var x,y,HM,VM : integer; AtStart,AtEnd : boolean;
begin
  AtStart := true; AtEnd := false; AddBlob := true;
  DrawTrackJoinOptions;
  WSLine := JoinLine^.SLPtr;
  with WSLine^ do begin
    x := SX; y := SY; HM := Sgn(EX-SX); VM := Sgn(EY-SY);
  end;
  repeat
    InvColour; circle(x,y,4,-1);
    Key := KeyGet; circle(x,y,4,-1);
    case Key of
    KeyRight : if NOT AtEnd then begin
                 x := x + HM; y := y + VM; AtStart := false
               end;
    'S','s'  : begin
                 WSLine := JoinLine^.SLPtr;
                 with WSLine^ do begin
                   x := SX; y := SY; HM := Sgn(EX-SX); VM := Sgn(EY-SY);
                 end;
               end;
    Ret      : begin StartX := x; StartY := y end
    end;
    with WSLine^ do
      if (x = EX) and (y = EY) then begin
        if WSLine^.Ptr = nil then AtEnd := true
        else begin
          WSLine := WSLine^.Ptr;
          with WSLine^ do begin
            x := SX; y := SY; HM := Sgn(EX-SX); VM := Sgn(EY-SY)
          end
        end
      end
  until (Key = Ret) or (Key = ESC);
  NormColour;
  if Key = ESC then begin Exit := true; Abort := true end
end;

PROCEDURE RemoveTrack;
begin
  if GetYESorNo('Remove') then begin
    Connections[EndCol,EndRow-3] := pred(Connections[EndCol,EndRow-3]);
```

PROGRAM FILE

```
                else AddToStr('('+GateDefs[SCol,Srow-3]+')');
                UseOut[loop] := true; AnyOut := true
              end
            end;
            WorkLine := WorkLine^.LPtr
          end;
          if Strg[1] <> '(' then Strg := '('+Strg+')';
          DefOut[loop] := Strg+'='
        end;
      if NOT AnyOut then Error(2)
      else begin
        OutDev := ord(GetYESorNo('Output to Printer')); DisplayTable
      end
    end;

    FUNCTION CheckGatesOK : boolean;
    begin
      CheckGatesOk := true;
      for Column := 1 to 8 do for row := 1 to 6 do
        if (GridInfo[Column,Row] in MultiInputs) and
           (Connections[Column,Row] < 2) then CheckGatesOk := false;
    end;

    PROCEDURE ReaComponent;
    begin
      Exit := false; DrawRemoveGateOptions;
      repeat
        Clr23; gotoxy(25,25); write('Select Gate to Remove');
        repeat GetOption until CheckExit or (Command = Grid);
        if (Command = Grid) then
          if (GridInfo[ArrowCol,ArrowRow-3]<>None) then begin
            if GetYESorNo('Remove') then begin
              GridInfo[ArrowCol,ArrowRow-3] := None;
              Connections[ArrowCol,ArrowRow-3] := 0;
              WorkLine := StartLine^.LPtr; TempLine := StartLine;
              while WorkLine <> nil do begin
                with WorkLine^ do
                  if (ECol = ArrowCol) and (ERow = ArrowRow) then begin
                    TempLine^.Lptr := WorkLine^.LPtr;
                    if WorkLine^.LPtr = nil then LastLine := TempLine
                  end
                  else
                    if (SCol = ArrowCol) and (SRow = ArrowRow) then begin
                      TempLine^.Lptr := WorkLine^.LPtr;
                      if WorkLine^.LPtr = nil then LastLine := TempLine;
                      Connections[ECol,ERow-3] := pred(Connections[ECol,ERow-3]);
                    end else TempLine := WorkLine;
                WorkLine := WorkLine^.LPtr
              end;
              ReDrawCircuit; Exit := true
            end
          end else Beep
      until CheckExit or Exit;
      CommandNum := 0
    end;
    FUNCTION Exists(S : Strfield) : boolean;  { Does the file exist }
    var found : boolean;
    begin
      assign(GridFile,S); {$I-} reset(GridFile) {$I+};
      Found := (IOResult = 0); if Found then Close(GridFile);
      Exists := Found;
    end;

    PROCEDURE SaveGrid;
    begin
      assign(GridFile,FName); rewrite(GridFile);
      for column := 1 to 8 do for row := 1 to 6 do begin
        writeln(GridFile,ord(GridInfo[Column,row]));
        writeln(GridFile,Connections[Column,row])
      end;
      WorkLine := StartLine^.LPtr; writeln(GridFile,0);
      while WorkLine <> nil do begin
        with WorkLine^ do begin
          writeln(GridFile,Scol); writeln(GridFile,Srow);
          writeln(GridFile,ECol); writeln(GridFile,Erow);
          writeln(GridFile,Ord(PutBlob));
          WSLine := SLPtr; writeln(GridFile,0);
          while WSLine <> nil do begin
            with WSLine^ do begin
              writeln(GridFile,SX); writeln(GridFile,SY);
              writeln(GridFile,EX); writeln(GridFile,EY)
            end;
            WSLine := WSLine^.Ptr;
            writeln(GridFile,-ord(WSLine = nil))
          end
        end;
        WorkLine := WorkLine^.LPtr;
        writeln(GridFile,-ord(WorkLine = nil))
      end;
      close(GridFile); CurCircuit := FName;
    end;

    PROCEDURE LoadGrid;
    begin
      ClearGrid; assign(GridFile,FName); reset(GridFile);
      for column := 1 to 8 do for row := 1 to 6 do begin
        readln(GridFile,i); GridInfo[Column,row] := GateTypes(i);
        readln(GridFile,Connections[Column,row])
      end;
      LastLine := StartLine; readln(GridFile,i);
      while i <> -1 do begin
        new(WorkLine); LastLine^.LPtr := WorkLine; LastLine := WorkLine;
        with WorkLine^ do begin
          readln(GridFile,Scol); readln(GridFile,Srow);
          readln(GridFile,ECol); readln(GridFile,Erow);
          readln(GridFile,i); PutBlob := (i = 1); LPtr := nil;
          new(WSLine); SLPtr := WSLine; LSLine := WSLine; readln(GridFile,i);
          with WSLine^ do begin
            readln(GridFile,SX); readln(GridFile,SY);
            readln(GridFile,EX); readln(GridFile,EY);
            Ptr := nil
          end;
          readln(GridFile,i);
          while i <> -1 do begin
            new(WSLine); LSLine^.Ptr := WSLine;
            LSLine := WSLine;
            with WSLine^ do begin
              readln(GridFile,SX); readln(GridFile,SY);
              readln(GridFile,EX); readln(GridFile,EY); Ptr := nil
            end;
            readln(GridFile,i)
```

PROGRAM FILE

```
        end
      end;
      readln(GridFile,i)
    end;
    close(GridFile); RedrawCircuit; CurCircuit := Fname;
  end;

  PROCEDURE GetName(S : Strfield);
  begin
    Clr25; gotoxy(10,25); write('Enter the required file name (8 chars max)');
    Clr01; gotoxy(40,1);
    if S <> '' then write('Current Circuit = ',CurCircuit);
    gotoxy(1,1); write('Enter File Name : '); readln(FName);
  end;

  PROCEDURE MainProc;
  begin
    repeat
      DrawMasterOptions; GetOption;
      if Command = Option then
      case CommandNum of
      3 : if CheckGatesOK then Process else Error(1);
      4 : begin
            GetName(CurCircuit); if Fname <> '' then
              if NOT Exists(FName) then SaveGrid
              else if GetYESorNO('Overwrite') then SaveGrid;
          end;
      5 : begin
            repeat
              DrawEditOptions; GetOption;
              if Command = Option then
                case CommandNum of
                AddComp : AddComponent;
                RemComp : RemComponent;
                AddTrak : AddorRemTrack(AddTrak);
                RemTrak : AddorRemTrack(RemTrak);
              end else Beep
            until CheckExit;
            Command := Zilch
          end;
      6 : if GetYESorNO('Clear') then begin
            DrawCircuitBoard; ClearGrid; CurCircuit := '';
            Release(StartData); StartLine^.LPtr := nil;
            LastLine := StartLine; GoBack := true
          end;
      7 : if GetYESorNo('Load') then begin
            GetName(''); if FNAme <> '' then
              if Exists(FName) then LoadGrid else Error(3)
          end;
      8 : if GetYESorNO('Exit') then ExitProg := true;
      end else beep
    until CheckExit
  end;

  begin
    Mark(TopHeap); ExitProg := false; new(StartLine); CurCircuit := '';
    StartLine^.LPtr := nil; LastLine := StartLine;
    HiRes; DesignComponents; DrawCircuitBoard; ExitPos; ClearGrid;
    Mark(StartData);
    repeat MainProc until ExitProg;
    Release(TopHeap); TextMode(BW80);
  end.
```

PC/AT Alarm Handler

by Robert Schifreen

The following listings enable you to set an alarm on the IBM PC/AT using the clock chip. The programs are part of the feature 'Clock this!' on page 148 of this issue. *Do not attempt to run these listings before reading the entire article.*

```
;A resident interrupt handler for
;MS-DOS that  is activated when the
;alarm in an AT is triggered.
;
;This program must be run prior to
;setting alarms, or nothing will
;happen when the alarm goes off.
;
;With this program installed, an
;alarm being triggered will make
;MS-DOS beep and display  a message
;on the screen.
;
;For assembly with the Microsoft
;MACRO Assembler.
;-----------------------------
```

PROGRAM FILE

```
code    segment
assume cs:code,ds:code, es:nothing
        org 100h  ; for a .COM file.
; *** define macros ***
push_m  macro arglist
        irp   register,<arglist>
        push  register
        endm
        endm
pop_m   macro arglist
        irp   register,<arglist>
        pop   register
        endm
        endm
disp_ch  macro char
        push_m <ax,bx,cx>
        mov ah,0eh
        mov bl,0
        mov bh,0
        mov al,char
        mov cx,1
        int 10h
        pop_m <cx,bx,ax>
        endm
push_all macro
push_m <ax,bx,cx,dx,di,si,es,ds>
endm
pop_all macro
pop_m <ds,es,si,di,dx,cx,bx,ax>
endm
; *** end of macros ***
;
; *** set up equates ***
CR        equ 0Dh
LF        equ 0Ah
EOM       equ '$'
start: jmp init
intent:
;This is where the resident code
;starts, as called by an Interrupt
;4A occuring.

jmp begin
; jump round the data

sound_port  db  0
spkr_on     db  0
msg db CR,LF,' ** The time has
    come! ** ',CR,LF,EOM

begin:
; first,  do a beep.  It's not safe
;to use any MS-DOS calls in  an Int
;4A  handler  so  we'll  drive  the
;hardware directly just for fun.

  push di
  push cx
  mov di,1000    ; frequency
  call sound_on ; turn on beeper
  mov cx,65000
  delay: loop delay
; wait for 65000 cycles
  call sound_off
; and turn off the beeper
   pop cx
```

PROGRAM FILE

```
        pop di

        push bx       ; now display msg
        push si
        push ds
        push cs
        pop ds
        mov si,offset cs:msg
        mov bl,4
        call disp_str_colour
        pop ds
        pop si
        pop bx
        iret
    ; and return from the interrupt
    ; handler to continue where we left
    ; off.

    ; ***  procedures ***
         sound_on  proc
    ; turn on speaker, with frequency
    ; in di
        cmp spkr_on,1
        jne s1
        ret
    ; if on, abort procedure
    s1:     push ax
            push dx
            mov al,0b6h
            out 43h,al
            mov dx,14h
            mov ax,4f38h
            div di
            out 42h,al
            mov al,ah
            out 42h,al
            in al,61h
            mov sound_port,al
    ; save value for sound_off routine
            or al,3
            out 61h,al
            pop dx
            pop ax
            mov spkr_on,1
    ; flag spkr as being on
            ret
            sound_on   endp

    sound_off  proc
    ; proc to turn off speaker
            cmp spkr_on,1
    ; is speaker already on ?
            je s2
    ; contine if spkr is on
             ret
    ; else abort procedure
    s2:      push ax
             mov al,sound_port
             out 61h,al
             pop ax
             mov spkr_on,0
    ; flag speaker as being off
             ret
             sound_off  endp

    ; Now, a procedure to display a
```

MICROMART

PROGRAM FILE

```
        ; string, using a screen attribute
        ; that can be specified by the
        ; caller.  On entry, SI must point
        ; to the offset of the string,
        ; which must be in the CODE
        ; SEGMENT. BL should be set to the
        ; attribute required.

        ; Strings of longer than 80 chars ;
        should have a crlf at the end of
        ; each line.
        ;
        ; Terminates on ascii 0 or '$'
        ;
        disp_str_colour   proc
                push_m <ax,bx>
                mov ah,0fh
                int 10h
        ; get display page into bh
                mov cl,bh
        ; save in cl
                pop_m <bx,ax>
                mov    bh,cl
        ; recover display page
                mov   cx,1
        ; write each char once
                mov   ax,cs
                mov   ds,ax
        ; string must be in ds
                cld
        again:

                lodsb
        ; get char into al
                cmp   al,'$'
                je    done
                cmp   al,0
                je    done
                cmp   al,CR
                jne   try1
                disp_ch CR
                jmp   again
        try1:
                cmp   al,0ah
                jne   try2
                disp_ch LF
                jmp   again
        try2:
                mov   ah,09h
                int   10h
        ; display char
                push_all
                mov  ah,3
                int   10h
        ; get crsr pos
                inc   dl
                mov   ah,2
        ; set new crsr pos
                int   10h
                pop_all
                jmp again
        done:
                mov   al,20h
                mov   bl,7
                mov   ah,9
                int    10h
```

PROGRAM FILE

```
; display a space in white,
; to reset default colour. Should
; really check what default colour
; was, and save it.
        ret
disp_str_colour   endp
;
init:
; come here to install resident
; portion
    mov ah,25h
; function to set an interrupt
; vector
    mov al,4ah
; specify which vector to set
mov dx,offset intent
; specify the value to set vector
; to.
int 21h         ; and do it
mov ax,3100h  ; terminate program
; but leave some code resident
mov dx,(init-start)/16+17
; specify how much code to leave
int 21h         ; do it
;
code ends
end start
; start execution at label 'start'
; ------------------------------
;           end of program
; ------------------------------
```

```
10 ' ------------------------------
11 '    CMOS alarm clock for the
12 '    IBM AT and real AT clones.
13 ' ------------------------------
20 CLS
30 SCREEN 0
40 KEY OFF
45 REM SET COLOURS.  CHANGE TO SUIT
50 C1 = 6   ' BROWN
60 C2 = 2   ' GREEN
70 C3 = 3   ' CYAN
80 COLOR C1
90 LOCATE 12,10
100 PRINT "Q - quit program    S -
    change status";
101 PRINT "    T - set time"
110 LOCATE 13,10
120 FOR J = 1 TO 52:PRINT "=";:NEXT
130 LOCATE 2,19
140 PRINT "CMOS Alarm Clock - all
    values in hex"
150 LOCATE 3,19
160 PRINT "------------------------
    ----------"
170 LOCATE 17,25
180 COLOR C1
190 PRINT "Current time is:
200 LOCATE 18,29
210 GOSUB 790 ' show time
220 LOCATE 19,19
230 PRINT "Change with MS-DOS TIME
    command"
240 LOCATE 9,26
```

PROGRAM FILE

```
250 COLOR C3
260 PRINT "Status :"
270 OUT &H70,11
280 S = INP(&H71) ' bit 5 = status
290 LOCATE 9,35
300 IF (S AND 32) = 32 THEN PRINT
   "Enabled "ELSE PRINT "Disabled"
310 COLOR C2
320 LOCATE 5,31
330 PRINT "ALARM"
340 LOCATE 6,29
350 PRINT "hh  mm  ss"
360 FOR X = 5 TO 1 STEP -2
370 OUT &H70,X
380 D = INP(&H71)
390 D$ = HEX$(D)
400 IF LEN(D$)=1THEN D$="0"+D$
410 LOCATE 7,29+(2*(5-X))
420 PRINT D$;
430 NEXT
440 K$ = INKEY$
450 IF K$ = "" THEN 170
460 IF K$ = "Q" OR K$ = "q" THEN
    CLS : COLOR 7 : END
470 IF K$ = "S" OR K$ = "s" THEN
    GOSUB 500
480 IF K$ = "T" OR K$ = "t" THEN
    GOSUB 570
490 GOTO 170
500 ' change status
510 OUT &H70,11
520 D = INP(&H71)
530 D = D XOR 32
540 OUT &H70,11
550 OUT &H71,D
560 RETURN
570 REM set time
580 GOSUB 750
590 PRINT "Enter hex value for
    hours or ";
591 INPUT "RETURN to leave
    unchanged ";H$
600 IF H$ = "" THEN 630
610 OUT &H70,5
620 OUT &H71,VAL("&h"+H$)
630 GOSUB 750
640 PRINT "Enter hex value for
    minutes or ";
641 INPUT "RETURN to leave
    unchanged ";M$
650 IF M$ = "" THEN 680
660 OUT &H70,3
670 OUT &H71,VAL("&h"+M$)
680 GOSUB 750
690 PRINT "Enter hex value for
    seconds or ";
691 INPUT "RETURN to leave
    unchanged ";S$
700 IF S$ = "" THEN 730
710 OUT &H70,1
720 OUT &H71,VAL("&h"+S$)
730 GOSUB 750
740 RETURN
750 LOCATE 15,5
760 PRINT SPC(70)
770 LOCATE 15,10
```

PROGRAM FILE

```
780 RETURN
790 REM show time
800 FOR X = 4 TO 0 STEP -2
810 OUT &H70,X
820 J = INP(&H71)
830 J$ = HEX$(J)
840 IF LEN(J$)=1 THEN J$="0" + J$
850 LOCATE 18,27+((2*(5-X))-1)
860 PRINT J$;
870 NEXT
880 RETURN
900 ' ----------
999 '     end
1000 ' ----------
```

```
1000 ' ------------------------------
1010 '   CMOS Ram Editor for the
1020 '  IBM AT and real AT clones.
1030 '
1040 'You are strongly advised to
1050 'read the accompanying article
1060 'before running this program.
1070 '
1080 '------------------------------
1090 ' ** Set Colours. Change
       these to suit ***
1100 C1 = 6 ' BROWN
1110 C2 = 2 ' GREEN
1120 C3 = 3 ' CYAN
1130 C4 = 4 ' RED
1140 ' *** Initialise & tidy up ***
1150 CLS
1160 FLAG = 0
1170 LOCATE 1,33
1180 COLOR C1
1190 PRINT "CMOS Ram Editor"
1200 LOCATE 2,33
1210 PRINT "----------------"
1220 LOCATE 23,8
1230 PRINT "Q - Quit      H - change
     a hex value";
1240 PRINT "     B - flip a binary
     bit"
1250 FOR X = 4 TO 19
1260 FOR Y = 1 TO 61 STEP 20
1270 LOCATE X,Y
1280   GOSUB    1550     '   convert
coordinates into 0 - 63
1290 H$ = HEX$(N)
1300 IF LEN(H$) < 2 THEN H$="0"+H$
1310 COLOR C2
1320 IF FLAG=0 THEN PRINT H$;"h = "
1330 LOCATE X,Y+6
1340 OUT &H70, VAL("&h"+H$)
1350 P = INP(&H71)
1360 P$ = HEX$(P)
1370 IF LEN(P$) < 2 THEN P$="0"+P$
1380 COLOR C3
1390 PRINT P$;"h"
1400 LOCATE X,Y+9
1410 PRINT ","
1420 LOCATE X,Y+10
1430 GOSUB 1600
1440 COLOR C4
1450 PRINT B$;"b"
```

PROGRAM FILE

```
1460 NEXT
1470 NEXT
1480 FLAG = 1
1490 K$ = INKEY$
1500 IF K$ = "" THEN 1250
1510 IF K$ = "Q" OR K$ = "q" THEN
     COLOR 7:CLS:END
1520 IF K$ = "H" OR K$ = "h" THEN
     GOSUB 1690
1530 IF K$ = "B" OR K$ = "b" THEN
     GOSUB 1850
1540 GOTO 1250
1550 N = 0
1560 N = 4 * (X-4)
1570 N = N + ((Y-1) / 20 + 1)
1580 N = N -1
1590 RETURN
1600 ' convert p to binary
1610 B$ = ""
1620 P = P + 1
1630 FOR W = 7 TO 0 STEP -1
1640 IF P > (2^W) THEN
     B$=B$+"1":P=P-(2^W):GOTO 1660
1650 B$=B$+"0"
1660 NEXT
1670 P=P-1
1680 RETURN
1690 ' change a hex value
1700 COLOR C1
1710 LOCATE 21,5
1720 INPUT "Enter address in hex or
     RETURN to quit ",A$
1730 IF A$ = "" THEN 1820
1740 LOCATE 21,5
1750 PRINT SPC(77)
1760 LOCATE 21,5
1770 PRINT"Enter new value for
     address ";A$;
1780 LOCATE 21,40
1790 INPUT AA$
1800 OUT &H70,VAL("&h"+A$)
1810 OUT &H71,VAL("&h"+AA$)
1820 LOCATE 21,1
1830 PRINT SPC(70)
1840 RETURN
1850 COLOR C1
1860 LOCATE 21,5
1870 INPUT "Enter address in hex or
     RETURN to quit ",A$
1880 IF A$ = "" THEN 1960
1890 LOCATE 21,5
1900 INPUT "Which bit to flip?
     (0-7, right to left) ",AA
1910 OUT &H70,VAL("&h"+A$)
1920 K = INP(&H71)
1930 K = K XOR (2^AA)
1940 OUT &H70,VAL("&h"+A$)
1950 OUT &H71,K
1960 LOCATE 21,1
1970 PRINT SPC(70)
1980 RETURN

1990 ' ------------
2000 '     END
2010 ' ------------
```

PROGRAM FILE

```
1000 ' ---------------------------------------
1010 '      CMOS Ram Editor for the IBM AT
1020 '      and real AT clones.
1030 '
1040 '      You are strongly advised to read
1050 '      the accompanying article before
1060 '      running this program.
1070 ' ---------------------------------------
1080 '
1090 ' *** Set Colours. Change these to suit ***
1100 C1 = 6 ' BROWN
1110 C2 = 2 ' GREEN
1120 C3 = 3 ' CYAN
1130 C4 = 4 ' RED
1140 ' *** Initialise and tidy up ***
1150 CLS
1160 FLAG = 0
1170 LOCATE 1,33
1180 COLOR C1
1190 PRINT "CMOS Ram Editor"
1200 LOCATE 2,33
1210 PRINT "---------------"
1220 LOCATE 23,8
CMOS Ram on the PC/AT
1230 PRINT "Q - Quit      H - change a hex value";
1240 PRINT "     B - flip a binary bit"
1250 FOR X = 4 TO 19
1260 FOR Y = 1 TO 61 STEP 20
1270 LOCATE X,Y
1280 GOSUB 1550 ' convert coordinates into 0 - 63
1290 H$ = HEX$(N)
1300 IF LEN(H$) < 2 THEN H$ = "0" + H$
1310 COLOR C2
1320 IF FLAG = 0 THEN PRINT H$;"h = "
```

```
1330 LOCATE X,Y+6
1340 OUT &H70, VAL("&h"+H$)
1350 P = INP(&H71)
1360 P$ = HEX$(P)
1370 IF LEN(P$) < 2 THEN P$ = "0" + P$
1380 COLOR C3
1390 PRINT P$;"h"
1400 LOCATE X,Y+9
1410 PRINT ","
1420 LOCATE X,Y+10
1430 GOSUB 1600
1440 COLOR C4
1450 PRINT B$;"b"
1460 NEXT
1470 NEXT
1480 FLAG = 1
1490 K$ = INKEY$
1500 IF K$ = "" THEN 1250
1510 IF K$ = "Q" OR K$ = "q" THEN COLOR 7:CLS:END
1520 IF K$ = "H" OR K$ = "h" THEN GOSUB 1690
```

CMOS Ram on the PC/AT

```
1530 IF K$ = "B" OR K$ = "b" THEN GOSUB 1850
1540 GOTO 1250
1550 N = 0
1560 N = 4 * (X-4)
1570 N = N + ((Y-1) / 20 + 1)
1580 N = N -1
1590 RETURN
1600 ' convert p to binary
1610 B$ = ""
1620 P = P + 1
1630 FOR W = 7 TO 0 STEP -1
1640 IF P > (2^W) THEN B$=B$+"1":P=P-(2^W):GOTO 1660
1650 B$=B$+"0"
1660 NEXT
```

PROGRAM FILE

```
1670 P=P-1
1680 RETURN
1690 ' change a hex value
1700 COLOR C1
1710 LOCATE 21,5
1720 INPUT "Enter address in hex or RETURN to quit ",A$
1730 IF A$ = "" THEN 1820
1740 LOCATE 21,5
1750 PRINT SPC(77)
1760 LOCATE 21,5
1770 PRINT"Enter new value for address ";A$;
1780 LOCATE 21,40
1790 INPUT AA$
1800 OUT &H70,VAL("&h"+A$)
1810 OUT &H71,VAL("&h"+AA$)
1820 LOCATE 21,1
CMOS Ram on the PC/AT
1830 PRINT SPC(70)
1840 RETURN
1850 COLOR C1
1860 LOCATE 21,5
1870 INPUT "Enter address in hex or RETURN to quit ",A$
1880 IF A$ = "" THEN 1960
1890 LOCATE 21,5
1900 INPUT "Which bit to flip? (0-7, right to left) ",AA
1910 OUT &H70,VAL("&h"+A$)
1920 K = INP(&H71)
1930 K = K XOR (2^AA)
1940 OUT &H70,VAL("&h"+A$)
1950 OUT &H71,K
1960 LOCATE 21,1
1970 PRINT SPC(70)
1980 RETURN
1990 ' ------------
2000 '      END
2010 ' ------------
```

dBASE™ III USERS

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Use 1-2-3®-like commands and menus.

After the master file is selected, R&R shows an empty screen area to "write" on. Text simply is typed and fields are inserted where wanted; 1-2-3-like commands do the rest. R&R isn't particular about the order of doing things. File relations can be set as needed, or all at once. Fields can be formatted when inserted, or later. Any part of the report can be changed at any time.

Set and edit file relations.

File relations are set one at a time through a series of commands aided by prompts. The narrative near the bottom of the screen shows the highlighted relationships in plain-English.
Up to nine relations may be set among up to ten files, through dBASE indexes. One-to-one, or "lookup", relations find a single record in the related file for each value of the linking field; for example, the company name for a specific customer number. One-to-many, or "scanning", relations find as many records in the related file as have the same value of the linking field; for example, all of the lineitems with the same order number.
Relations may be nested in up to nine levels, with a "scanning" relation and any number of "lookup" relations at each level.

Insert fields from pull-down menus.

Using the Field insert command, fields from the pull-down menu are inserted at the current cursor location. The pull-down menu graphically shows file and field relationships.

Move fields and text freely around the report.

Individual fields, segments of text, or entire lines can be highlighted and then moved elsewhere with the cursor movement keys.

Sort and independently group records.

R&R makes complete and efficient use of dBASE indexes for file processing and record ordering. When the resulting record order is not as wanted, R&R can sort records on up to eight levels, using any fields including those calculated by R&R itself.

Create new calculated fields.

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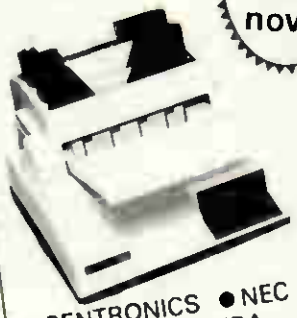

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● BBC TWIN 80T DRIVES. Viglen case, Solidisk 64SWR, joysticks, lots of ROMs and disk software. Books, magazines, approx 30 disks. £350. Eves 699 3858, Days 486 5811 x6535.

● COMMODORE 715 COMPUTER. (256k) £375. 8250LP dual drive (2Mb) £425. 1361 matrix printer (150 cps, 136 char) £225. Or £950 complete system, including: cables, manuals, Superscript II. Tel: Lionel Tun (01) 928 3065/(01) 407 7411.

● BBC+.64k, as new, still in boxes. DFS, ADFS, Vector I MEGA ROM/?. Akhter disk drive, CSX 400A. Zenith monitor, Ferguson tape recorder, lots of software. Elite, Revs, White Knight, etc. Bargain £600 o.n.o. 961 2837.

● SHARP MZ731. Green monitor, Quickdisk, plotter, cassette, Magicbyte printer interface, 50+disks, manuals, club magazines, database, Wordproc, business accounts. Best offer. Buyer collects. Catt, 1 Rosemoor, Walwyns Castle, Haverfordwest, Dyfed, SA62 3ED.

● CAD GRAPHICS SYSTEM FOR IBM/OLIVETTI. Tecmar graphics master 640x400x16 colour card with Microvitec 895 long peristence phosphor colour monitor, £950. CAD software also available. 0224 319209 after 6.00pm.

● COMMODORE 8050 DISK DRIVE. Recently serviced, £300 o.n.o. Tel: (0884) 256910 after 6pm.

● IBM-PC AND

TRANSACTION FILE

COMPATIBLES ADD INS. Brand new megapage, two megabyte, LIM standard, EMS board, software, £500. Irwin 110 internal 10 megabyte tape backup, controller and manuals, £250. 0224 319209 after 18.00.

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● TWO CUMANA DISK DRIVES. Apple 2E compatible, hardly used, still boxed. £90 o.n.o. each Tel: Begley 0257 421597.

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● SHARP MZ80B. Twin Disks, RS232C, CPM2.2, Wordstar, DBase II, Supercalc, MBasic. With manuals, many others. Also modem and printer available. Suit business hobbiest, £399. Offers. Tel: Newbury 200395 anytime.

● GEMINI BOARDS. IVC GM812, £60. FDC GM829, £75. RAM GM802, £40. Pair boxed disk drives +PSU, Pertec, FD250. £80. Nascom case rack +PSU, £20. Wanted: Gemini CPU GM811. (0375) 670511.

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● HAL 10Mb WINCHESTER. For Apple II or III, £350. Wordstar with Mailmerge and Z80 card, Visicalc with utilities. All manuals, £150. Tel: Reading (0734) 340868.

● APRICOT PORTABLE. 256k RAM, 720k drive, MS-DOS. Four master disks. Full set manuals. Plus Apricot writer 80. Only £300. Tel: (01) 579 9935 Eves and ask for Paul.

● AMSTRAD 6128, GREEN SCREEN. Centronics printer. Five inch drive. Serial interface, colour modulator. Software including: Wordstar, Newword, DBase II, MBasic, Pascal+. First offer over £450 the lot. Tel: Dunbar 63332 after 6.

● SIRIUS COMPUTER WANTED. Any model, hard or floppy, dead or alive, with or without software or manuals. Can collect anywhere. Please Tel: Malcolm on Leeds (0532) 860795.

● MICROVITEC CuB. 14" COLOUR MONITOR, £135. Sanyo 14" colour monitor, £135. Kaga Taxan vision Q.L. 12" colour monitor, £135. Tel: (0532) 860795 anytime.

● MICROVITEC 1451.DQ3 COLOUR MONITOR. For QL, as new, £150. Also Cumana dual 3.5" disk drive, with interface, £175. Tel: Evercreech (0749) 830598.

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● C.A.D./OFFICE, P.C. (Philips) 512k HD, twin floppies, colour, A.3. plotter, D.W. printer, mouse, maths chip, Autocad, Enable, DBase 3, Word, Gem, Multimate, Turbo lightning, Datasoft, etc. No offers. £5,000. (01) 8210679.

● AMSTRAD PCW8256. 11 months old, boxed. Supercalc, Prospell, very good condition only selling to upgrade. £350. Tel: 0223 6327029. Nick Reynolds.

● HP41CV. Card reader, optical wand, time module, X-func module, rechargeable battery, charger, 6 solution books. All in excellent condition, boxes and manuals. Complete, £300 o.n.o. (061) 226 5601 Thomas.

● APPLE MACINTOSH. 512k, complete with internal 10Mb hyperdrive hard disk and software. All original, boxed with manuals. Mint condition, only £1200. contact Michael (01) 937 5411 ext 356 (daytime) or (01) 202 1401 Eves.

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● ICL SYSTEM. IO SERIES, 120 mini main frame. Plus cartridge, keyboard and green screen high res monitor. First reasonable offer accepted. Tel: R. Higginson on Tamworth 0827 56066 for quick sale.

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● AMSTRAD CPC6128, green screen, DMP2000 PRINTER. Excellent condition. Software including Devpac80 assembler, graphic adventure creator, Protext word processor, several games. £300. Andy, Swindon (0793) 825488 Eves.

● FUTURE FX20. 2x800k floppies, 128k RAM, CPM-86, Spellbinder wordprocessor, DBase II, £800 o.n.o. Tel: (01) 211 3074 or (01) 301 3930.

● ATARI-ST PUBLIC DOMAIN DISKS. Games, utilities, accessories, languages, MIDI etc. Lists, info., plus free ST-Club Newsletter: P. Glover, Mangrove House, Balls Park, Hertford, SG13 8AP. (Disk +36p stamps for free sampler disk).

● IBM PC/XT MONOCHROME GRAPHICS AND HERCULES COMPATIBLE BOARD. With printer port, £35. Philips 7513 hi-res green monitor, suitable for above inc. cable, £55. Both less than 1 year old. 0482 651203.

● XEROX 820(Z80). With 2x5¼" F/D (CPM2.2). Xerox 820(Z80) with 2x8" F/D (CPM 2.2), 10Mb Corvus W/D with multiplexer. Offers? Tel: (0905) 27243 Pat Knapman.

● APPLE IIe — AS NEW. 64k, 1 disk drive, green Kaga monitor. Software includes: DOS, Applewriter word-processing, and 1 game. All manuals included. £625. Tel: (01) 550 0323 after 7pm.

● NEC SPINWRITER 3510. Plus bidirectional tractor, cables, ribbons. Virtually unused, perfect condition. £450 o.n.o. Tel: 836 5454 x2769.

● COMPAQ 286 PORTABLE. IBM AT 100% compatible, 20Mb hard disk, 640k, graphics card. £3400 worth of software (1-2-3(2), Symphony 1.2, Supercalc, Wordstar and dictionary, projects, Windows, Topview, Norton 3.0, copyiiPC, dBase ...) inclusive manuals £1840. (01) 871 3498.

● AMSTRAD PC1512. TWIN DISK DRIVE monochrome, brand new, fully guaranteed, unused. £550 including VAT. Current price in shops, £639. Complete with manual and software. Tel: 090566 691 Eves and W/Es Fardon.

● AMSTRAD 6128, COLOUR MONITOR. Second 1Mbyte drive, Multiface II, books, joystick, Supercalc, Neword, Micro draft, Cobol, C. etc 5" & 3" disks. Games, Oki printer. cost approx. £2,000+, will accept £800 o.n.o. Tel: (0329) 47552.

● IBM/AMSTRAD ACCOUNTS SOFTWARE. Genuine reason for sale, Sage accounts plus, £169.90 and Compact accounts plus, £159.90. A saving of over £80 each. Both new and unregistered. (0604) 712447.

● SIRIUS COMPUTERS FOR SALE. Choice of two: One with twin floppers, one with 10Mb hard disk. Could deliver. Tel: (0532) 860795.

● NEC PC8201A LAPTOP PORTABLE. Extra 16k RAM, £230 o.n.o. PC8206A, 32k RAM cartridge, £80. Brother FB100, 3.5in portable disk drive with MTDOS operating system, £130 o.n.o.. T-view80. £25. Tel: (01) 346 1321 Eves Michael.

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● TAXAN KAGA 12" COLOUR MONITOR. PAL/RGB. Virtually unused. Cost over £240. A bargain at £180. Tel: (0743) 860494.

LEISURE LINES

Brain-teasers courtesy of JJ Clessa.

Quickie

A boy and a girl are talking. 'I'm a boy,' said A. 'I'm a girl,' said B. If at least one is lying, which is the boy and which is the girl? Think about it.

Prize puzzle

My credit card number is rather unusual. Its value is the sum of the squares of three consecutive integers. Only four of the digits 0–9 are used in its makeup, and these appear consecutively as the last four digits of the number. It is the smallest possible number to satisfy these conditions and there are no leading zeros. What is it?

(By the way, if you solve it — please don't use it — I'm already in the red!)

Answers on postcards please, or backs of envelopes, to reach *PCW* not later than 30 April 1987. Send your entries to Leisure Lines, April Prize Puzzle, *PCW*, 32-34 Broadwick Street, London W1A 2HG.

Winner: January 1987 puzzle

A low response indicating a harder than usual problem: of the 90 entries, 20 were incorrect. However, the problem was worded ambiguously. We intended to ask for the smallest integer that could be expressed in exactly 10 different ways, as the sum of a succession of consecutive integers. The answer to this problem is 59049.

Unfortunately, we omitted the word 'exactly' and the answer of 315 can be expressed in 11 different ways.

In the interests of fairness, therefore, we accepted either solution. Incidentally, most of the correct entries contained both solutions to cover the ambiguity.

The winning entry came from a previous winner, Mr SN Higgins of Malvern, Worcs. Congratulations, Stan, your prize (once again) is on its way.

Meanwhile, to all the unlucky ones, keep trying. END

ACC NEWS

If your club is doing something interesting, whether locally or nationally, don't keep it to yourself. Rupert Steele is here to spread the word.

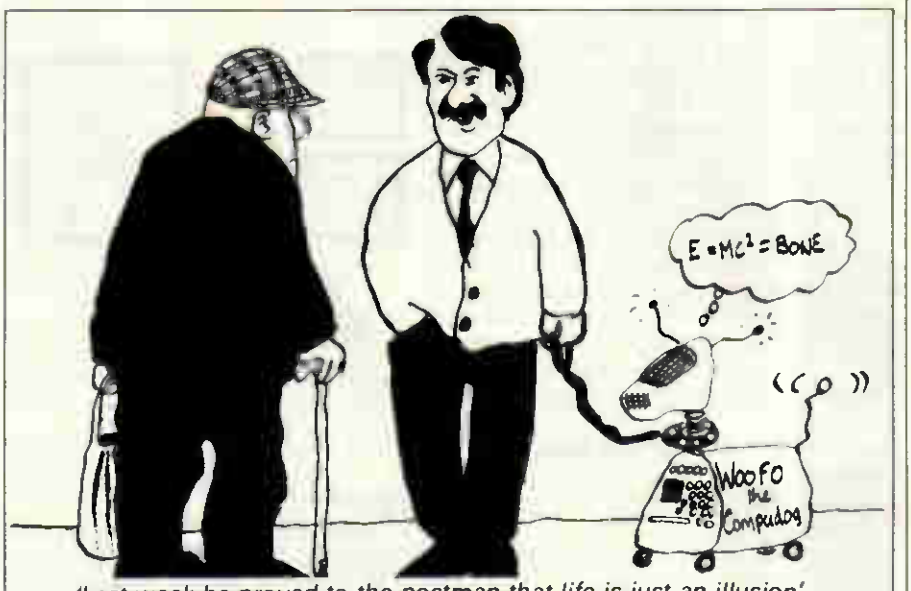
The Association of Computer Clubs has issued a newsletter to affiliated computer clubs. This newsletter sets out the new, simplified administrative arrangements of the ACC and gives an overview of its activities. Probably the most striking of these is ClubSpot 810, run by the Association's Electronic Publishing Committee. This entirely amateur database is, incredibly, the third most accessed information provider on the Prestel system, with over one million frame accesses per month. The Electronic Publishing Committee confidently expects to reach number two very shortly. This database includes science fiction, photography and amateur radio (G8ABC and all that — I imagine that CB is strongly frowned upon), as well as the traditional home computing features. Computer clubs affiliated to the Association can ask for frames within ClubSpot which they can edit themselves. Training conferences for budding editors are held by the ACC approximately every four months. To apply for a place, follow the instructions on page 8102110 of Prestel.

Meanwhile, the Association's cheap insurance schemes remain available, relieving those who run local computer clubs from worry over public liability risks or (if the optional extra units are taken out) damage to equipment brought to meetings. The full details of these schemes (which I set up in an earlier form some years ago when I was ACC chairman), are available from the ACC, and I would certainly recommend them to anyone running a club with large meetings.

Around the clubs

The Kensington and Chelsea Computer Society has ceased meeting until interest improves. It hasn't formally wound up, but dwindling attendances have made further formal meetings impracticable. The club ran for exactly two years, and its departure as an active force typifies problems that I hear about from readers. As I was chairman of KCCS, I can describe our difficulties without apportioning blame.

The most difficult problem for anyone running a computer club always seems to be where to meet. Premises tend to be unheated, unreliable or too expensive. KCCS was offered a room above a pub for no charge, but it quickly became apparent that there were other, more lucrative, uses for the venue, and we turned up on a few occasions to find no room available. That episode cost us three quarters of our membership. We then moved to other, utterly reliable premises which made only a modest charge, but the damage had been done.



'Last week he proved to the postman that life is just an illusion'.

The second difficult problem in a club is over-reliance on key people. *Don't* place too much responsibility on any one person.

The third cause of KCCS' suspension is of a rather different nature. While the overall level of computer club activity seems to be roughly constant, there has been a marked switch of activity away from the local get-together type of club towards the mail-orientated support groups for particular machines, languages or computer applications. The reason for this is simple. Computers are no longer so expensive that they have to be shared and people tend to join clubs to get precise, targeted information relevant to their machine.

But some clubs, I am pleased to hear, are able to beat this trend. Toby Champion has written to me about the Ilford Computer Users Group. The club is for home computer users of any age living in or around Ilford. There is a monthly magazine and regular meetings and members get a discount of 5–10 per cent on equipment purchased at two local computer stores. Contact Toby at 78 Sandhurst Drive, Ilford IG3 9DE, or call him on (01) 597 1860 for futher information.

Another group which joined the ACC some time ago is the BBC Micro User Group (of Norwich). It meets on the first and third Tuesday of each month in Room A3 of Norwich City College. For more information, or if you want to join the 30-strong membership, contact Mr Sarre, 53 Roseberry Road, Norwich NR3 3AB, or call him on (0603) 402384.

I've also had a note from the 68 Microgroup. This is a cross between a large national user group operating through a newsletter and a local club. The group holds meetings in North London about once a month. So if you're into hardware or software for the 6800 or 68000 microprocessors, get in touch. Contact J Turner, 63 Millais Road, London E11 4HB for the full picture.

Finally, I have had a note from Philip Ramage, the secretary of the Croydon Apple User Group, now entering its sixth year of operation. The club has just held its AGM which also incorporated a talk on Polaroid Palette — an imaging system for computers, including the Apple II. The system allows for the presentation of coloured slides, which would be useful in advertising and education. For full details, contact Philip at 515 Limpsfield Road, Warlingham, Surrey or call him on (08832) 6715.

To tell the ACC about your club, to request a mention in this column, or to obtain labels for mailing to the ACC's register of computer clubs, contact Rupert Steele, 12 Philbeach Gardens, London, SW5 9DY. Tel: (01) 370 0601.

For any other enquiry, including the details of your local computer club, send an sae and details of the enquiry to John Dale, 12 Poplar Road, Newton, Powys SY16 2QG. END

END ZONE

NUMBERS COUNT

Mike Mudge looks at W-Sequences, an introduction to an endless source of unsolved problems in number theory.

This problem area was first suggested to me by Philip Newton Webb of Llanelli, some eight years ago. At that time Philip had already spent seven years investigating a subset of the problems, and must be among the most experienced researchers into the properties of W-Sequences.

This topic provides a fascinating area for empirical number theory, a limitless supply of unsolved problems defined by an absolute minimum of mathematical symbolism, and I strongly recommend it as a natural entry point for new readers in this field.

The definition of a W-Sequence

Consider five positive integers a,b,c,d_1, and d_2 satisfying $2 \leq a \leq b$, $c \geq 0$, $d_1,d_2 \neq 0$.

The sequence $W(a,b,c,d_1,d_2)$ is defined by the following rules:

(i) The first term $W_1 = c$.

(ii) The even terms $W_{2n} = aW_n + d_1$.

(iii) The odd terms (other than the first defined at (i) above)

$W_{2n+1} = bW_n + d_2$.

(iv) The sequence calculated as above is then rearranged so that the terms are in increasing numerical order; thus, in general, the subscript n will no longer be in numerical order. Note: If $d_1=d_2=1$ we write $W(a,b,c)$, and if further $c=1$ we abbreviate the notation to $W(a,b)$.

Further, it should be observed that if $d_1=d_2$ then the value of a equal to b is excluded; we then have $2 \leq a < b$. Without this restriction, it is easy to see that $W_{2n}=W_{2n+1}$ and everything becomes rather trivial.

An example of a W-Sequence

If $a=3$, $b=5$, $c=2$ and $d_1=d_2=1$, then $W(3,5,2)$ is generated as follows:

$W_1=c=2$; $W_2=3W_1+1=7$;

$W_3=5W_1+1=11$; $W_4=3W_2+1=22$;

$W_5=5W_2+1=36$; $W_6=3W_3+1=34$;

$W_7=5W_3+1=56$; $W_8=3W_4+1=67$

then rearranging we obtain: 2, 7, 11, 22, 34, 36, 56, 67, 103, 109, 111, 169, 171, 181 as far as W_{14}.

Junction points of a W-Sequence

For certain W-Sequences — that is, for certain choices of a,b,c,d_1 and d_2 — there exist *junction points* denoted by Z where $Z=W_m=W_n$ and the two subscripts m and n are not equal. For example, in W(2,6) we find: $W_1=1$, $W_2=3$, $W_3=7$, $W_4=7$; thus $Z_1=7$ is the first junction point.

In W(2,5) we find that

$W_7=W_{16}=31=Z_1$.

In W(2,3) we find that

$W_{11}=W_{16}=31=Z_1$

$W_{51} = W_{80}=175=Z_2$

. . .

$W_{35291}=W_{202832}=1640335=Z_{101}$

Problems

(a) What are the terms of a W-Sequence? Test cases: evaluate W(2,3), W(2,3,2), W(6,9), W(3,4,1) and W(3,4,2) between 1 and 10^6. Count the number of terms in each and further show the sub-totals for each 10000.

(b) Given n, evaluate W_n for a specified W-Sequence.

(c) What are the junction points, if any, for a specified W-Sequence? Test cases: evaluate junction points in W(2,3), W(2,3,2), W(2,3,*c*) where c is to be input.

(d) What are the values of a,b,c,d_1 and d_2 for which there exists at least one junction point?

Hints

(i) Apart from the value of $c=W_1$ itself, all terms in W(2,3,c) can only leave remainders 1,3,4,5 when divided by 6.

(ii) Apart from the value of $c=W_1$ and possibly W_2,W_3 and W_4, every term in W(6,9,c) leaves remainder 7,10,37 or 43 when divided by 54, except in the case where c is a multiple of 18 when the remainder 1 also occurs on division by 54.

Readers are encouraged to send their thoughts, together with complete or partial attempts at the solutions to the above problems, to Mike Mudge, Square Acre, Stourbridge Road, Penn, Staffordshire WV4 5NF, tel: (0902) 892141 to arrive by 1 July 1987.

It would be appreciated if such submissions contained a brief summary of results; together with thoughts relating to W-Sequences in a form suitable for future publication in *PCW*. These submissions will be judged using suitably vague criteria, and a prize will be awarded by *PCW* to the 'best' contribution received by the closing date.

Please note that submissions can only be returned if a stamped, addressed envelope is provided.

Mike Mudge welcomes correspondence on any subject within the areas of number theory and other computational mathematics. Particularly welcome are suggestions, either general or particular, for future Numbers Count articles; all letters will be answered in due course.

Isolated readers can be put into contact with others sharing the same interests. However, greater efficiency regarding published problems should result from contacting the prize-winner directly.

Review: Back to basics

This invitation to go 'Back to basics' produced an excellent response; the transposition of 64 to yield 46 in the sixth line of Devi's Number being unfortunate, but not troublesome.

Submissions divided broadly into two classes: those who used string-handling software — for example, on a BBC Micro — and were restricted to 255-digit integers; and those who used the generally much slower array-handling software.

The winner has been chosen from the second category and is Ettrick Thomson of Woodhaven, Leiston Road, Aldeburgh, Suffolk IP15 5PX. Ettrick used a Spectrum Plus with 48k RAM, an Alphacom 32 printer and a cassette recorder; the normal Spectrum Basic being enhanced by BetaBasic written by Betasoft and allowing for example procedures with arrays as parameters.

It should be mentioned that Ettrick's programs were by no means the most efficient submitted, but some feel for his approach may be obtained from the following extract: '. . . printouts use old-style numerals which, like lower-case letters, have ascenders and descenders. As with lower-case letters, these help in avoiding confusion between certain numerals and certain numeral/letter combinations . . . It would be a pity if the USA influence led to a disappearance of old-style numerals, especially in work on large integers.'

Mention must be made of the submission from Alan Thomas of Tasmania who refers readers to his paper of January 1980 in *APC*, vol 1, no 8, page 64, detailing Monster Multiplier based upon The Trachtenberg Speed System of Basic Mathematics. Alan also has a Devi-ous Method for the Devi Calculation which I will be pleased to forward to readers. END

MICROCHESS

Kevin O'Connell reports on the fortunes of competitors at the 17th North American Computer Championship.

The 17th North American Computer Championship was played in Dallas, Texas concurrently with the World Microcomputer Championship. The tournament venue, a hotel ballroom, was somwhat more mundane than the site for the micro tournament, which was played in the Dallas Infomart, a replica of the Crystal Palace (yes, the Crystal Palace of the 1851 Great Exhibition).

The North American contest also got off to a less pulsating start than the micro event, with the leading contenders (Hitech and Cray Blitz) both out of the running. The withdrawal of Cray Blitz and the absence of any other claimant for the vacated place meant that Ken Thompson, whose Belle was reserve, reluctantly stepped in to fill the breach and avoid an odd number of contestants which would have meant one competitor receiving a bye in each of the five rounds.

Thompson's reluctance was increased by his near certainty that Belle was suffering from 'growback'; this complaint can often afflict Schottky ROMs, with particles or vaporised metal recrystallising. As a result, Thompson fears that Belle's evaluation function is a shadow of that which won the World Championship in 1980 and might be rapidly becoming little more than a random move generator. Nonetheless, Belle was able to make a 100 per cent score.

Final results were (all US unless otherwise stated): 1 Belle 5/5; 2 Lachex 4; 3 Novag Expert X (Hong Kong) 3½; 4-5 Bebe, Sun Phoenix (Canada) 3; 6-11 Chip Test, Cyrus 68K (England), Chess Challenger X, Fidelity Experimental, Mephisto Motorola (West Germany), Recom-Rebel 87 (Netherlands) 2½; 12-13 Merlin (Austria), Vaxchess (England) 2; 14 Ostrich (Canada) 1½; 15-16 Waycool, Rex ½.

The performance of the Novag computer, against other computer opposition, makes me wish I had been a little more circumspect in what I said about these machines in the February issue of *PCW*. The good showing of Cyrus 68K (from my own company, Intelligent Chess Software), while not up to the standard of our third place the previous year (behind Hitech and Bebe, but ahead of Phoenix, Cray Blitz and Lachex among others), nonetheless helped to make up for our poor showing in the micro tournament. The program also played two very good games, the one which follows being an excellent demonstration of the fact that a good position is much more important than material (at least in moderate doses).

White: Cyrus 68K. Black: Sun Phoenix. Opening: French Defence.

1	e2–e4	e7–e6
2	d2–d4	d7–d5
3	Nb1–c3	Nb8–c6

This is rarely seen. By blocking his c-pawn, Black deprives himself of the traditional freeing move c7–c5 and he is normally saddled with a lifeless position.

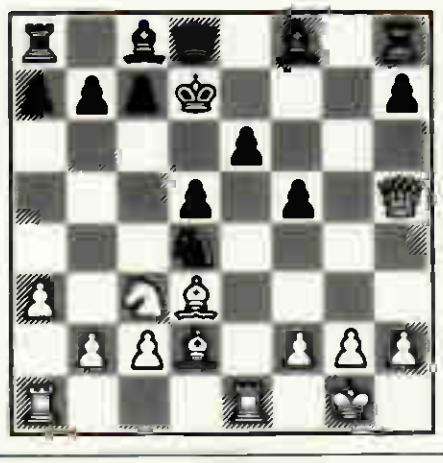
4	e4–e5	Bf8–b4
5	Bf1–e2	f7–f6
6	Ng1–f3	Ng8–e7
7	e5xf6	g7xf6
8	Bc1–d2	Ne7–f5
9	a2–a3	Bb4–f8

Thus far Black has made the best of a bad job, but now the bishop should have gone to e7.

10	Be2–d3	

There is nothing wrong with 10 Bd2–f4 to hold the d-pawn, but this is much more aggressive and probably better.

10	. . .	Nc6xd4
11	Nf3xd4	Nf5xd4



So, Black has won a pawn, but at enormous cost since now his king will be stranded in the centre.

12	Qd1–h5+	Ke8–d7

12 . . . Ke8–e7, providing a target along the e-file, would be even worse.

13	O–O	f6–f5
14	Rf1–e1	

White has all the time in the world to bring his pieces into play. In the meantime, Black can do nothing.

14	. . .	h7–h6

This only creates yet another weakness. The immediate, and thematic, c7–c5 was better.

15	Qh5–g6	c7–c5
16	Nc3–b5	Kd7–c6

16 . . . Nd4xb5 is unappetising, but should have been tried.

17	Nb5xd4+	c5xd4
18	Bd3xf5	

Now White regains his sacrificed pawn, wins another and retains much the better position.

18	. . .	Bf8–d6
19	Bf5xe6	Bc8xe6
20	Re1xe6	Kc6–c7
21	Bd2xh6	

Now White is simply two pawns up, with a far superior position, and still has good attacking changes against the black king.

21	. . .	Qd8–d7
22	f2–f4	Ra8–g8
23	Qg6–f6	Bd6–c5
24	Qf6–e5+	Kc7–c8
25	Kg1–h1	

White has easily parried Black's few paltry threats and the end comes swiftly now.

25	. . .	Rg8–e8
26	f4–f5	a7–a5
	1–0	

Black resigned, being helpless after 27 Bh6–f4 Bc5–a7 28 Ra1–e1. END

END ZONE

UK BULLETIN BOARDS

An up-to-date list of UK bulletin boards, compiled by Peter Tootill.

Tel No	Name	Location	Weekday hours	Weekend hours	Baud	Notes
(0001)185 4179	Dublin Fido	Dublin	10pm-8am	10pm-8am	3/1275	
(0001)885 634	DUBBS-Dublin	Dublin	8pm-8am	24	3-24	
(0001)903 341	IACCBBS	Eire	24	24	3	Irish ACC. Runs on Comodore 64
(01)200 3439	Airtel - TBBS	London	24	24	3/1275	Pilots area
(01)200 7577	TBBS London NW	London	24	24	3/1275	TBBS, Tandy Users Group
(01)207 2989	Dark Crystal Fido	London	24	24	3-12	
(01)248 5747	Prestel 24 hrs	London	24	24	3	No graphics on this number
(01)346 7150	Marctel	London	24	24	3/1275	FBBS system.
(01)348 9400	TBBS London	London	24	24	3-12	
(01)399 2136	MG-Net	London	-	Sun 5pm-10pm	3	
(01)429 3047	OSI Lives!	London	24 Ring back	24 Ringback	3	
(01)450 9764	Techno Line	London	24	24	1275v	Commercial + 452 1500 eve +w/e
(01)452 1500	Techno-line 2	London	evenings	24	1275v	Commercial
(01)455 6607	NNBBS London	London	24	24	3/1275	
(01)542 3772	WBBS Wimbledon	London	-	sat7pm-mon8am	3/1275	
(01)542 4977	TBBS Rovoreed	London	24	24	3-24	
(01)543 7020	Dataflex Fido	S.London	24	24	3/1275	
(01)573 8822	Taecom	London	7pm-8am	all day Sun	300	Interak micro section
(01)580 1690	Poly Fido	London	24	24	3-12	
(01)638 2034	CyberZone	London	24	24	3	
(01)624 5338	Twighlight Phone	London	24	24	3	
(01)648 0018	MBBS Mitcham	London	24	24	3/1275	
(01)658 6942	Typnet	London	24	24	3	
(01)679 1888	Distel	London	24	24	3	Display electronics -Commercial
(01)679 6183	Distel	London	24	24	3/1275	Display Electronics - Commercial
(01)735 6153	Brixton ITeC	London	24	24	1275	
(01)853 3965	Assylum	London	24	24	3	Writers and comms areas
(01)863 0198	London U'ground Fido	London	24	24	3/1275	Fido -Amiga,Atari ST sigs
(01)883 5290	NBBS London	London	24?	24	3/1275	
(01)888 8894	Gnome at home	London	24	24	1275v	
(01)927 5820	Owltel	London	24	24	1275v	
(01)941 4285	Metrotel	London	24	24	1275v	
(01)960 4742	ITCU Exchange & Mart	London	24	24	1275v	ITeCs central system?
(01)968 7402	Communitel	London	24	24	1275v	
(01)985 3322	Hackney BBS	Hackney	24	24	1275v	
(01)986 4360	Health data	London	24	24	1275v	
(0204) 43082	Bolton BBS	Bolton	8pm-8am	24	3-24	8am-8pm on ring back
(0206)862 354	Pete's Place	Colchester	24	24	3	
(021)430 3761	CBABBS	Birmingham	24 (not Thurs)	24	300	
(021)444 1484	TUG II	Birmingham	8am-10pm R/B +	10pm-8am	3	
(0222)461 824	Capital Data Line	Cardiff	24	24	3	Computer repair company
(0222)464 725	Cardiff ITeC	Cardiff	24	24	1275v	
(0223)243 642	Acorn BBS		24	24	1275v	
(0224)641 585	ABERDEEN ITEC	Aberdeen	24	24	1275v	
(0224)781 919	Aberdeen Commodore	Aberdeen	24	24	300	Commodore 64 based
(0247)455 162	SBBS II (Irish Man)	Ireland	9pm-11pm r/b +	11pm-9am	3/1275	rates are daily
(0247)467 863	Fido Bangor	Bangor NI	24	24	3-24	PC-DOS,CP/M, BBC,Tech. help sigs
(0258)54 494	TBBS Blandford	Dorset	24	24	300	Blandford Computers
(0268)22 177	BITEC	Basildon	24	24	1275v	
(0268)25 122	BITEC	Basildon	24	24	300	
(0268)710 637	RICBBS	Basildon	5pm-10pm	24	?	
(0272)421 196	Octopus	Bristol	6pm-6.30am	24	3/1275	
(0274)480 452	OBBS Bradford	Bradford	24	24	3/1275	Colour for BBC users
(0295)720 812	Bloxam	Bloxham	10pm-1am	10pm-1am	300	
(0342)315 636	Fido PD Software	E.Grinstead	24	24	3-24	PD software database
(0367)81 507	Comp. for Christ £2	Faringdon Ox	24	24	3/1275	Sponsored by Courier Consultancy
(0376)518 818	REACT	?	24	24	300	
(0384)635 336	West Midlands	Stourport	6pm-8am	6pm-8sm	300	TBBS
(0392)53 116	CBBS South West	Exeter	24	24	3/1275	
(0394)276 306	BABBS-1 Felixstow	Felixstow	24	24	300	
(0395)272 611	CFC	?	24	24	300	John Burden

UK BULLETIN BOARDS

(0401)50 745	MBBS Leconfield	Leconfield	24	24	3/1275	
(0429)234 346	On-Line Systems	Cleveland	24	24	3/1275	Commercial
(0443)733 343	MGBBS Mid Glamorgan	Ferndale	6pm-1am	6pm-1am	300	was on 755298
(0463)231 339	Betelgeuse 5		24	24	3/1275	
(0482)465 150	Hamnet	Hull	6pm-8am	24	3/1275	Radio Hams
(0482)859 169	Forum-80	Hull	7pm-11pm	1pm-11pm	3/1275	Midnt-8am Bell 103
(0483)573 337	Fido Compulink 1	Guildford	24	24	3/1275	Multi-user (see C/link 2)
(0483)573 338	Fido Compulink 2		24	24	3-24Bel	Multiuser system
(04862)25 174	PBBS-'Adult' BBS	Mitcham	24	24	3/1275	
(0492)49 194	Cymrutel	Colwyn Bay	24	24	1275	
(0506)38 526	Livingstone BBS	Livingstone	24	24	300	
(051)220 3761	Fido Compulink North	Liverpool	24	24	3/1275	
(051)428 8924	Liverpool Mailbox	Liverpool	24	24	3-24	Britain's first 24 hr system
(0524)60 399	CNOL	Lancaster	24	24	300	Clinical BBS for medics
(0532)600 749	L.E.M.S Fido	Leeds	10pm-8am	10pm-8am	3/1275	
(0534)39 389	Jersey Fido	Jersey	24	24	3/1275	
(0592)860 313	JMBBS Amstrad BBS	Fife	9.30pm-8am	9.30pm-8am	300	Sponsored by John Menzies
(0602)817 696	MACTEL	Nottingham	24	24	3-12	Macintosh Users
(0604)20 441	Norview	Northants	24	24	1275v	
(061)427 1596	OBBS Manchester	Manchester	24	24	3/1275	
(061)494 6938	Fido TeePee link	Manchester	24	24	3-24	
(061)773 7739	Fido Manchester	Manchester	24	24	3/1275	Mektronic Electronic design cons
(0625)33 703	Telemac 15	?	24	24	3/1275	
(0628)824 852	C.A.T.S. Fido	Maidenhead	24	24	3/1275	V22/bis coming
(0642)481 643	System 2000 Com.Club	Redcar	7pm-7am	?	300	
(0642)784 819	Fido Teeside	Cleveland	24	24	3/1275	
(0698)884 804	SABBS	?	24	24	300	Atari based system
(0702)54 6373	C.View Rochford	Kent	24	24	1275v	
(0702)552 941	Maptel	?	24	24	300	Commercial system
(0705)524 805	Gosport Apricot BBS	Gosport	24	24	300	300
(0705)736 025	BBS09	?	7pm-10pm Wed	10am-10pm Sun		
(0707)52 242	RSGB	London	24	24	1275v	
(0742)667 983	PIP	Sheffield	24	24	300	
(0752)364 059	Haunting Thunder	?	2am-6am???	???	3/1275	Fido
(0762)333 872	PBBS£1 Portadown	N.Ireland	10pm-1am R/B	10pm-1am	R/B	300
(0766) 4154	Fido Dragon	Porthmadog	24	24	3-24	
(0767)50 511	Fido Gamlingay	Sandy,Beds	24	24	3-24	
(0782)265 078	Stoke ITeC	Stoke	24	24	1275v	
(0792)203 953	FBBS Swansea	Swansea	24	24	3	
(0792)297 845	Bulletin AT Fido	Swansea	24	24	300	
(0874)711 147	Communitree	?	24	24	300	
(0883)844 164	LABBS	?	24	24	3/1275	The Prisoner - 2 lines
(0895)420 164	CBBS(London NW)	?	24	24	300	
(0895)52 685	London West Tech	?	24	24	3/1275	TBBS
(0903)212 552	Lasermail Fido		24	24	3/12	Subscribers (12/24 coming?)
(0905)52 536	Access Fido	Worcester	24	24	3-24	Midi section
(0908)668 398	Key Board	M.Keynes	8pm-8am ex.Tue	and Thurs	12h	Spectrum Micron BBS
(091)477 3339	Log On the Tyne Fido	Tyneside	10pm-7am	10pm-7am	3/1275	
(0923)676 644	SBBS - Watford	Watford	9pm-11pm plus	+11pm-6am	3/1275	Times are daily
(0925)411 265		Warrington	24	24	3-24	
(0934)29 570	Avon Fido	Weston sMare	24	24	3/1275	
(0935)77 025	MBBS Cheshire	?	24	24	3/1275	

END

DIARY DATA

THE ELECTRON & BBC MICRO USER SHOW — 20-22 March 1987
UMIST, Manchester — Database Exhibitions (061) 456 8835

COMMODORE COMPUTER SHOW — 10-12 April 1987
Novotel, London — Database Exhibitions (061) 456 8835

LOTUS WORLD '87 — 13-15 April 1987
Kensington & Chelsea Town Hall, London — Jonathan Horne (025) 683456

ATARI COMPUTER SHOW — 24-26 April 1987
Novotel, London — Database Exhibitions (061) 456 8835

END

Computers by Post

LOWEST U.K. PRICES GUARANTEED

PRINTER RIBBONS

		2+	5+	12+
ACORN	AP80	£2.70	£2.20	£2.00
	AP100	£2.70	£2.20	£2.00
AMSTRAD	DMP1	£3.90	£3.30	£3.10
	DMP2000/3000	£4.40	£4.10	£4.00
	PCW8256/8512	£4.30	£4.00	£3.80
BROTHER	HR5	£3.00	£2.80	£2.60
	HR15 Corr	£2.90	£2.50	£2.30
	HR15 FAB	£3.30	£2.90	£2.60
	HR15 MS	£3.20	£2.80	£2.50
	HR15 also for HR25/HR35			
	EP44	£2.90	£2.50	£2.30
	M1009	£3.40	£2.90	£2.70
CANON	PW1080A Black	£3.10	£2.60	£2.40
	PW1080A Red or Blue	£4.50	£4.10	£3.80
	PJ1080 Ink Jet Colour. One Off			£10.90
	PJ1080 Ink Jet Black. One Off			£8.90
CBM	1515	£2.70	£2.20	£2.00
	1525	£2.70	£2.20	£2.00
	MPS801	£3.60	£3.00	£2.80
	802/1526	£3.70	£2.90	£2.70
	803	£3.40	£2.90	£2.70
	MPS1000	£2.70	£2.30	£2.10
	4022	£2.70	£2.30	£2.10
	MSC801 Colour. One Off			£18.50
	DPS1101 SS	£1.60	£1.30	£1.20
	DPS1101 MS	£2.20	£1.80	£1.60
	DPS1101 Corr	£1.80	£1.50	£1.40
CENTRONICS	GLP	£3.40	£2.90	£2.70
CITIZEN	120D	£5.00	£4.60	£4.30
DAISYSTEP	2000 MS	£3.10	£2.60	£2.40
	2000 FAB	£4.90	£4.20	£4.00
EPSON	MX/FX/RX80 Black	£2.70	£2.30	£2.10
	MX/FX/RX80 Red or Blue	£3.90	£3.20	£3.00
	100 Series	£3.70	£3.30	£3.00
	LX80/LX86	£2.70	£2.30	£2.10
	JX80 Colour. One Off			£18.50
	LQ800	£3.70	£3.30	£3.10
	LQ1000	£4.50	£3.90	£3.60
JUKI	6000/2200 MS	£4.00	£3.60	£3.40
	6000/2200 Corr	£3.10	£2.70	£2.50
	6100 MS	£2.20	£1.80	£1.60
	6100 SS	£1.30	£1.00	£0.90
	6100 Corr	£1.80	£1.50	£1.40
KAGA	KP810 Black	£3.10	£2.60	£2.40
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	84	£3.90	£3.40	£3.20
	Mate 20 Colour	£7.00	£6.50	£6.20
	Mate 20 Black	£6.60	£6.20	£6.00
PANASONIC	Dot Matrix	£5.00	£4.60	£4.30
QUENDATA	DWP1120 MS	£3.10	£2.60	£2.40
	DWP1120 FAB	£4.90	£4.20	£4.00
QUME	Sprint 7/9 MS	£2.80	£2.30	£2.10
	Sprint 7/9 FAB	£4.00	£3.70	£3.40
SEIKOSHA	GP50	£6.00	£5.50	£5.20
	GP80	£2.70	£2.20	£2.00
	GP100/250	£2.60	£2.20	£2.00
	GP500/550	£3.90	£3.30	£3.10
	GP700 Colour One Off			£18.50
	SP1000	£6.00	£5.50	£5.20
SHINWA	CP80	£3.70	£2.90	£2.70
	Fastext 80 (Twinpack)	£11.70	£11.20	£10.90
SMITH CORONA (originals)	TPI M/S	£8.50	£7.90	£7.20
	TPI Fabric	£3.90	£3.60	£3.40
	TPI Corr	£5.00	£4.70	£4.50
	D100/200	£4.80	£4.40	£3.90
	D300	£6.00	£5.50	£5.30
STAR	DP/GEMINI/SG	£1.40	£1.10	£1.00
	SR15	£4.90	£4.50	£4.30
	NL10	£5.40	£4.70	£4.40

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		BOXES OF 10 DISKS 1-2	3-9	10+
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MD-1D	S/side D/dens 40TR	£9.99	£9.50	£9.25
MD-2D	D/side D/dens 40TR	£11.99	£11.50	£11.25
MD-2DD	D/side Q/dens 80TR	£15.99	£15.50	£15.25
MD-2HD	D/side H/dens 1.6MB	£26.99	£25.99	£25.49
VERBATIM – DATALIFE				
MD525	S/side D/dens 40TR	£11.60	£11.00	£10.60
MD550	D/side D/dens 40TR	£14.80	£14.00	£13.60
MD577	S/side Q/dens 80TR	£14.99	£14.75	£14.49
MD557	D/side Q/dens 80TR	£19.50	£19.00	£18.60
MD HD	D/side H/dens 1.6MB	£27.99	£26.99	£25.99
FUJI	*S/side D/dens 40TR	£10.99	£10.50	£10.25
	*D/side D/dens 40TR	£13.49	£12.99	£12.75
*Coloured Disks – red, green, blue, beige, grey £1.00 per box extra.				
	D/side D/dens 80TR	£17.99	£17.50	£17.25
3½"		BOXES OF 10 DISKS		
JVC/TDK	S/side D/dens	£17.99	£17.25	£16.99
SONY/FUJI	S/side D/dens	£18.99	£18.25	£17.99
FUJI/TDK	D/side D/dens	£26.99	£26.50	£25.99
SONY	D/side D/dens	£27.99	£27.50	£26.99
BULK 3½" D/SIDE D/DENS DISKS BY VERBATIM				
	10 x Disks	£1.99 each		£19.90 pack
	20 x Disks	£1.89 each		£37.80 pack
3" DISKS				
	CF2 5 Disks	£2.99 each		£14.95 pack
	CF2 10 Disks	£2.89 each		£28.90 pack

ENVELOPES

	PRICE PER BOXED	BOX
110mm x 220mm White Self Seal 90gsm	500	£11.50
110mm x 220mm Manilla Banker Gummed 70gsm	500	£9.50
324mm x 229mm Manilla Self Seal 90gsm	250	£17.90

DISK STORAGE

LOCKABLE DISK BOXES

MODEL	SIZE	CAPACITY	PRICE
DD40L	3"/3.5"	40	£8.50
GS100	3.5"	100	£13.90
DD50	5¼"	50	£8.90
DD100	5¼"	100	£11.70
LIBRARY CASE	5¼"	10	£1.50
NON-LOCKABLE DISK BOXES			
MD12/30	3"/3.5"	24	£7.20
MF50	5¼"	50	£8.00
MICRODRIVE HOLDERS			
WALLET		4	£1.75
WALLET		20	£4.50

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11 x 9½	60	2000	£12.50	£12.00
11 x 9½	70	2000	£15.50	£14.50
EXACT A4	70	2000	£20.90	£18.75
11¾ x 9¼	90	1000	£13.20	£11.25

COMPUTER LABELS

	Price per thousand in brackets 1000	2000	4000
70 x 36mm	£5.40	£8.80 (£4.40)	£16.00 (£4.00)
89 x 36mm	£5.50	£9.00 (£4.50)	£16.40 (£4.10)
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3 across only	£7.20	£12.40 (£6.20)	£22.80 (£5.70)
102 x 36mm	£5.70	£9.40 (£4.70)	£17.60 (£4.40)

Please state number of labels across sheets (1, 2 or 3).

PRINTERS

Epson LX86	£199.95
Epson FX800	£319.95
Epson FX1000	£409.95
Epson EX800	£415.95
Epson LQ800	£469.95
Citizen 120D	£155.95
Amstrad DMP2000	£139.95
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Micro P MP165	£199.95
Seikosha MP1300A	£389.95
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Star Powertype Daisywheel	£199.95
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COMPUTERS

Acorn BBC Master	£399.95
Acorn BBC Master Compact	P.O.A.
Amstrad PCW8256	£379.95
Amstrad PCW8512	£475.95
Amstrad CPC464 Green	£169.95
Amstrad CPC464 Colour	£249.95
Amstrad CPC6128 Green	£239.95
Amstrad CPC6128 Colour	£325.95
Atari 520STM	£213.95
Atari 520STFM	£327.95
Atari 520STFM + mono monitor	£409.95
Atari 1040STF	£489.95
Atari 1040STF + mono monitor	£572.95
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Commodore C64	£139.95
Commodore C64C compend	£204.95
Commodore C128D	£429.95
CBM 1541C Disk Drive	£168.95
CBM Amiga 512K Syst 1	£995.95
Sinclair Spectrum 128K + 2 inc Joystick + Software	£126.95

AMSTRAD PC1512

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HD20 Meg Mono Monitor	£879.95
HD10 Meg Colour Monitor	£949.95
HD20 Meg Colour Monitor	£1049.95

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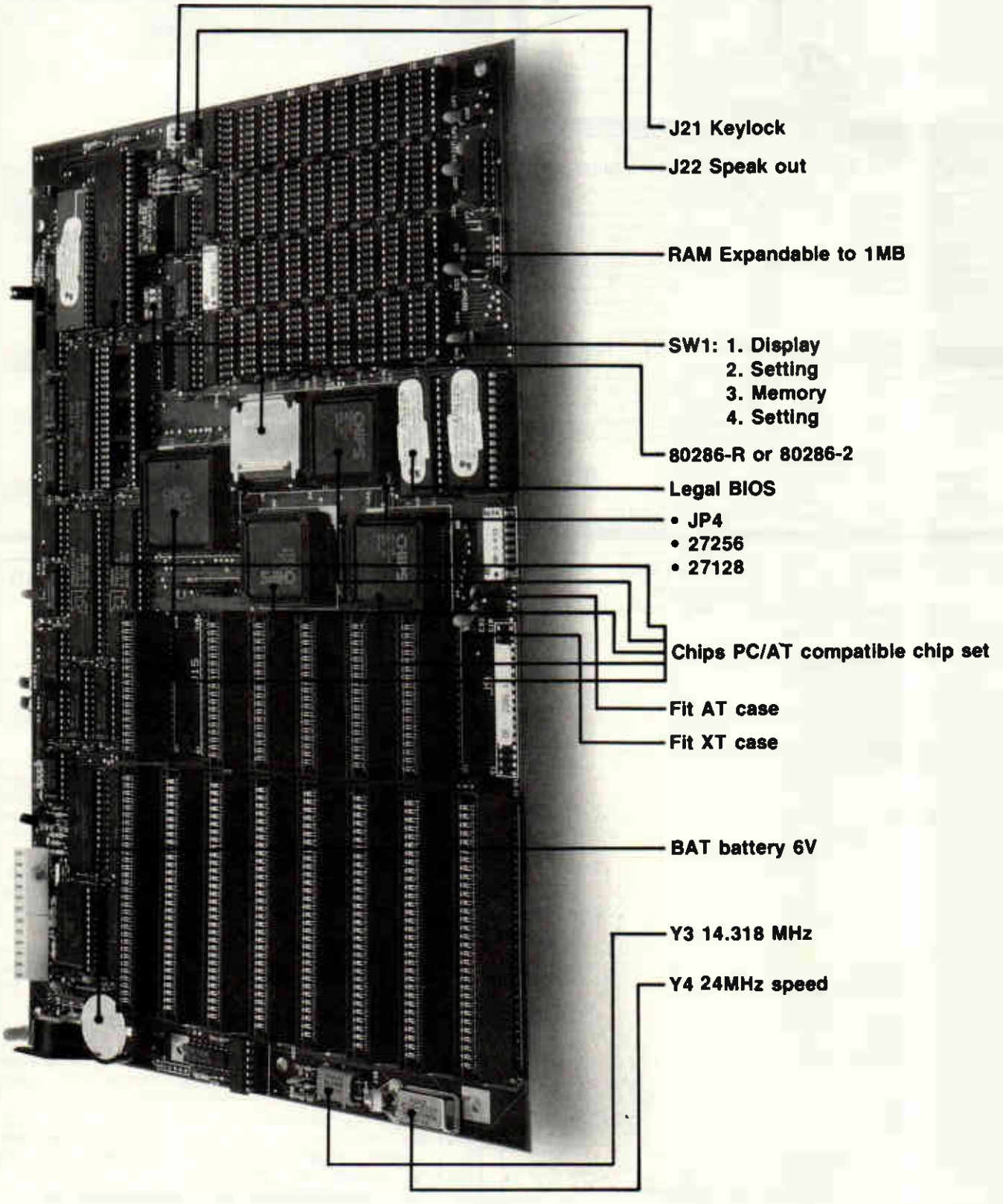

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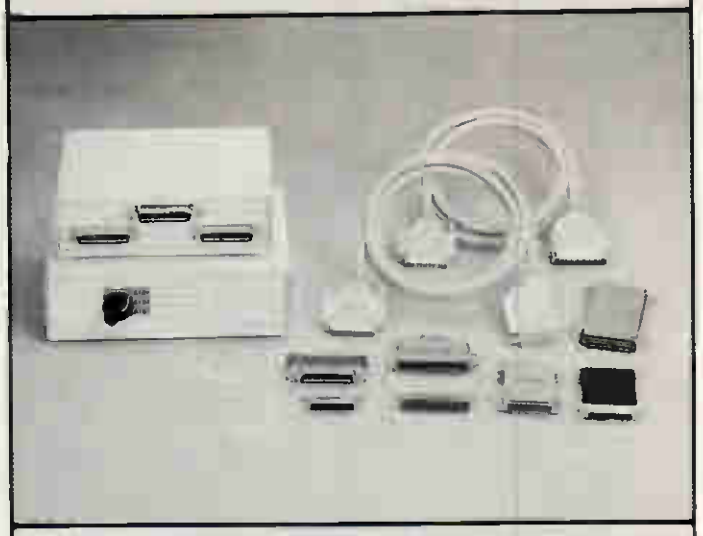

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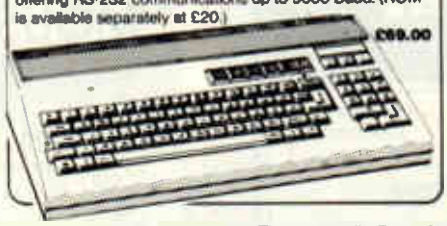

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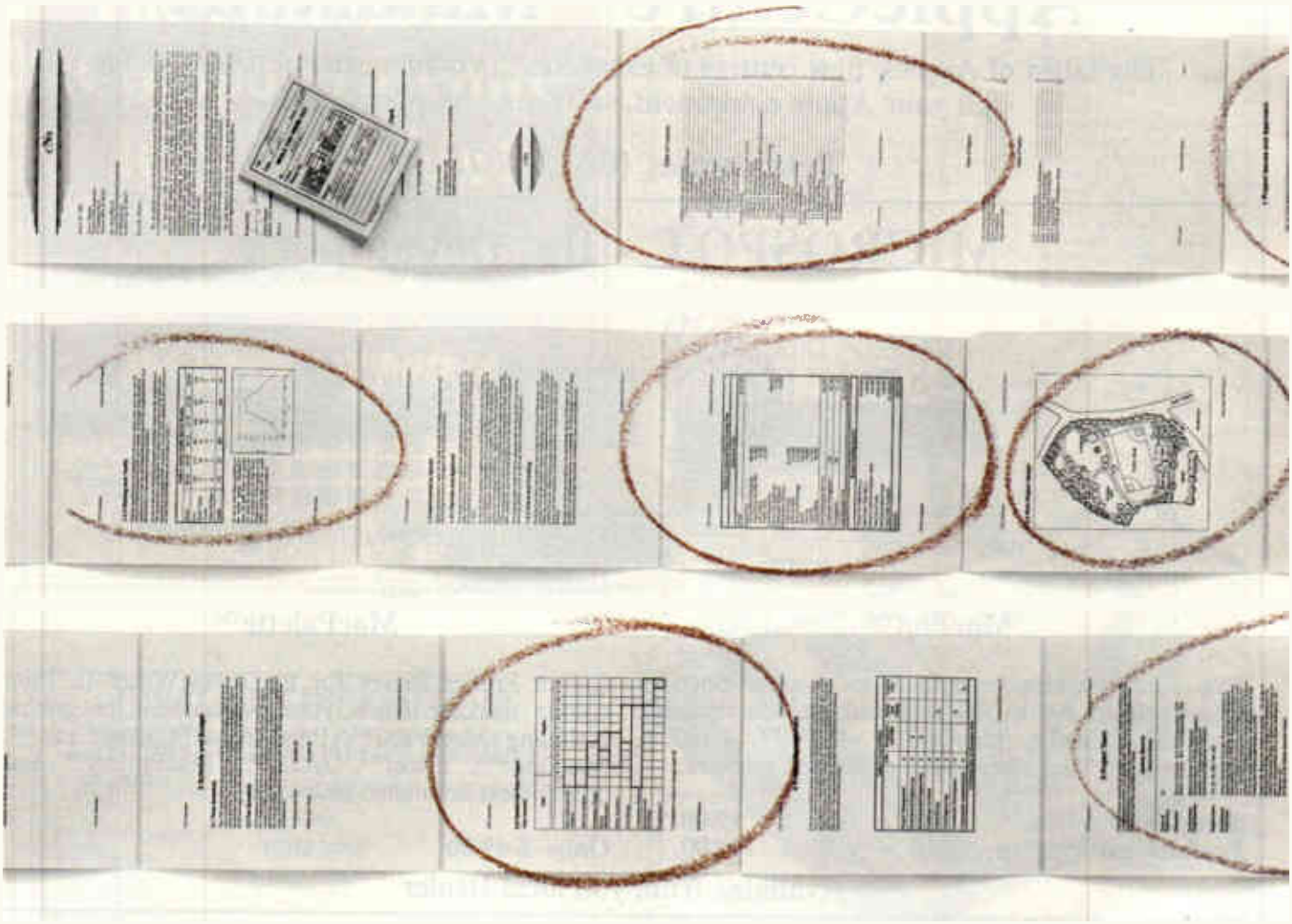

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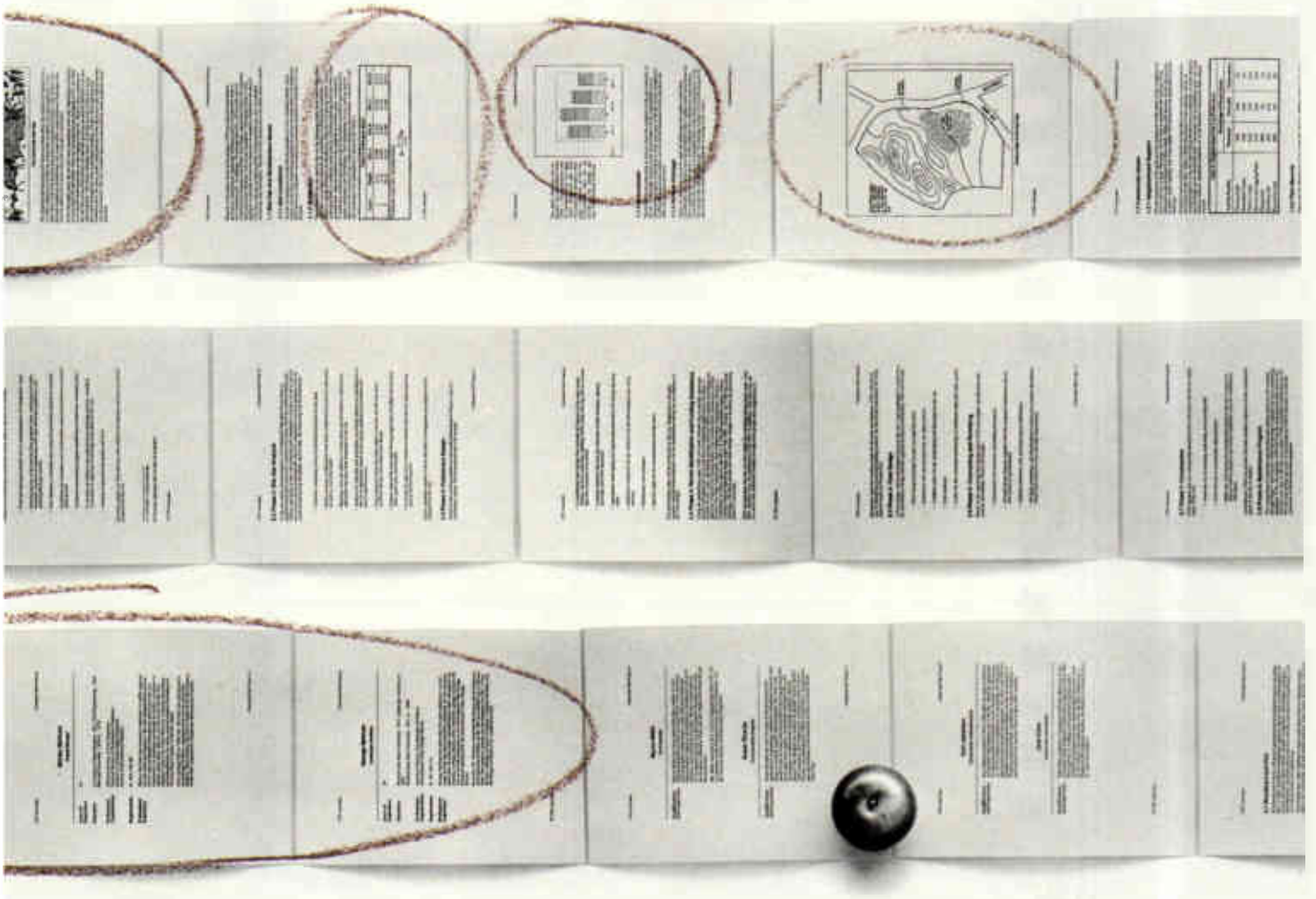

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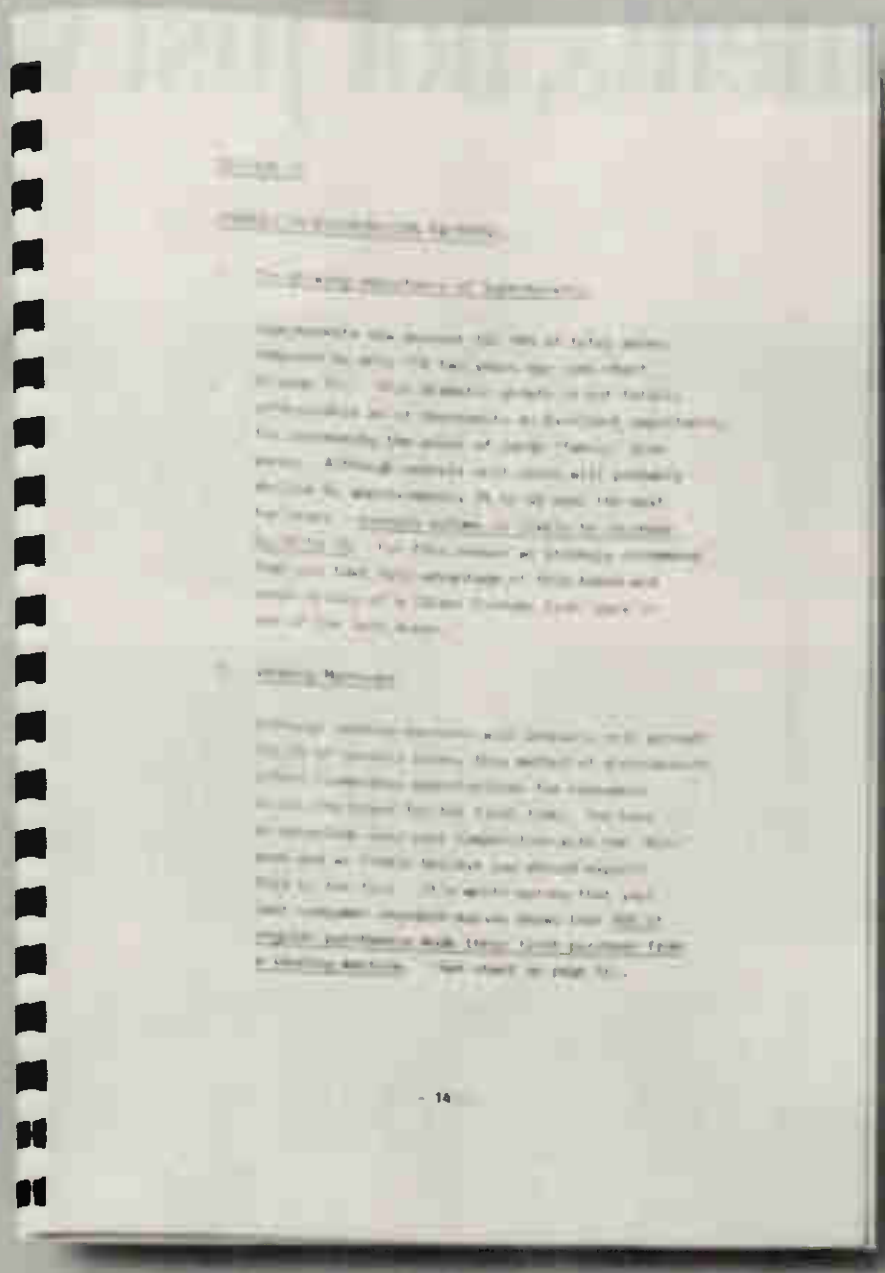

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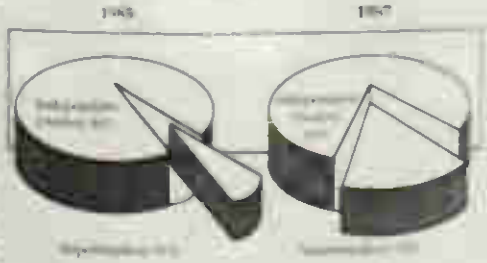

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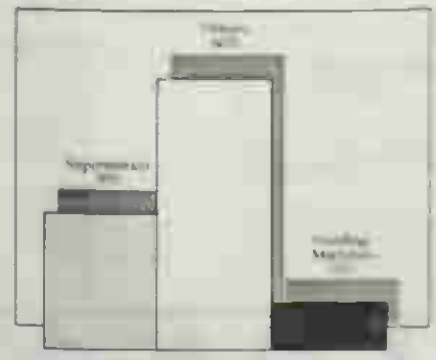

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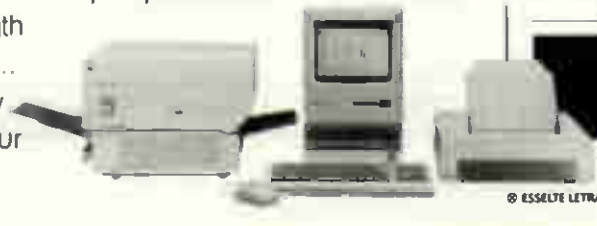

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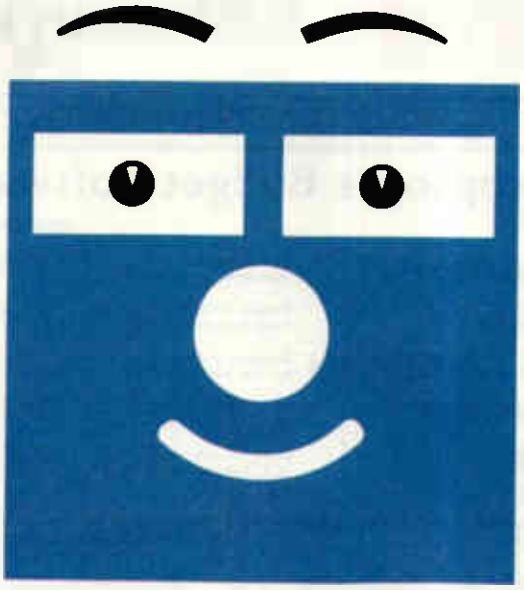

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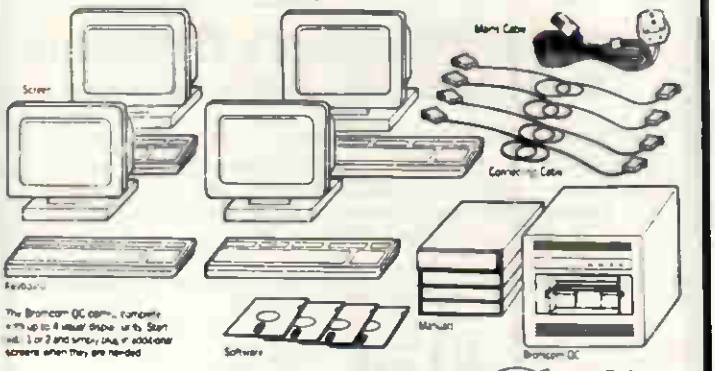

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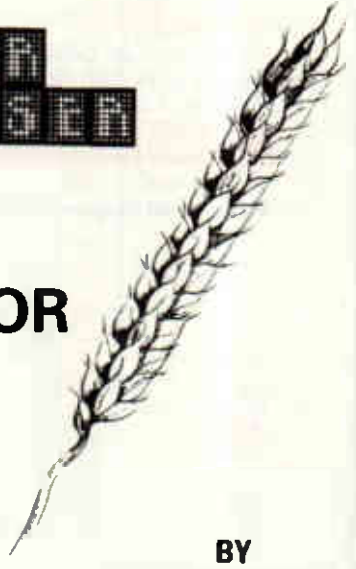

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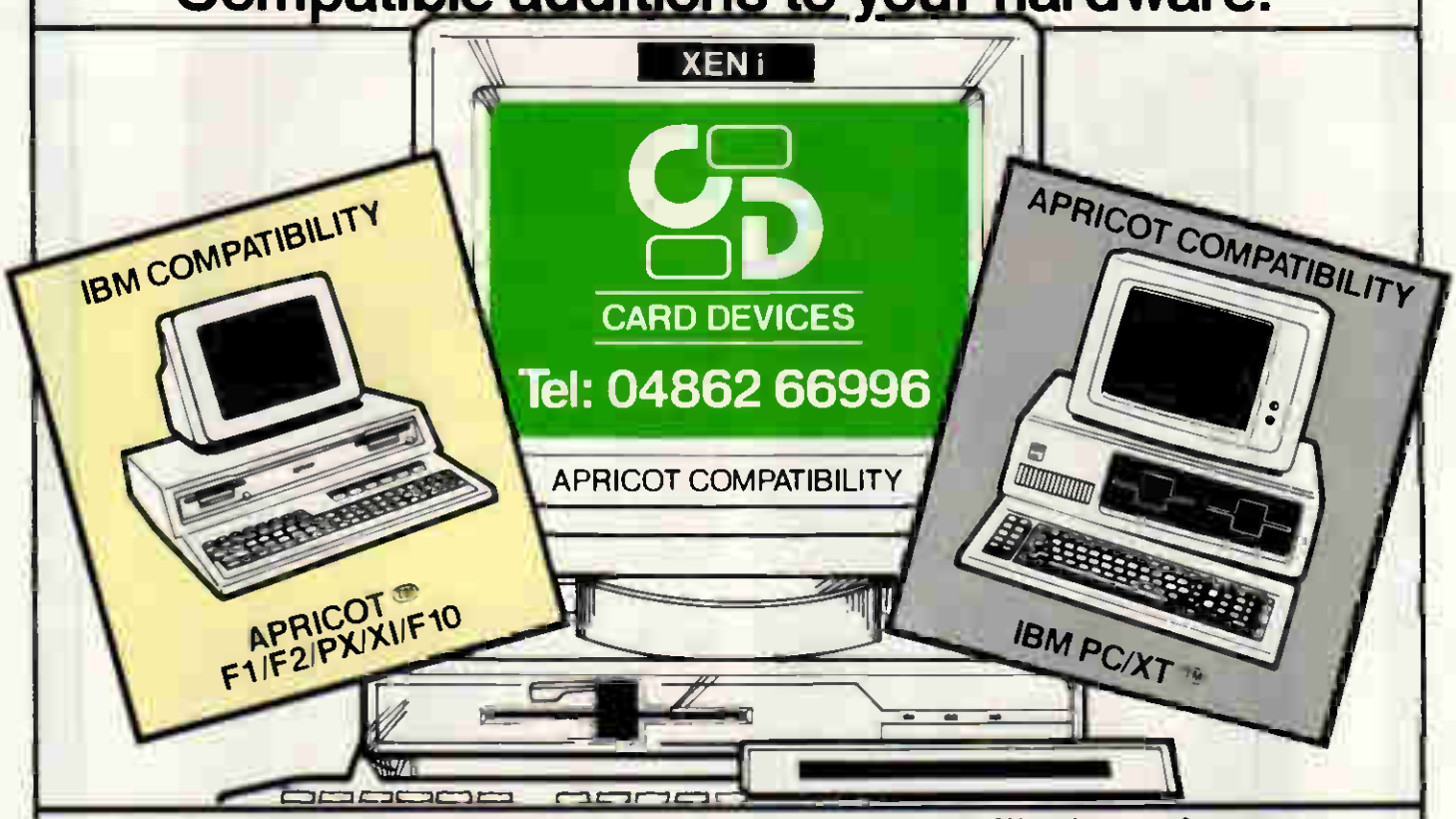

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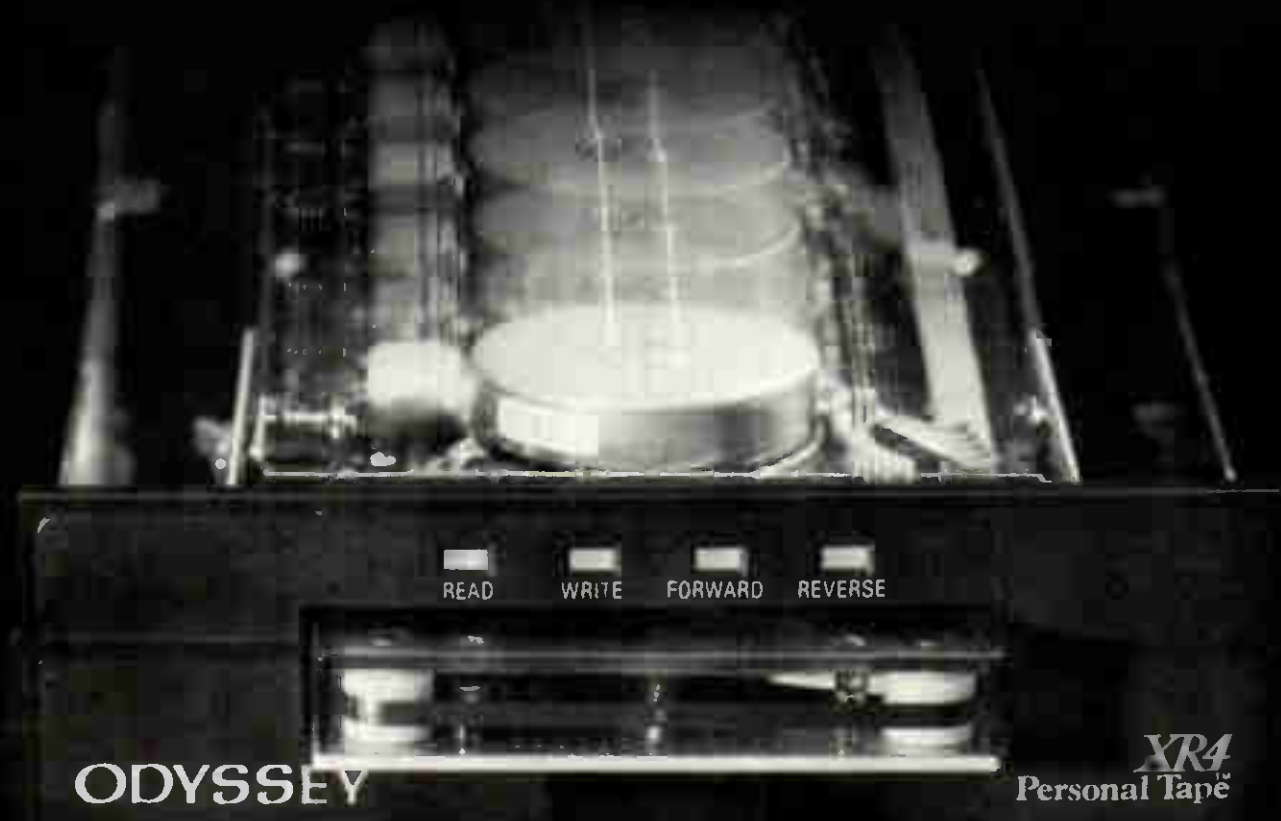

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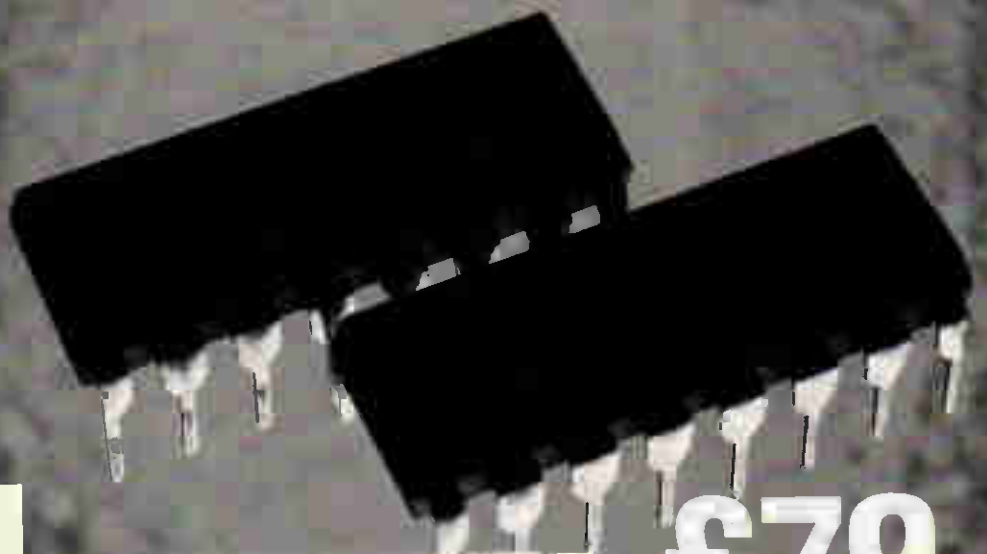

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- real time clock as standard

GRAPHICS
- full bit-mapped display
- palette of 512 colours

Using Atari Monitors (on 520 & 1040)
- 640*400 high resolution - monochrome
- 640*200 medium resolution - 4 colours
- 320*200 low resolution - 16 colours
- 80 column text display (40 col low res)

Using Domestic TV (on 520)
- 640*200 medium resolution - 4 colours
- 320*200 low resolution - 16 colours
- 40 columns * 25 line text display

SOUND AND MUSIC
- 3 programmable sound channels
- frequency programmable 30Hz - 125KHz
- programmable volume
- wave & dynamic envelope shaping
- programmable attack, decay, sustain, release
- Musical Instrument Digital Interface (MIDI)
- MIDI allows connection of synthesisers etc

MOUSE
- high precision
- 2 button control
- free with 520ST-FM/1040ST-F
- non slip ball motion sensor
- removable ball for easy cleaning

STANDARD SOFTWARE
- GEM desktop
- TOS operating system
- ST BASIC interpreter/language system

INPUT/OUTPUT

MIDI out	(5 pin DIN) 31.25K baud
MIDI in	(5 pin DIN) 31.25K baud
audio out	1.0V DC peak to peak, 10K ohm
audio in	1.0V DC peak to peak, 10K ohm
RGB monitor	1.0V DC, 75 ohm
mono monitor	1.0V DC, 75 ohm
mono horizontal scan rate	35.7KHz
mono vertical scan rate	71.2KHz
sync	5V DC (active low) 3.3K ohm
modem/serial	RS232C, 50 to 19,200 baud
floppy disk	250 Kbits/s
hard disk	11.3 Mbits/s
mouse	standard Atari connector
joystick	standard Atari connector
cartridge port	128K capacity
RF output (520ST-FM)	for TV use

OPERATING SYSTEM
- TOS with GEM environment in ROM
- hierarchical file structure with sub-directories and path names
- user interface via GEM, with self explanatory command functions
- multiple windows + icons
- window resizing, re-positioning and erasing
- drop down menus (selected by mouse)
- GEM virtual device interface

COMMUNICATIONS
- RS-232C serial modem port
- 8-bit parallel printer port
- MIDI port (also for networking use)
- VT52 terminal emulation

KEYBOARD
- standard QWERTY typewriter format
- 95 full stroke keys
- 10 function keys
- 18 key numeric keypad + cursor keys
- variable auto-repeat & key click response
- keyboard processor reduces CPU overhead

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Finally, there's a personal computer that not only solves problems like other computers but also solves the one problem that other computers have created. Affordability. Silica Shop are pleased to present the ST range of personal business computers from Atari. The ST was designed utilizing the most recent breakthroughs in semiconductor technology, producing a personal computer that performs tasks with fewer parts. Which means it costs less to make. And less to buy. The latest ST computers now include built in power supplies and built in disk drives. The TOS operating system and GEM window environment are now on ROM chips which are already installed in the ST keyboard. This enables automatic instant booting when you switch on. Silica Shop are pleased to offer the complete Atari ST range. Our mail order department is situated in Sidcup and we have 4 retail outlets at Sidcup, Orpington, Lion House (Tottenham Court Rd) and Selfridges (Oxford Street). We have eight years experience of Atari products, longer than any other UK company, and are well established as the UK's No 1 Atari specialist. With a group turnover of over £5 million and in excess of 70 staff, we provide unbeatable service and support. We provide several facilities which you will find invaluable during your Atari computing life and most of these facilities are available ONLY FROM SILICA. We suggest that you read through what we have to offer, before you decide where to purchase your Atari ST.

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When you purchase any Atari ST keyboard, you will not only receive the best value for money computer on the market, but you will also receive the following from Atari Corporation as part of the package:

* BASIC Language Disk * BASIC Manual * ST Owners Manual * TOS/GEM on ROM

If you buy your ST from Silica Shop, you will also receive:

* NEOchrome - colour graphics programs * 1st Word - Word Processor

In addition, we at Silica would like to see you get off to a flying start with your new computer, so we have put together a special ST STARTER KIT worth over £100, which we are giving away FREE OF CHARGE with every ST computer purchased at our normal retail prices. This kit is available ONLY FROM SILICA and is aimed at providing users with a valuable introduction to the world of computing. We are continually upgrading the ST Starter Kit, which contains public domain and other licensed software, as well as books, magazines and accessories all relevant to ST computing. Return the coupon below for full details.

DEDICATED SERVICING - Only From Silica

At Silica Shop, we have a dedicated service department of five full time Atari trained technical staff. This team is totally dedicated to servicing Atari computer products. Their accumulated knowledge, skill and experience makes them second to none in their field. You can be sure that any work carried out by them is of the highest standard. A standard of servicing which we believe you will find ONLY FROM SILICA. In addition to providing full servicing facilities for Atari ST computers (both in and out of warranty), our team is also able to offer memory and modulator upgrades to ST computers.

1Mb RAM UPGRADE: Our upgrade on the standard Atari 520ST-M or 520ST-FM keyboard will increase the memory from 512K to a massive 1024K. It has a full 1 year warranty and is available from Silica at an additional retail price of only £86.96 (+VAT = £100).

TV MODULATOR UPGRADE: Silica can upgrade the 1040ST-F to include a TV modulator so that you can then use it with your TV set. This is an internal upgrade and does not involve any untidy external boxes. A cable to connect your ST to any domestic TV is included in the price of the upgrade which is only £49 (inc VAT). The upgrade is also available for early 520ST computers at the same price.

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We aim to keep stocks of all Atari related products and our warehouse carries a stock of £½ million. We import many software titles direct from the USA and you will find that we have new releases in advance of many of our competitors. Unlike dealers who may only stock selected titles, we have the full range. In addition, we carry a complete line of all books which have been written about the Atari ST. A range as wide as ours is something you will find is available ONLY FROM SILICA.

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At Silica Shop, we recognise that serious users require an in-depth information service, which is why we mail free newsletters and price lists to our ST owners. These are up to 48 pages long and are crammed with technical details as well as special offers and product descriptions. If you have already purchased an ST and would like to have your name added to our mailing list, please complete the coupon & return it to us. The information service is available ONLY FROM SILICA.

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520ST-M

The affordability of Atari computers is reflected in the price of the 520ST-M keyboard, which is a mere £259 (inc VAT). This version of the ST comes with 512K RAM, as well as a modulator and lead for direct connection to any domestic TV. The price does not include a mouse. In addition, when you buy your 520ST-M from Silica, you will also receive the FREE Silica 'ST Starter Kit'. During 1987, many software houses will be producing games software on ROM cartridges, which will plug directly into the cartridge slot on the 520ST-M keyboard, giving instant loading without the expense of purchasing a disk drive. With the enormous power of the ST, you can expect some excellent titles to be produced, making this the ultimate games machine. If your requirement is for a terminal, then the 520ST-M can fulfill this role too. Leads are available to connect the ST to a variety of monitors, and with the imminent introduction of terminal software on ROM cartridge, the ST provides a low price terminal for business use. If you wish to take advantage of the massive range of disk software available for the ST range, you will need to purchase a disk drive. Atari have two floppy disk drives available, a ½ Mbyte model £149 and a 1Mbyte model £199. Full details of these drives, as well as the Atari 20Mbyte hard disk are available on request. If required at a later date, the mouse may be purchased separately.

£259

520ST-FM

The 520ST-FM with 512K RAM and free mouse, represents a further breakthrough by Atari Corporation in the world of high power, low cost personal computing. This model is the latest addition to the ST family and is not only powerful, but compact. It is priced at only £399 (inc VAT) a level which brings it within the reach of a whole new generation of computer enthusiasts. When purchased from us, it comes with the FREE Silica 'ST Starter Kit' see paragraph on the left. To make the 520ST-FM ready for use straight away, Atari have built into the keyboard a ½ megabyte disk drive for information storage and retrieval, allowing you easy access to the massive range of disk based software which is available for the ST. This new computer comes with all the correct cables and connections you will need to plug it straight into any standard domestic television set. You do not therefore have to purchase an Atari monitor if you do require a monitor however, these are available with the 520ST in the following money saving packages:

520ST-FM Keyboard	Without Monitor	- £399 (inc VAT)
520ST-FM Keyboard +	High res mono monitor	- £499 (inc VAT)
520ST-FM Keyboard +	Low res colour monitor	- £549 (inc VAT)
520ST-FM Keyboard +	Med res colour monitor	- £699 (inc VAT)

Because the 520ST-FM has its own power transformer built into the keyboard, there are no messy external adaptors to clutter up your desk space. You are left with only one mains lead, serving both the disk drive and the computer. You couldn't ask for a more stylish and compact unit.

£399

1040ST-F

For the businessman and the more serious home user, Atari have their most powerful model, the 1040ST-F with 1024K RAM. The low cost powerhouse can be introduced into a business environment as a stand-alone system, or can support a mainframe computer as a terminal. The 1040ST-F not only features twice as much memory as the 520ST-FM, but also includes a more powerful built-in disk drive. The drive featured on the 1040ST-F is a one megabyte double sided model. The extra memory facility of the 1040ST-F makes it ideal for applications such as large databases or spreadsheets. Like the 520ST-FM, the 1040ST-F has a mains transformer built into the console to give a compact and stylish unit with only one mains lead. The 1040ST-F is also supplied from Silica Shop with a free software package and 'ST STARTER KIT'. In the USA, the 1040ST-F has been sold with a TV modulator like the 520ST-FM. However, for the UK market, Atari are manufacturing the 1040ST-F solely with business use in mind and it does not currently include an RF modulator, the means that you cannot use it with a domestic TV (Silica Shop do offer a modulator upgrade for only £49). The 1040ST-F keyboard costs only £599 (inc VAT) and, unless a modulator upgrade is fitted, will require an Atari or third party monitor. There are three Atari monitors available and the prices for the 1040 with these monitors are as follows:

1040ST-F Keyboard Without Monitor	- £599 (inc VAT)
1040ST-F Keyboard + High res mono monitor	- £809 (inc VAT)
1040ST-F Keyboard + Low res col monitor	- £799 (inc VAT)
1040ST-F Keyboard + Med res col monitor	- £999 (inc VAT)

The 1040ST-F comes with a mouse controller and includes 1Mbyte of RAM. It has a 1Mbyte double sided disk drive and mains transformer, both built into the keyboard to give a compact and stylish unit, with only one mains lead.

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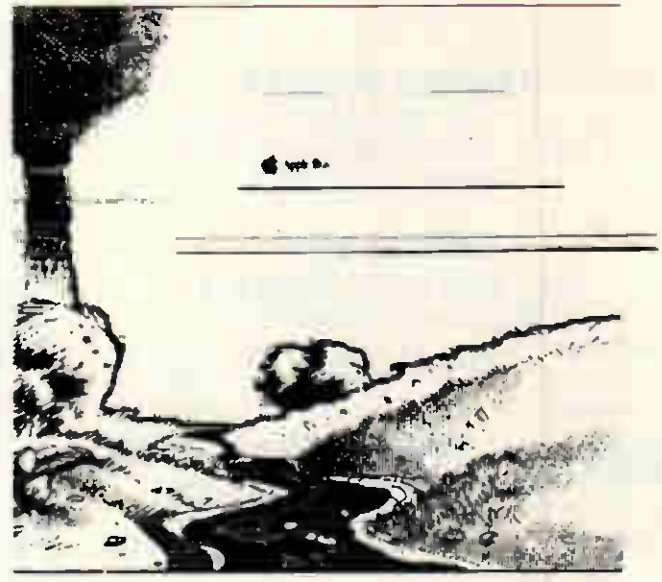

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Financial

Mike Taylor, Principal Technical Officer of Surrey County Council, Kingston-Upon-Thames, uses his Macintosh to plan an annual budget of around half a billion pounds. "Terrific - so innovative" he says, "Who needs an MS-DOS machine when there is a Macintosh around?

That's the bottom line.

Apple Desktop Publishing

QE2 passengers enjoy their own edition of the International Herald Tribune everyday, little do they know that a Macintosh is at the centre of this satellite transmitted newspaper. Martha Wooding, a publishing consultant, reports: "The priorities for creating an on-board newspaper for the QE2's passengers were quality and speed, the Macintosh was the obvious answer.

Now she does make the front page news

Information Management

Michael Bird, Managing Director of Consumer Magazines for International Thomson Publishing, is a long standing user of Macintosh with Jazz, exploiting all five applications of the program.
He reports that the Macintosh graphics on Jazz are of paramount importance for his appreciation of current trends and future projections. "Sometimes the image on the screen is surprising. Figures can be a revelation when graphically represented.

Word Processing

Douglas Adams, author of "The Hitchhiker's Guide to the Galaxy", confessed that he was bowled over by the Macintosh after a short demonstration.
Michael Bywater, a writer and contributor to Punch magazine, is no less impressed. He summed up the Macintosh in one sentence. "Very much superior to any other available computer in all respects.

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Local Area Networks

PC Phil Morton of the West Midlands Police helped to instigate a network of five Macintoshes to keep track of files and documents. The system will shortly expand to analyse crime trends and evaluate officer postings. He reported: "The whole system is very, very good - I am highly impressed - It exceeds all my expectations. The five Macintoshes are in use night and day.

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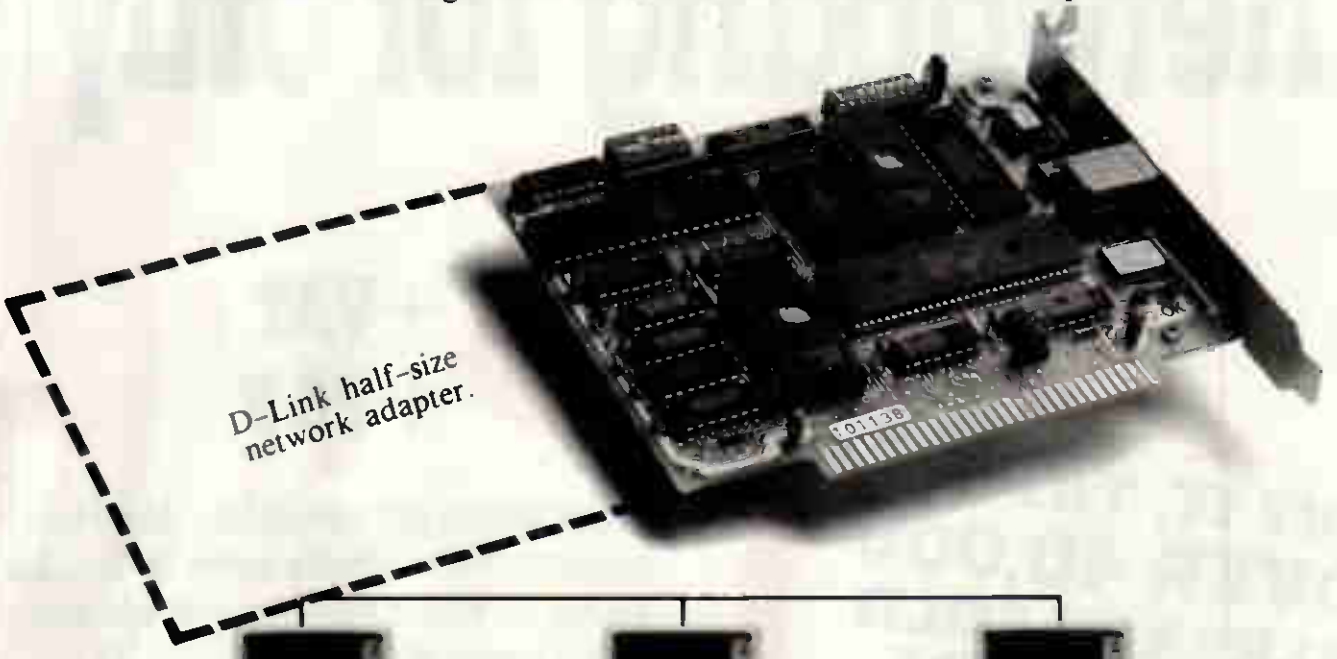

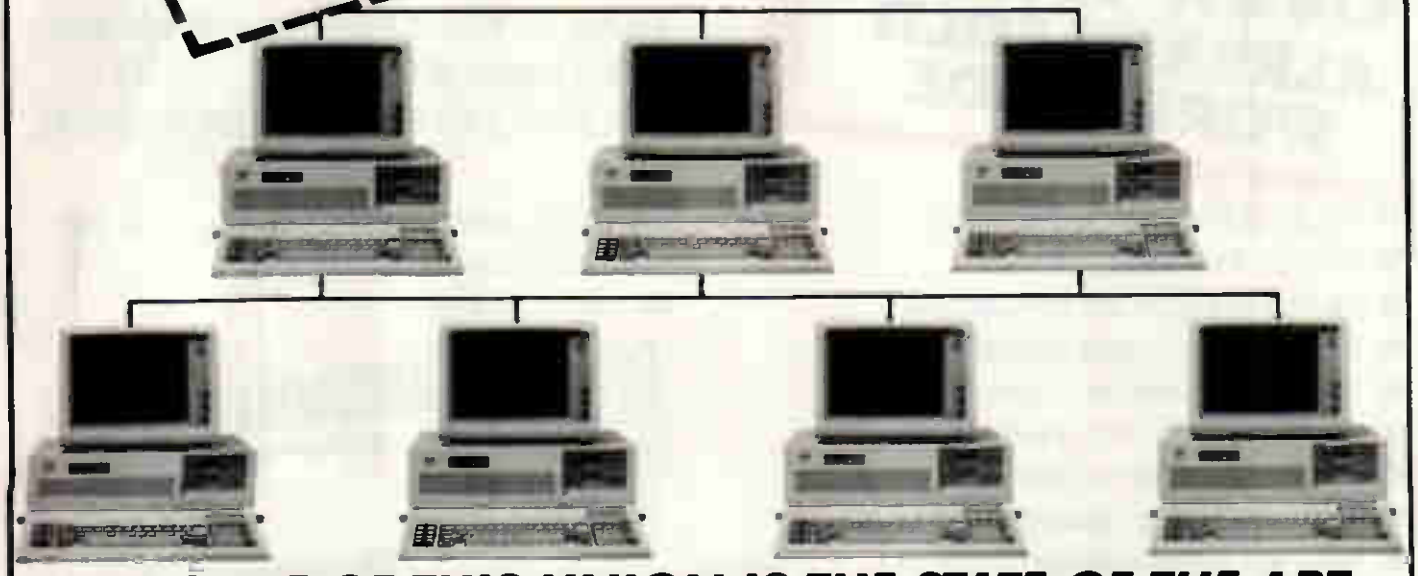

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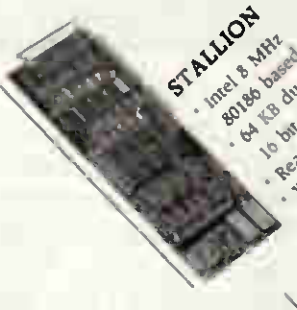

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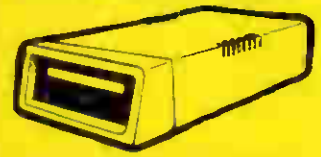

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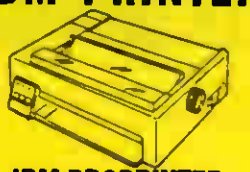

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JANUS/Ada S-Pack	MS-DOS	£1970
Augusta (with source)	CP/M-80	£ 75
JANUS/Ada C-Pack	CP/M-80	£ 130
JANUS/Ada D-Pack	CP/M-80	£ 260
Supersoft Ada	CP/M-80	£ 250

CHIP CHAT

Our grateful thanks go to a reader who spotted Dixons sales staff getting their wires crossed and leading potential comms users up the garden path. An eager staff member was overheard advising a customer who had just bought a Kirk Enterprise modem to use with his Amstrad PC.

'Have this program,' the worker said, handing over a copy of the excellent American shareware comms program Procomm. 'This'll get you logged on to Prestel.'

Fact one: Procomm doesn't do viewdata emulation. Fact two: Procomm won't handle split baud rates like 1200/75. Fact three: being American, Procomm comes configured for a Hayes-compatible modem; the Enterprise isn't.

To add insult to injury, Procomm is user-supported which means it cannot be given away free as part of a commercial transaction. You may be assured that the Dixons branch has now been told to curb its enthusiasm for user support and get back to shifting boxes . . .

Also getting its wires crossed is Modem House, the controversial modem manufacturer which used to plaster its modems with green stickers saying 'approved for connection to the intergalactic network' or similar when it couldn't get BT's official ones.

Just two days after we received a notice that the company had gone into voluntary liquidation, we found in the post a catalogue extolling the virtues of its new internal modem for the Amstrad PC.

Modem House boss Keith Rose must have sent the price list through his intergalactic network and it got lost in the Alpha Centauri sorting office . . .

The company which installed the photocopiers at Olivetti's Putney head office must be making a pretty penny. Olivetti has sent us yet another revised price list — the second in two weeks.

With PC compatible marketing being such a cut-throat business these days, perhaps we'll soon have daily price changes published in the newspapers alongside the stock market quotations . . .

Some people will try anything to get into *PCW* cheap. Interface Devices of Hastings is concerned that people don't confuse it with the recently folded Interface plc whose stock is being advertised by Morse Computers of Holborn.

'To address the damage we feel this advertisement has done to our own business we would like to talk to you about placing an advertisement for our own products — perhaps at a discount price to us.'

At that rate, our deputy editor Nick Walker could claim cheap TV time because people think he is the manufacturer of a brand of crisps and production editor Ginny Conran could get cheap furniture because she keeps on getting mail addressed to the head of Heals and Habitat . . .

Not that the computer industry has a monopoly on people with an eye to a quick buck. We were recently visited by a photocopier salesman who had clearly had a bad day.

Everywhere he went, people were more interested in discovering where they could lay their hands on an Amstrad PC than in buying a photocopier.

Despairing of earning enough commission to buy his next square meal, he came in asking if we'd like to buy his list of Amstrad sales leads . . .

Thorn EMI is the company which brought you the computer adventure War Games that was linked with a film of the same name. In both, a hacker breaks into the Pentagon computer and starts to have fun.

Thorn EMI has announced a contract to supply three software systems to the UK's contribution to the US Star Wars project. Ominously they have names like 'Tracking and Kill Assessment' and 'Battle Management'.

Could there be a link, and will we now see Harrison Ford employed by that other Hollywood star Ronald Reagan to push the button . . .

The PR man for a well-known lapheld manufacturer was proudly clacking away loudly on his new battery-powered toy at the recent Apricot 386 launch. The machine comes with what can only be described as an 'improved' LCD screen, but still with no backlight.

'Look at this,' he beamed as his fingers bashed away at the noisy keyboard, entering up his preliminary thoughts before taking down detailed notes

At that point, Apricot MD Roger Foster took to the podium and the lights were greatly dimmed.

The rest was silence. . .

The problem with marketing men is that they often spend as much time selling themselves as they do the products. Stuart Greenfield looks like he's angling for a job on ITV as a song and dance man. In fact this photo is meant to be promoting the NEC Multisync monitor which Stuart's company, First Software, distributes. The other photo the company supplied shows him lounging on a pile of boxes like some centrefold pin-up waiting for the studio to warm up before he takes his clothes off.

This month . . .

This seems to be a month of mould breaking. After a long period when micro creativity seems to have been stifled by an unquestioning obeisance to the great god of PC compatibility, colour and excitement is breaking through the grey, making it an exciting industry to be part of.

Each time we scan through the pages of this issue of *PCW*, it takes our breath away. Page after page is filled with innovative and exciting products which show that the computer industry is far from dead from the neck up.

The new Macs combine numerous innovative features such as expandability and colour that have long been sought after. The Amiga 2000, too, provides an option for those who want the excellent colour and sound capabilities of an Amiga but don't want to let go of the apron strings of PC compatibility. And Lion's Orator card shows the way forward for communications products.

There's also Lotus Manuscript, a product that goes beyond mere word processing, and extra goodies for those who want to put life back into their Commodore 64s.

Finally, don't forget to complete the reader survey on page 89 — we wouldn't want you to miss out on winning one of our six prizes. In fact, why not fill it in now before your head starts spinning with this month's marvels?

The Micro P printers produce words faster than you can say them at prices we like to shout about.

Our dot matrix printers have all the features you'd expect from best selling machines; fast speeds, graphics and on some there's optional font cards to give you various type styles to help you look good on paper.

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MP 165 – £229 RRP EX VAT
This best selling 80 column printer is capable of 165 cps in draft mode or 35 cps in Near Letter Quality (NLQ). It boasts a 2k buffer, high resolution graphics capability as well as friction and tractor feed.
It suits all major micros and is Epson compatible.

MP 200 – £329 RRP EX VAT
A brand new machine, giving 200 cps in draft and 40 cps in NLQ mode. This 80 column printer has many features including 7k buffer, high resolution graphics and optional interchangeable IC Font cards. It is IBM and Epson compatible and will hook up to almost any micro.

CPA-80+ – £199 RRP EX VAT
With 100 cps quality printing the CPA-80+ probably gives more cps per £ than any other printer available. It is packed with features you would normally find on a more expensive printer including friction and tractor feed and graphics capability. It will connect to almost any micro and is Epson compatible.

MP 201 – £399 RRP EX VAT (Not shown)
A 136 column printer with same specifications as MP 200.

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