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AUSTRALIA'S TOP OMPUTER MAGAZINE

SPECIAL FEATURE: Comprehensive Guide to Desktop Publishing

ULTRA-CHEAP CLONES: BARGAIN BUYS OR HIGH-TECH JUNK?

Seven budget PCs compared

Which of these new words will give you the most zitboodle?

Remember the good old Anglo-Saxon days when *wig* meant *war*?

How about when *radio* was *wireless*?

Every year, new words creep into our language, giving us greater control of our ever-changing world.

In this list of recent arrivals you will find one new Word in particular that gives you power over all others.

anfo *[milit]* a type of home-made explosive used for terrorist bombs in Ulster.

bumblepuppy *[sport]* in bridge, a game played at random, with neither rhyme, reason nor sensible planning.

cocktail *[medic]* **1.** a barium enema. **2.** castor oil.

electronic smog *[audio]* non-ionising radiation – i.e.: radio or TV waves or radar – emitted into the air in such amounts as to threaten public health.

FIDO *[aerospace]* Fog Investigation Dispersal Operation: a method of dispersing fog above airports by using the heat from petrol burners.

fuff *[TV]* fake snow for wintertime effects.

googol *[science]* slang for 10 to the hundredth power.

humint *[espionage]* human intelligence: gathering of material by means of human beings – spies – rather than by electronic surveillance.

kludge *[computers]* **1.** an improvised do-it-yourself lash-up which may well work. **2.** a factory-made computer which still has some (endearingly) odd characteristics.

meg *[finance]* $1,000,000.

nodders *[TV]* the interviewer's reaction shots, often no more than nodding at the answers his questions receive, which are usually filmed after the actual interview and edited into the tape prior to transmission.

nuplex *[industry]* a complex of manufacturers all of whom use nuclear power within their factories or plants.

nybble *[computers]* half a byte or four bits.

operant conditioning *[business]* the persuading of one's workforce to do what you wish them to do – often by providing incentive schemes, productivity bonuses, etc.

psychic income *[econ]* **1.** aka: *psychic compensation*: the non-monetary and non-material satisfactions that ideally accompany an economic or work activity. **2.** the non-measurable mental and emotional satisfaction a consumer gleans from an item or a service that he/she purchases.

quasimodo *[sport]* in surfing, riding a surfboard in a crouched position; from the posture of the fictional 'Hunchback of Notre Dame' in Victor Hugo's *Notre Dame de Paris* (1831).

rep-tile *[maths]* aka: *reptile*: two-dimensional figures of which two or more can be grouped together to make larger scale models of themselves.

soup *[science]* the waste products of a chemical process.

space gun *[aerospace]* a hand-held instrument that propels the astronaut while he is working outside the capsule.

vidkids *[entertain]* youthful addicts of computerised arcade video games.

wargasm *n [milit]* a crisis that could lead to the outbreak of a war; the war that followed such a crisis: in both cases the image is of an escalating compulsion towards conflict that takes over from sense and restraint and must reach its nuclear climax.

white hole *[science]* a hypothetical source of matter or energy, posited as the 'other ends' of black holes and as such expelling all the matter and energy.

wormhole *[science]* a hypothetical passageway in space that connects a black hole and a white hole.

yumpsville *n [movies]* the unsophisticated rural and small-town audience whose favourite films mix sex and violence and keep the dialogue and intellectual stimulus down to a minimum.

zitboodle *[business]* power. (see *New Microsoft Word*).

New Microsoft Word 3.0 *[for the Macintosh]* is the last word in document processing.

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John Brown; MS7

* Definitions from *Newspeak. A dictionary of jargon* by Jonathon Green. (Except for *zitboodle*. We invented one great new Word so why not another?)

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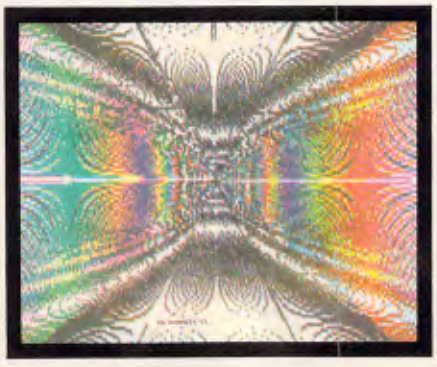

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DTP SPECIAL

101 SEYBOLD DESKTOP PUBLISHING SHOW

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107 PUBLISHING ON THE IBM PC

There's no doubt about the current boom in desktop publishing; and the availability of true WYSIWYG packages — such as GEM Desktop Publisher, The Office Publisher, PageMaker and Ventura Publisher — has spurred the increase in sales. *APC* takes an in-depth look at each of these products and then compares them against each other.

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PageMaker has long been in the forefront of desktop publishing for the Mac, but it seems that XPress, the latest release from Quark, is ready to take the lead and establish itself as the new yardstick. Kester Cranswick examines both packages and gives us his choice.

DESKTOP PUBLISHING

Unfortunately, due to lack of space this month, a table listing the features and specifications of desktop publishing packages, for the IBM PC and Mac, will be included in the November issue of *APC*.

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- *Tri-colored LED*
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- *Industry standard ST412 interface*

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Like other MiniScribe products, the 3650 incorporates the company's high standards of quality and innovation. The 3650 utilizes MiniScribe's field-proven rack and pinion linear actuator system which provides positioning accuracy throughout temperature extremes as well as rugged resistance to shock and vibration. In addition, the drive incorporates the industry standard ST412/506 interface.

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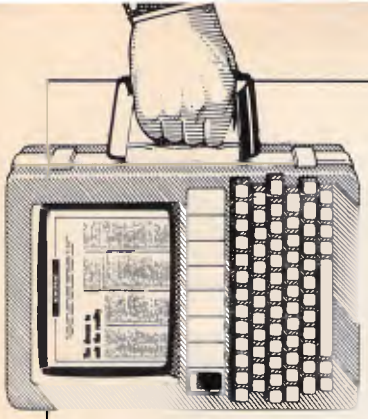


More multi-tasking, multi-user operating systems appear — this time from Digital Research, more delays for PS/2 clones, Turbo Pascal breaks the 64k memory limit and Lotus removes copy protection from 1-2-3: just some of the news in this month's round-up of micro happenings.

DOS-emulation 'liberates' programs

Rapid advances in software-emulation techniques are helping to bring PC software to non-PC-compatible workstations.

The latest research effort comes from Hunter Systems in the US, which claims its new XDOS emulation software may be one of the fastest of these programs.

XDOS, expected to be shipped by the end of this year, will allow computers based on the Motorola 68020 chip to run IBM PC software at speeds at least twice as fast as an AT, claimed Hunter Systems' President, Colin Hunter.

"PC software is going to be liberated from the constraints of the PC architecture and available on much more powerful computers," Mr Hunter said of the emulation technologies now being used by Hunter Systems and other companies.

Emulation allows a machine to run software designed for another machine without special hardware or recompilation of the software. Though emulation programs are believed to be the least expensive way to run incompatible software, until recently their operation on microprocessors slowed down software execution to unacceptable levels.

John Logan, senior analyst at the Yankee Group, an American market-analysis firm, said emulation techniques signify a direct threat to the IBM PC architecture in the workstation market.

Machines based on the Motorola 68020 processor — which comprise more than 40 per cent of the installed base of workstations — frequently offer superior graphics capabilities and a solid library of technical software, but in the past couldn't run MS-DOS software.

"Now companies like Hunter are saying you can have your cake and eat it, too," said Mr Hunter.

A version of XDOS for the Fairchild Clipper chip, an advanced Reduced-Instruction-Set- Chip (RISC) processor used in some high-end workstations, will be introduced in 1988, and other versions are likely to follow, Mr Hunter said. XDOS is currently implemented only for Unix, but Mr Hunter said it could be targeted to other operating systems as well.

In recent test, XDOS ran PC software on a Sun Microsystems' Sun 3/160 workstation, which contains a 16MHz Motorola 68020 chip, at about twice the speed of a PC/AT, Mr Hunter said.

He added that although no formal comparisons have been made, he was confident that XDOS will enter the new year as the fastest emulation software available for the 68020.

Phoenix Technologies and Insignia Solutions both market PC emulators for the Motorola chip. Phoenix officials have claimed its emulation can achieve two or three times the power of an XT on a 16MHz 68020 machine.

According to Mr Hunter, XDOS uses a combination of both compilation and interpretation emulation techniques. Compilation seeks to translate 'foreign' instructions to a machine's native code prior to execution. Interpretation, on the other hand, performs that translation during execution.

"We get the performance benefits of a compiler, and the accurate simulation advantages of an interpreter," said Mr Hunter, though he declined to be more specific on his firm's technique.

Other companies' emulation techniques rely heavily on some form of interpretation. Phoenix's program, for instance, interprets whole blocks of instructions at a time whenever possible.

XDOS users must run a short installation process the first time PC software is run on a foreign workstation. Mr Hunter claimed that the process, called XStall, is "just like installing any software" for the PC, usually requiring a few minutes for most applications.

Atari reveals all

Finally, Atari has confessed: it is designing a Transputer-based system. When Atari has finished designing this new machine, the company should be able to wave two fingers at Acorn's claim to have the 'fastest micro in the world'.

A Transputer, for those who have spent the past few months reading other magazines, is a 32-bit microprocessor designed by a UK company, Inmos. It has two unusual features: first, it has a reduced (fast) instruction set; and, second, it is capable of working in parallel with other Transputers.

So much, readers of this column will already know. But up until now, all this has been denied by Atari. Now, it has done more than confess — it has revealed all. The company finally broke down the barriers and arranged for me to meet Jack Lang, founder and chairman of Perihelion, who has been designing a Transputer-based 'workstation' for nearly a year now; and whose workstation will become the new Atari machine next year, when it is finished. Lang was encouraged to tell all he wanted to about the future design.

The two companies have signed an official contract whose details are desperately hard to extract. But my sources seem convinced that the essence of it is that

Atari has the rights to the machine, while Perihelion keeps control of the operating system, Helios. Atari will then license Helios from Perihelion. That is sensible because it will mean that there is a real chance of Helios becoming a Transputer standard, not an Atari-only operating system.

Now, as to the machine. The good news for ST users is that it will be available to them as an upgrade. And it will also be available as a standalone box — roughly the same size as the Mega ST box.

There are already Transputer upgrade boards available, but what Atari and Perihelion are aiming for is a much more powerful, versatile system than a simple co-processor.

Eventually, what I expect to see (based on what Jack Lang and Hugo Davenport are designing with Richard Miller, the new managing director of Perihelion), will be under $2500, and will have only the rudiments of the St left inside it.

The Transputer-based Atari ST is going to make the likes of Steve Jobs' next launch look sick, and will certainly end the debate about whether the Atari or the Amiga is the most advanced machine.

At a rough guess, the machine will be 10 times as powerful as an IBM AT — more, if you measure floating point operations. The T800 version of the Transputer is a very, very fast chip.

The key aim will be to make genuine animation possible at very high resolution.

To do this, the ST will become just the input and output processor for the Transputer. The Transputer will be an amazing graphics engine and a hugely powerful number cruncher.

And, because of its Transputer links, it will be able to add other Transputers, either as a local area network of Atari Transputer systems, or as a multi-processor array.

Inside, I would expect a special-purpose logic array to be the interface between Transputer and screen, and it looks as though it will have a wide range of very high-resolution screen modes — all very gee-whiz.

Gee-whizzery doesn't make a sensible machine, however. What makes this one sensible is that you should be able to emulate any other screen with the choice of these modes, so the appearance of a proper IBM PC emulator is almost inevitable.

I also expect the Transputer to have 1Mbyte of screen memory, driven by a bit blitter, and 4Mbytes of system memory, upgradable to 64Mbytes (well, more actually, because the Transputer can talk to 4GBytes, but not in one box).

Now for the operating software. Tim King, managing director of Perihelion Software is the man who originally wrote AmigaDos for Commodore. He has been very open about the fact that he will *not* be writing AmigaDos again.

"We produced a better filing system with AmigaDos," said King, "but the world wants MS-DOS compatibility, not a better system."

Helios will have MS-DOS compatible files, but it will not be MS-DOS. And it will certainly *not* be Unix either. Tim King said: "Miles Chesney, the designer of the Transputer, always believed that you could — theoretically — get Unix on to a Transputer machine. But it would be silly."

Silly, because of the nature of the machine which Unix imagines it is running on. Unix has to have all its processes separate, and (says King) to do this on the Transputer, you'd have to have a different Transputer chip for each process. Typically, that would be 50 chips — an enormously powerful machine. And Unix requires system processes to be 'insulated' from each other, but, on the Transputer, you can't arrange this. It allows processes to communicate — no, it has been expressly designed to make such communication fast. "It would be like trying to power a bicycle by connecting a mains lead to the lamp dynamo," was the way someone put it to me. "It would work in that it would make the wheels go round, but you'd have to wonder what the point was."

As to what Helios will be (as opposed to what it *won't* be) we'll have to wait for details. King wants it to be the standard non-Occam operating system for the chip. Occam is the multi-processor language invented by Inmos, and now has the status, as Jack Lang put it, of an assembler. It's pretty good at getting the best out of the chip, but it isn't written in the C language, and a C compiler is what most software of the future will be written for.

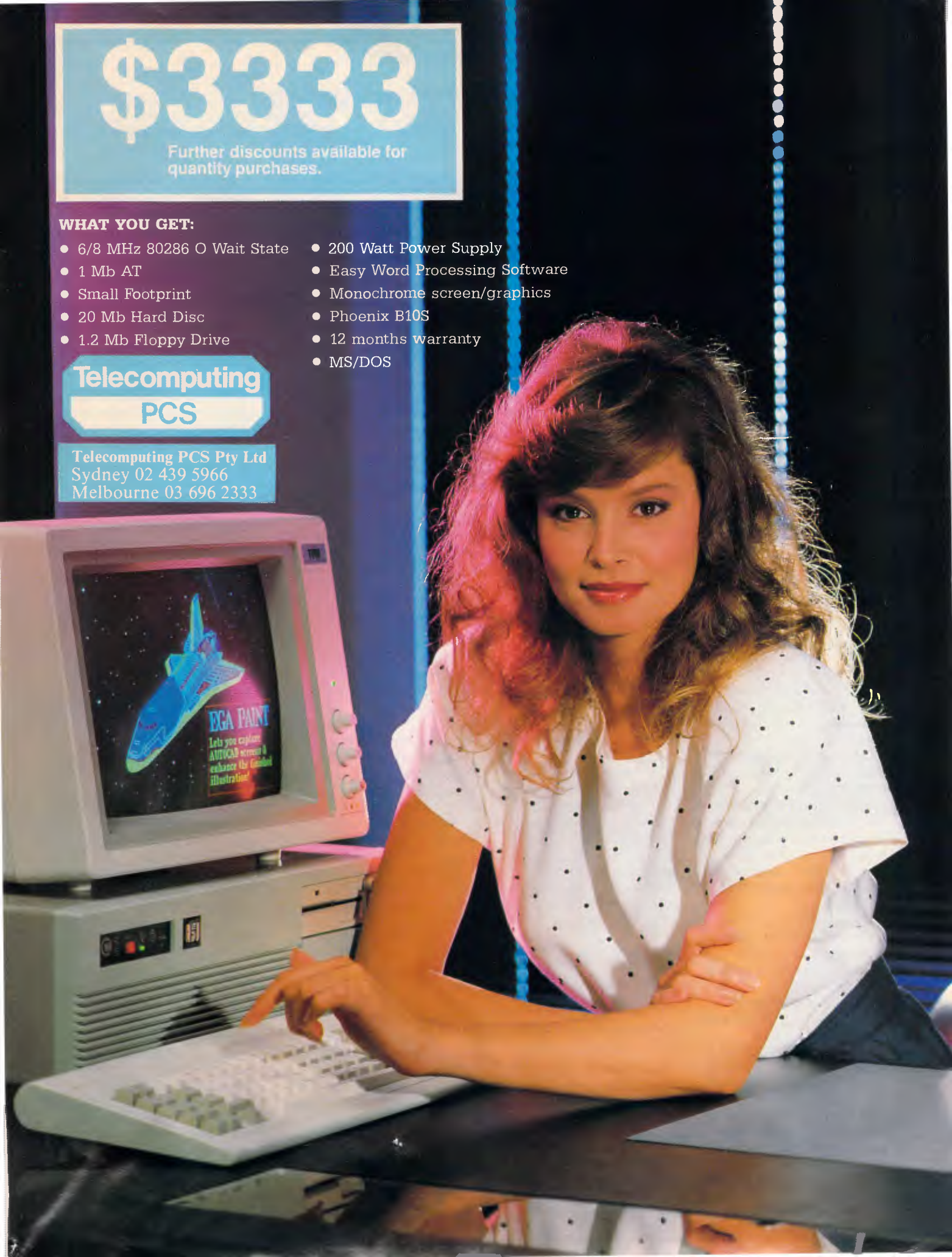
There is precious little software currently available for a Transputer, and by the time the machine is ready for the market, there had better be some under way.

Programmers have to get excited about it, so Jack Tramiel, much against his own instincts, has decided to break the veil of secrecy, even though it will give potential rivals a chance to catch up earlier.

For my part, I'm amazingly excited already. Parallel

Xerox has launched a free local bulletin board service for Ventura users. The board, which can only be accessed by registered Ventura users, carries technical information and hints and tips from Xerox staff and other Ventura users.

Xerox is encouraging users to use the service to exchange advice and style sheets. The bulletin board is on (02) 449 0463.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EGA PAINT

RISC chips are the way for this technology, and I wasn't expecting this much of a step forward this year. But not everyone will agree.

You will, believe me, read a lot of pooh-poohing about the idea from established commercial programmers and machine builders. Most of them will explain, as if to a troublesome child who simply will not pay attention: "The trouble with having a machine which is very good at running parallel processes, is that there isn't any recognised way of dividing the world up into parallel problems."

Established programmers think of the world as sequential because they have been trained, brainwashed and tortured into seeing it that way, in order to cope with it on serial processors. But, as any fool who knows nothing about computing could tell you the world *is* parallel!

Indeed, there is a special branch of computing — real-time computing — devoted to the problems that arise when you try to get a system running in control of things that happen when *they* want to happen, rather than when the computer thinks it's okay.

The problem isn't getting the problems into parallel form, but getting the programmers untrained from the unnatural and perverse mind-set they have been distorted into by the need to write programs step by step on a sheet of paper. That will take time.

The technology of using processor arrays becomes tricky when you have to write programs for a limited number of parallel machines, and you don't know how many will be available.

A compiler that takes your code and 'spreads it around' according to the number of Transputers available, is said to be technically feasible, but no such thing will exist for a few years yet, say the theorists.

I expect Perihelion to work on the next-generation machine at the same time — a machine with eight Transputers — so that people know they will have eight chips to share the process with.

Atari will be running programmer seminars from around the end of this year, explaining in detail what the Transputer-based machine will do and how to exploit it. If you are asked to pay $500 to attend, I'd suggest it was worth the money.

Guy Kewney

Polaroid has introduced its PalettePlus image recorder. Advancements over the original includes compatibility with EGA output (or EGA compatible output utilising a 21.85KHz sweep) and improved operating software.

While the PalettePlus is capable of producing images with resolutions as high as 920 x 700 pixels, output resolution is dependent on the actual hardware and application software combination used. So, if the graphics application software used does not have built-in drivers for the PalettePlus, image resolution with an EGA-equipped computer will be 640 x 350 pixels.

The PalettePlus sells for $3800 (excluding sales tax).

PostScript clones pave way to powerful, cheaper lasers

Eight developers at last month's Seybold Desktop Publishing Conference showed page description languages that the companies claim not only are compatible with Adobe System's PostScript, but surpass the current price/performance barrier of PostScript laser printers.

Developers copying the language interpreter include Phoenix Technologies, Control-C Software, Imagen Corp, Conographic Corp, Eicon Technology, Lincoln & Co, Raster Image Processing and Bauer Enterprises. (Although the interpreter is proprietary to Adobe, the language specifications are in the public domain). Imagen and Conographic had previously announced their products, but showed them for the first time at the conference; the six other firms officially announced as well as demonstrated their languages.

The grand total of hardware and software manufacturers trying to tap the booming success of PostScript is now close to a dozen. Adobe licenses its languages to IBM, Apple, Digital Equipment, AST Research, Wang Laboratories and other large printer manufacturers.

For users, the PostScript clones mean lower cost and more powerful laser printers, several developers said. The units are expected early next year from Okidata, Kyocera International and other Japanese printer manufacturers, according to industry sources.

As compatibles makers work to get their products out the door, Adobe continues to add functionality to PostScript. Adobe officials last month demonstrated PostScript's support for a colour thermal printer from QMS Corp — the first colour printer to use the Adobe interpreter.

PostScript-compatible manufacturers such as Phoenix claim their interpreters are faster than Adobe's. As a result, they claim, the compatibles perform the job of describing sophisticated pages of text and graphics to the laser printer at a faster rate than offered by Adobe.

Bell & Howell's Qunitar Division is the first printer-controller manufacturer to use Phoenix's PostScript interpreter. Bell & Howell President Craig Douglass said the company will use the interpreter in its Texas Instruments TMS 34010 line of printer controllers and will license the controllers to laser-printer manufacturers. The laser should be available in the second quarter of 1988, he added.

The PostScript clones are still in development stages and have not been thoroughly tested for software and PostScript compatibility, according to Paul Brainerd, president of desktop publishing software developer Aldus Corp of Seattle.

"We have not seen prototypes of the printers or actual output," he said. "It is too early to see if they have achieved full compatibility. Before users run out and buy one, they should pause and make sure that the printer is fully PostScript compatible."

Charles Greschke, execu-

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tive vice president of Adobe, said users will have to decide whether the PostScript implementations are successful and added that developing PostScript "was not a trivial task".

One concern for many users is font compatibility. Many of the PostScript clone manufacturers are licensing fonts from Bitstream Inc. The Bitstream fonts use the same metrics as Adobe's fonts (meaning that they have the same character widths), but a page printed on an Apple LaserWriter, and one printed on a PostScript-compatible printer will look different, according to Robert Friedman, president of Bitstream. "That's because our fonts look different than Adobe's," he said, adding that the products will not be incompatible.

Mac dBase shipping

More than one year after it was announced and after a series of delays, Ashton-Tate is finally shipping the first copies of its dBase Mac for Apple's Macintosh.

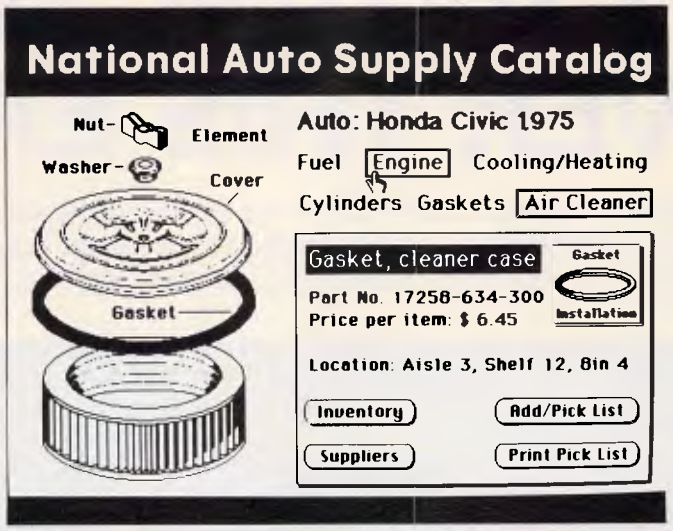
Ashton-Tate originally intended to ship the program by the fourth quarter of 1986, but pushed that date up to July 31 of this year.

Unable to meet that deadline, Ashton-Tate announced in early August that it was rescheduling the program's shipping date to August 31.

Ashton-Tate began developing the dBase Mac prototype in 1985, and has since improved its performance and tailored it to support the new Macintosh II and Macintosh SE, according to a company spokesman.

"dBase Mac fulfills a key strategic element of Ashton-Tate's long-term strategy — to extend the dBase standard into new market segments," explained Roy Folk, executive vice president and general manager of the company's Software Products Division.

dBase Mac is Ashton-Tate's first Macintosh offering. The program will be available here sometime in October for $995.



Graphics and text are completely integrated in one of the Apple HyperCard information 'stacks'. (See 'On course for good training'.)

On course for good training

Apple's launch of the HyperCard is destined to have a major impact on the software industry. By enabling users to customise their work, as well as develop applications around their personal needs, Apple is continuing to hold IBM at a safe distance while at the same time making it difficult for IBM software to keep up with Apple's new, creative programs.

Although it has been suggested that the HyperCard would be useful for developing training and educational programs for computer-aided learning, the product that will break ground in this area is called Course Builder.

Developed by Bill Appleton, a pioneer of visual authoring systems for the Mac, Course Builder brings a powerful level of creativity and intuitive design to the concept of courseware. Its unique visual language enables users to create courseware simply by drawing a chart of their ideas; the desired message can then be delivered with graphics, text, animation and sound, and receive input from dialog boxes, menus, or mouse clicks.

The program includes object graphics such as rectangles, ovals, round rectangles, polygons, arcs, lines and text, while the paint program includes eight levels of 'fatbits' and auto-scrolling. The animation system can enhance presentations with movement — frame by frame control, sprite libraries, sprite chaining and movement interpolation and, finally, the sound program allows the designer to develop the background music or verbal instructions with three kinds of digital sound, and phoneme voice output.

Course Builder will make courseware design so simple that it could even be used as a teaching method for children. For details call TeleRobotics International on (615) 690 5600 in the US.
Tim Bajarin

Multi-user DOS upgrade

Digital Research is shipping new versions of its DOS-based multi-tasking, multi-user operating systems for 8086 and 80386 systems.

Concurrent DOS XM (Expanded Memory) and Concurrent DOS 386 support most standard DOS applications. Moreover, applications written specifically for Concurrent DOS — of which there are more than 700 available — have multi-tasking and multi-user capabilities not available under DOS, according to Frank Iveson, vice president of international marketing.

Concurrent DOS 386 version 1.1 is a multi-user, multi-tasking operating system for 80386-based computers. Functioning as a control program that takes advantage of the 80386's virtual 8086 mode, it is capable of true simultaneous processing of DOS-compatible applications.

Concurrent DOS 386 is available in a three-user system configuration ($735) or a 10-user configuration ($1005). The program is easy to install and operates with familiar DOS commands, according to the firm.

The enhanced version of Concurrent DOS XM, release 5.2, is a multi-tasking, multi-user operating environment for 8088/86 and 80286 PCs that takes advantage of EMMS (Enhanced Expanded Memory Specification) memory. The new product offers improved support of the Enhanced Graphics Adaptor (full 16 colours), enhanced support for the IBM PC/AT keyboard and disk formatting for up to four partitions per hard disk.

As with Concurrent DOS 386, Concurrent DOS XM will run standard DOS applications in single-tasking mode, or will run Concurrent-specific applications in multi-tasking, multi-user mode.

Concurrent DOS XM can manage up to four application windows on the system console. It is compatible with AST Research's AST-Four Port/DOS card and Control System's four-port Hostess Multiport Network Adaptor for supporting multiple users on a single PC. The three user version of DOS XM will retail for $620

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and the six user version for $735.

Concurrent DOS products do not yet support IBM's PS/2s, but will be upgraded to do so before the end of the year. All registered users of Concurrent DOS 386 version 1.0 and Concurrent DOS XM version 5.0 will be offered an upgrade to version 1.1 and 5.2 respectively, at no charge. These new versions of Concurrent DOS should be available here this month according to Barry Clancy, the national product manager. Call MicroAustralia for more details on (02) 809 6722.

Turbo Pascal beats 64k limit

Borland International has demonstrated its long-awaited upgrade to Turbo Pascal, version 4.0, which breaks the 64k program-size barrier developers have long agonised over with version 3.0.

Borland officials claim Turbo Pascal has an installed base of more than 750,000 users. The new version will carry the same suggested list price as the current version; existing users can upgrade, though as this issue went to press Tech Pacific, Borland's Australian distributor, could not confirm the upgrade cost.

The compiler smashes the 64k program-size barrier by enabling developers to build a program in logical units, each up to 64k in size, and then use Turbo Pascal 4.0's built-in linker to join the units together and create an executable file. Programs can be compiled to either memory or disk.

"When compiling to an .EXE file, the 'smart' linker removes all unused code, leaving more memory available for the program's work space," said Gary Whizin, Borland's Pascal product development manager.

Version 4.0 also has a built-in 'make' facility that enables it to automatically recompile and relink only those program units or modules that have been changed since the last compilation. The program also has a stand-alone make facility that automatically relinks and recompiles units of code written in assembler or other languages, said Mr Whizin.

"If you ask it to do a make, it will automatically find, link and compile the correct components," said David Intersimone, Borland's director of languages and tools. "You don't have to build any lists and teach it the dependencies of your code."

The product includes an upgrade utility through which users can run their source code. The utility will either make changes to the code so that it is compatible with 4.0 specifications or flag pieces of code that need to be rewritten, Mr Intersimone said.

Compilation speeds have been dramatically improved, Mr Intersimone claimed. Version 4.0 compiles more than 25,000 lines of code per minute on an 8MHz IBM PC/AT, compared with the speed of version 3.0 at 15,000 lines per minute, he said.

"3.0 was good for small projects and applications, but it didn't have any library facilities, and you had to deal with everything as one big file." said one industry analyst.

Similar to Borland's Turbo C, 4.0 now offers an interactive, windowed user interface in addition to its original command-line interface.

Turbo Pascal's graphics support has also been enhanced, officials claimed. The compiler contains a module for device-independent graphics, with 10 drivers for various graphics adaptors, said Mr Whizin.

The new version should be available this month.

Era of change at Borland

Now that Borland and Ansa are one and the same company, expect to see some significant changes at Borland International.

With this move, Philippe Kahn, Borland's charismatic leader, is positioning his company as a serious player in the business applications market. Known primarily for its programming tools and desktop utilities, as well as direct marketing, Borland is taking some big chances in trying to get into an area where the big three software houses already *own* the market.

In particular, although databases serve as the underlying code behind most of the market's software applications, Ashton-Tate's dBase III Plus still reigns supreme.

Ansa's product came out to a fanfare of trumpets but, as anyone who has used Lotus 1-2-3 will realise, people are very reluctant to change products once they familiarise themselves with a particular application.

Borland's only hope is to grab the attention of users searching for their first database, and help them understand the advanced features that the Paradox system offers.

Although Borland's move is interesting, it is doubtful whether the company will be able to make any dent in Ashton-Tate's sales. But with the talents of Ron Posner, former executive vice-president of Ashton-Tate and now president of Ansa, as well as a seasoned sales force from Ansa, Borland has an excellent chance of bringing out some serious DP-related products. And the sales force could build Borland beyond the cheap and dirty utility market.

The most controversial part of the deal was the naming of Ben Rosen on Borland's board of directors. One of the industry's top venture capitalists and the current chairman of Compaq Computers and Ansa, Rosen is one of the shrewdest and strongest leaders in the field today.

By comparison, Kahn, also known as a strong wheeler and dealer, has a much looser management style; sources close to Borland feel that the two will come head-to-head many times in the decision-making process at Borland International board meetings.

But don't expect major changes overnight.

Paradox still has a tough road ahead of it and Borland will need time before it can become a serious contender in the field.

Tim Bajarin

Toshiba, treachery and the American way

Toshiba appliances are currently being ritually stamped on, on Capitol Hill in the US, by Congressmen. They're outraged that the company should have supplied America's enemies with 'restricted' technology, and Toshiba equipment has been banned from the US in many places.

Toshiba ships equipment to Australia. Are we being treacherous in buying it?

My answer: only if it's treacherous to buy American goods, because America supplied weapons to Iran.

Here's what Toshiba supplied: a milling machine, supplied in 1982, which allows a Soviet factory to produce nine submarine propellers at a time. The tool makes it possible to produce a quieter propeller.

Here's a funny thing. According to The Source, an American online database, a tool which would permit the shaping of four propellers would have been permitted under the laws which Toshiba broke.

And another funning thing: the October 1979 issue of the US Navy's *Guide to the Soviet Navy* reports that the noise of Soviet submarines has decreased 'drastically'.

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NEWSPRINT

If the keyboard pictured above casts your mind back to August 1986, your memory serves you well. APC published a picture of a similar keyboard featuring LCD keycaps, which was only available in Asia.

This time however, it's an Australian company which has come up with the goods, Keycorp Limited.

The keyboard, called the Keymaster, was designed by 23-year old Newcastle lad, John Wood, who spent most of his time helping inexperienced users perform basic tasks, such as word processing, on PCs.

The Keymaster keyboard and Keypad (used in conjunction with an existing keyboard) is designed to simplify the use and learning curve of software on a personal computer.

The ten function keys found on a standard keyboard are replaced by ten 8 x 5 character LCD keycaps, which display a range of user options relative to the application in use. These 'intelligent function keys' change options as the user progresses into the application.

The keycaps are driven by their own Z80 processor with 2k ROM and 16k RAM. The RAM is loaded with the 'map' of LCD display information for all operator options for a particular software package. The processor in the keyboard then tracks the position of the user in the package and displays the appropriate information on the keycaps. When the user depresses one of the keys, the processor performs the appropriate table look-up and sends the scan code, or sequence of scan codes appropriate to that function.

The Keymaster operates with a variety of MS-DOS software, including Lotus 1-2-3, Framework II, WordStar, Word and dBase II and III.

Summarising the benefits of Keymaster, David Ballantine, managing director of Keycorp, concluded "The principal benefit is that of making computers easier to use by inexperienced operators — thereby significantly reducting costly training time, reducing reliance on manuals and encouraging users to explore fully the capabilities of the package they are using."

The full Keymaster keyboard retails for $1500 and the Keypad retails for $1200.

For more details contact Keycorp (02) 698 5299.

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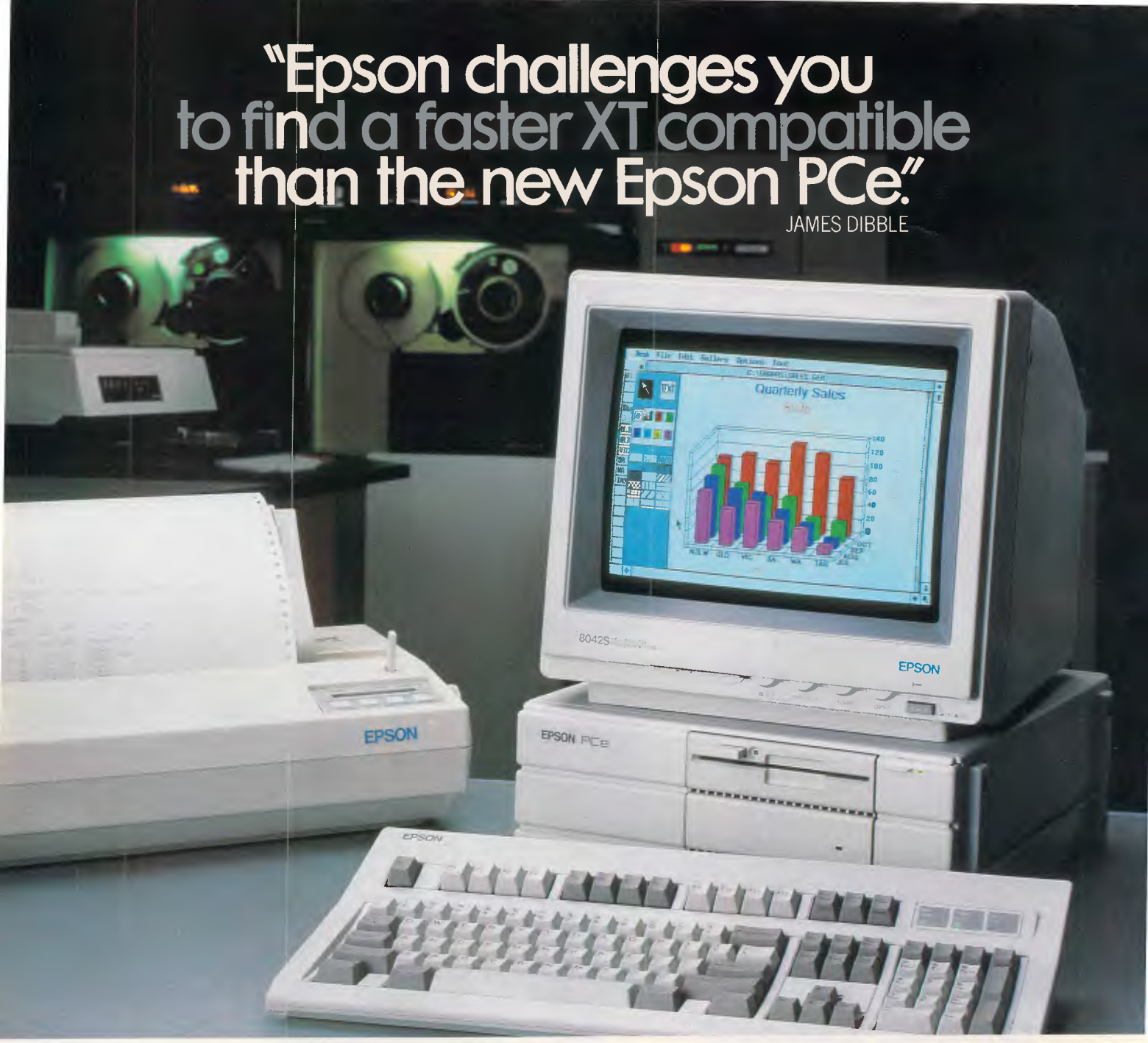

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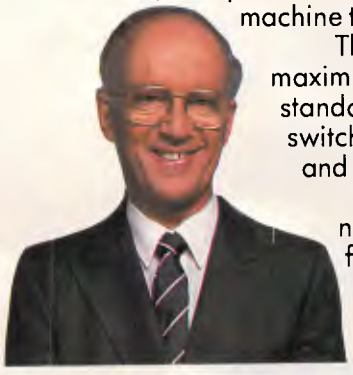

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American Congressmen stop at, in the search for publicity that will win patriotic votes? *You* answer that one.

Guy Kewney

CD ROMs and all DAT

The news that Atari will shortly be showing a device for reading CD ROM disks coincides with the discovery that another audio breakthrough — Digital Audio Tape (DAT) — may be pretty useful for computer users, too.

Atari promised that it would announce a CD data archive as soon as the price dropped below $1500. In fact, although the price is there, the ability to archive your own data on to CD isn't yet: you have to buy someone else's published disc with, say, an encyclopaedia on it.

In Atari's case, there will be a plus: it will be able to work as a genuine CD player, and you'll plug it happily into your hi-fi and listen to the Beatles, or whatever.

It will also come bundled with Grolier's American Encyclopaedia, which I think is normally worth $US130.

From a New York company, Magnetic Press Inc, comes the other half of this story: the use of DAT for data storage — specifically, for backing up hard disks.

Theoretically, a single DAT tape can hold the data contents of three CD ROMs; that's 1400Mbytes, and they run at 1.53Mbits per second.

Magnetic Press doesn't actually sell such a thing: no one sells DAT, yet. At $4000 per recorder in Japan, that's not surprising.

American lobbies fiercely oppose DAT because of the opportunity for piracy of CD music.

But Magnetic Press has published a little study hinting that American resistance to DAT (which keeps the price high) may crumble when American micro users realise how useful it could be for copying the data on 40Mbyte hard disks.

Details, if you're interested, on (212) 219 2831 in New York.

Guy Kewney

FM modems

A Sydney-based company has introduced two modems that use the FM radio bandwidth, rather than Telecom leased or dial-up land lines. Using DCA-approved FM band 40.45MHz, these modems can transmit and receive over distances of 200kms at speeds up to 4800 baud.

The range of the modems depends on the terrain and environment and the topography of the network. "Existing US sites including difficult terrain in New York and Chicago, so the modem is quite flexible in overcoming many FM broadcast problems", said a spokesman for the Australian distributor, Peak Pacific.

Error-free transmission protocols and total data security are claimed of the modems. Each base costs under $3000 (excluding sales tax but including installation).

DTP market holds its breath

Last winter at Macworld in San Francisco, Ann Arbor Software introduced FullWrite Professional for the Macintosh. This was the talk of the show, because it took the plunge towards the integration of word processing, graphics and page layout and put them all in one single, easy to use program.

Although the product has still not been launched, it is considered to be one of the most important products to be released this year in setting the tone for the next generation of word processors.

The idea that word processing and desktop publishing (DTP) will merge very soon is causing serious debate. Serious desktop publishers insist otherwise and claim that the page layout task should be separated from the editing features so that the designer has better control. This opinion is evidenced by the DTP software that is currently available on the market.

Except for Ashton-Tate's soon-to-be-released Byline which includes a full-featured powerful word processor, almost all of the leading desktop publishing software treats the editing capabilities as precisely that — low-key editing functions.

But many industry leaders see the handwriting on the wall, so to speak.

The eventual merging of DTP and word processing is inevitable when you look at products such as T/Maker's WriteNow.

With FullWrite Professional, the user has access to word processing, illustration, graphics, and the type and layout capabilities inherent in desktop publishing.

Expect traditional word processing publishers to take note of these advances in integration.

Tim Bajarin

Classroom brawl ahead

The introduction of the IBM PS/2 Model 25 was greeted with a real yawn in the US computer market.

The single unit device — a sort of cut-down all-in-one Model 30 — copies the Macintosh concept, although it is much bigger than a Mac.

Although IBM will sell the Model 25 through its dealer channel, industry insiders say that what IBM is really about to do is make an all-out assault on the educational market.

Last year IBM donated $US500,000 worth of IBM PC/XTs to an elementary school in San Jose, California, and sources close to IBM say we should expect to see more donations in major school districts over the next 12 months.

This IBM tactic of 'buying its way' into a market is scorned by folks at Apple as Apple has secured nearly 30 per cent of the education market on business terms.

To date, IBM did not have a machine specifically designed for the education market. But, with the Model 25, it can focus on marketing to the technology-driven education field. And with the 50-55 per cent discounts it gives to schools, IBM can make owning an IBM product *very tempting.*

Apple is unlikely to sit still through this and let IBM take its territory. And it is rumoured that Apple will be aiming the Mac at the 9th-12th grades (14 to 17-year-olds) and leaving the Apple IIs in the lower end of the education market.

High school students are really enamoured of the Mac, and this could help Apple keep a foothold in the upper grades. And, as for the lower grades: well, Apple owns them today, but with the Model 25 and IBM's determined move to conquer even this territory, there could be some real bloodletting ahead.

Tim Bajarin

IBM faces up to the WIMPs

When Steve Jobs and his team were designing the Mac back in 1982, it was suggested to him that they make it IBM-compatible.

Being of a revolutionary nature, Jobs killed any talk about *his* machine having IBM compatibility, and went on with the Mac's proprietary operating system.

When Commodore was working on the original Amiga, it *also* looked at IBM compatibility and decided that this would eventually be offered via a separate unit — Commodore didn't want any of that 'DOS' stuff muddling up the great Amiga graphics operating system.

At Atari, Jack Tramiel was also working on his own creation. He *also* looked at the issue of IBM PC com-

patibility and said that the market for his machines couldn't care less about DOS compatibility.

While it cannot be denied that these three machines have gained attention and various degrees of market acceptance, the IBM standard has continued to gain strength.

But, with Microsoft and IBM now adopting the WIMP environments used by Apple, Commodore and Atari, we are beginning to hear a different tune.

Apple now has cards which turn the Mac into an IBM-compatible PC; Commodore is secretly working on a new version of the Amiga that has both PC and Amiga operating systems on the board, and can be switched back and forth via a toggling method; and, finally, sources say that Atari may even bundle pc-ditto (reviewed in this issue) with its more upscale models of the ST giving the user a choice of OS and software.

Apple, Commodore and Atari still believe that their own operating systems and computers are the best, but they have had to take a more conciliatory approach to the dominant IBM way of computing.

The important questions are whether users really need two operating systems, or can they manage with the operating system that comes with their machine?

To which users must ask themselves the following:

- What tasks do I need the computer for?
- Do I need to run DOS-specific software on this computer or do I just need PC file compatibility?

There are over 10,000 different PC programs available. But it is worth noting that the basic applications required by PC users are available on any of the non-DOS computers as well.

At the current time some of the best solutions for computing are on the Mac — for example, Excel, Write Now and 4th Dimension. And for first-time users the ease of use of the Mac makes it an ideal machine for beginners. With its new multi-tasking OS, Multifinder, the Mac is now more powerful than ever.

Ironically, despite its smaller sales, the Mac and its excellent human interface have revolutionised the world of computing to the extent that the PC world is soon going to look just like the Mac as soon as OS/2 and Presentation Manager arrive.

Giving 68000-based machines PC ability is a great marketing gimmick, but industry insiders feel that the issue of file compatibility is the thing to look for — not the ability to run PC software on the actual machine.

Tim Bajarin

Voice printing: hear this

A new application of voice technology called 'voice printing' is beginning to catch on. Voice printing is the ability to extract database information in a spoken form, for use over the telephone or other voice systems.

Speech Plus has just signed a major agreement with Bell telephone operating companies which will use their system as an order and service entry device. Using this system, a field service engineer or repair man calls the computer by phone and the computer speaks back the information needed.

Directions for the next repair site can be issued in this way too. The system will replace many order entry clerks as it can be on-line 24 hours a day, and accessed, with the right codes, from any telephone in the world.

Until now Speech Plus' products have worked with large mainframes and some selected minis. But, with the power a fully-loaded PS/2 Model 80 can deliver, voice-printing systems could be available for distributors, supply houses and so on.

Speech Plus is on (415) 964 7023 in the US.

Tim Bajarin

Lotus will remove copy protection

Succumbing to user demand, Lotus will drop copy protection on future versions of 1-2-3 and Symphony, company officials said last month "The next releases of 1-2-3 (version 3.0) and Symphony (version 2.0) will drop copy protection," a Lotus spokesman said.

Lotus has remained the only major software developer to market copy-protected products, despite a substantial backlash from the user community.

"We've found that copy protection is one of those aggravating nuisances that people want to remove, but they don't want to (purchase) the upgrade just for that. That's why we've timed it to coincide with the new releases," the spokesman said.

None of the nearly one dozen new programs the company has introduced over the last year has been copy protected, he said.

Users and industry analysts greeted Lotus's move with enthusiasm, although they pointed out that it was a long time in coming.

Compaq borrows PS/2 features

Compaq Computer's two new 20MHz 80386-based PCs, which should have been announced by the time you read this, will be equipped with VGA-compatible graphics and 3.5in disk drives — two key features of IBM's PS/2 line, according to several sources close to the company.

The move allows Compaq to borrow some of the PS/2's elements while preserving compatibility with standard PC add-in boards.

In addition, Compaq is thought to be negotiating to bundle a new version of Microsoft's Windows 386 operating environment with the new machines.

These are among the latest details to emerge as the expected announcement of the machines draws closer (and this issue goes to press).

Industry observers also expect Compaq to release a faster version of its Deskpro 386. The enhanced computer, which reportedly will be built around a 20MHz '386 chip, will feature a faster memory architecture and faster disk access.

Compaq is also expected to release a '386-based model of its Portable III. The upgraded portable will also have new hard disks, including a 100Mbyte drive, said sources briefed by Compaq.

Compaq will offer 3.5in floppy-disk drives as an option on both new machines, the sources said. Users will now be able to buy machines with either 3.5in or 5¼in drives — or both — on the same machine.

PS/2 clones delayed

Whatever claims they hear in the next few months, users shouldn't expect to see PS/2 compatibles on sale until the middle of 1988.

Between now and the end of November's Comdex, several companies plan to announce key components of PS/2 machines, such as peripheral chip sets of BIOS products.

But it will take until the middle of next year for vendors to design, test and mass-produce PS/2 compatible machines, according to numerous sources in the compatibles industry.

"The consensus seems to be: expect to see products in dealers' hands in the May-to-June time frame," said Collier Buffington, general

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manager of the PS/2 effort at Western Digital.

"Toward August next year I think you can anticipate buying clones," said John Gordon, who recently resigned as vice president of sales for Phoenix to become president of another BIOS firm, Paterson Laboratories. "That's probably as quick as we can do it".

Some components of the PS/2 are or will soon be available from a number of vendors, including 3.5in disk drives and VGA chips.

But the BIOS and chip sets needed to replicate IBM's Micro Channel bus architecture are much harder to design.

Clone makers also fear IBM will sue them for patent or copyright infringement. This possibility could cause them to take a wait-and-see attitude while they puzzle out IBM's legal strategy.

Even when all the pieces are in place, the biggest question of all remains: will there be a market for PS/2-compatible computers?

The timetable for a PS/2 BIOS moved up last month, as Phoenix said it plans to introduce a working PS/2 BIOS at Comdex in November.

Western Digital's Faraday Electronics subsidiary will announce a PS/2-compatible BIOS and chip set, said Mr Buffington, but no date has been set.

While prototype PS/2 machines might show their faces at Comdex, the chip sets in them are 'jellyware' because they are only preliminary designs that still must be checked for problems, said Mr Buffington.

dBase pop-up applications

A new development tool from Apex Software in the US promises to give dBase programmers an entree to designing and executing memory-resident dBase applications.

The new package, called FrontRunner, is a memory-resident development environment that comprises a subset of Ashton-Tate's dBase III Plus language and commands, popular extensions to the dBase language and an integrated compiler.

The program is positioned as a utility for programmers who want to develop memory-resident dBase applications or who want to access dBase power from other PC applications, explained its creator, Jeff Cooper, president of Apex and the author of a number of dBase programming utilities published by Ashton-Tate.

"Using memory-resident techniques to fit an application into 640k is a big advantage," said Adam Green, an independent consultant and the author of several books on dBase. However, he cautioned that FrontRunner would best serve users by focusing on portions of dBase's functionality.

FrontRunner, which requires between 110k and 150k, depending on the application, can be used to develop full dBase programs that pop-up on top of other applications.

In addition, FrontRunner's pop-up capabilities would enable a dBase programmer to write a memory-resident application that directly accesses a dBase database, he added.

"FrontRunner provides programmers with the first memory-resident programming language other than assembly language," Mr Cooper said. This means that developers can use dBase to develop any kind of pop-up utility instead of having to learn assembler.

Mr Cooper said that Ashton-Tate is currently negotiating to acquire the rights to the product. An Ashton-Tate spokesman was not available for comment.

APC does not know of any Australian distributor for the product yet, however it would be worth giving Ashton-Tate a call in Sydney towards the end of this month. In the meantime, FrontRunner is available now from Apex in the US for $US295. Apex is a small company that specialises in dBase utilities. It is located at 4516 Henry Street, Suite 406, Pittsburgh, Pa 15213. Tel: (412) 681 4343.

New versions of Paradox

Borland and Ansa Software held a press conference last month to reveal plans for Ansa's Paradox database, new links between Ansa and Borland products and the completion of the two companies' merger.

Six new versions of Paradox headed the agenda, and the firms also announced a software engine that will allow Turbo Pascal version 4.0, Turbo C and Turbo Prolog programmers to write applications that have hooks into the Paradox database.

A version of Paradox for '386-based computers will be the first of the new products out of the block. It will be followed next year by versions for the OS/2; Windows; OS/2 Presentation Manager and Unix operating systems; and a version with SQL (Structured Query Language) capabilities, according to company officials.

All versions will be compatible with one another — with the exception of the Windows and Presentation Manager versions, due to their graphical interface — allowing users to transfer files freely and build applications that can run under all versions, said Philippe Kahn, Borland's president.

Packets to Canberra

Two groups of packet radio enthusiasts recently established a link from Melbourne to Canberra using a series of dedicated VHF repeaters.

According to a statement from the Melbourne Packet Radio Group, "data signals from Melbourne are lifted over the Great Dividing Range by station VK3RPL situated high in the Divide where it looks clear to the north over the Strathbogie Ranges and along the Goulburn Valley to VK3RPW at Shepparton.

"This central Victorian packet repeater provides excellent coverage and is the vital mid-state link. . . The Shepparton signals follow the general direction of the eastern section of the Midland Highway, passing north of Benalla and Wangaratta, arriving at VK3RPN Wodonga in good shape to travel interstate into NSW. The toughest part of the data highway is the job of VK3RPN: the long haul north-east over Albury to VK2WG-1, east of Wagga. VK2WG-1 is tasked with ensuring the packet signals avoid the Kosciusko National Park and have a clear run to Canberra.

"The time taken for the data signal to travel between Melbourne and Canberra will depend on the level of traffic on the data highway. An average time for the return trip is around ten seconds."

Anyone wanting to participate or find out more about packet radio should contact VK3QQ QTHR, call (03) 434 3810 or write to the President, Melbourne Packet Radio Group, PO Box 299, St Albans, Victoria.

Bludners

Last month's printer survey contained an incorrect telephone number for Genicom (Australia) Pty Ltd. It should have read (02) 406 6411.

The printer survey omitted the range of Mitsui printers, which will be published in the November issue of *APC*.

And last month's advertisement for Oceanic Electronics should have stated that the Australian distributor is Computer Wholesalers, Suite 37, 406 Stirling Hwy, Cottesloe 6011 in Western Australia, Tel: (09) 385 1765.

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El-cheapo PCs

APC takes a look at seven of the cheapest IBM compatible PC systems currently available in Australia — are they junk, or bargain buys?

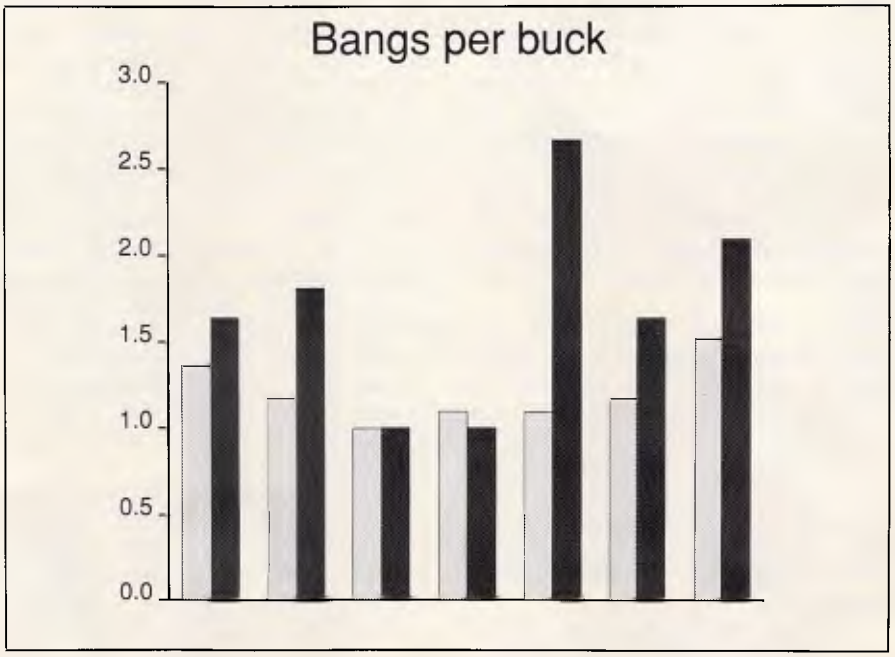
In these days of 80286-based 4Mbytes PCs and 80386 machines with demand paged virtual memory, gigabyte address spaces and throughput measured in MIPS, there are those among us who claim that the 8088 is dead.

They are wrong. The 8088 is more alive than ever, precisely because of the rapid movements at the top end.

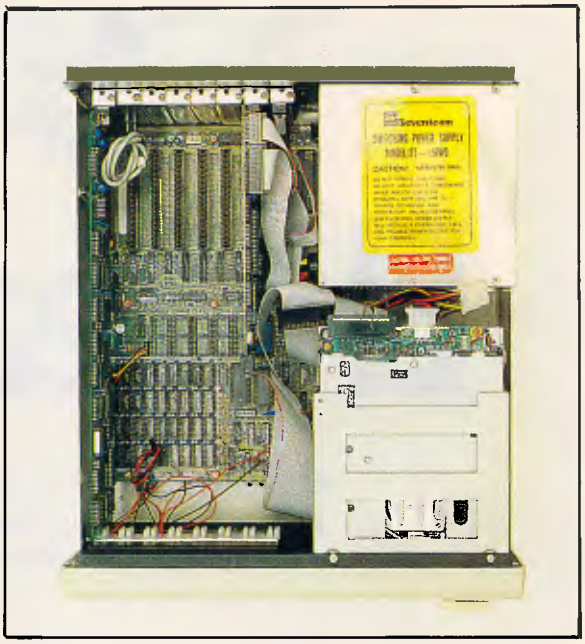
Consider the situation. The 80386 is the premier chip of the time, having addressed all of the shortcomings of the 80286 and highlighted it as the stopgap it is. A new dawn of PC operating systems is about to break. Yet IBM comes along and forces OS/2 to support the 80286, thereby making the operating system more complex, less efficient and less powerful than it really should be. Moreover, OS/2 pricing and hardware support means that its global success is far from assured, except in the longer term. Add to this the Micro Channel Bus architecture, which IBM has hailed as the way of the future and the rest of the industry is scrambling to support. Yet IBM also provides a Model 30 which effectively obligates everyone to support the older bus standard as well.

The question arises, if you were going to spend money on a PC, what would you buy? My feeling is that the long term will see the 80386 or 80486 in a Micro Channel environment running a rationalised OS/2. However, very few people buy technology looking at the long term view, since most products have such short lifetimes. Many people are reluctant to spend the big dollars required for an 80386 system when OS/2 will run on 80286 processors. Others are not prepared to fiddle about with the hotch-potch 80286 when better things are available. Some are not the least interested in OS/2 until it has application availability equal to that of MS-DOS. Many might think seriously about an 80386, but remain undecided about the Micro Channel.

In a corporate environment, the decisions tend to be more easily taken since the money is coming out of someone else's pocket and purchases can be painlessly written off over two or three years. At the same time, the decision can be even harder, since an organisation will probably be reluctant to burden itself with a combination of OS/2, MS-DOS, 80286, 80386, Micro Channel Bus and normal bus machines. Software may not be easily ported between environments and expansion boards cannot be moved around freely.



'Bangs per buck' — just one way of comparing the relative merits of these seven ultra-cheap clones. The lighter shading denotes price (in thousands of dollars) and the darker shading a performance index. See Table 3 for more details. (Machines in order from left to right are from Altantis, Rod Irving, MicroDOS, Commodore , Uni-x, Atronics and Technology Interface)



A small footprint and stylish appearance makes the Atronics machine an attractive buy

Buying at the leading edge is often a difficult proposition. But for anyone who thinks it's all getting too hard, a viable alternative exists.

Possibly the best value buy available today remains the humble 8088, 640k, MS-DOS-burning PC. That statement may not be true if you calculate bytes or MIPS per dollar, but is certainly true in terms of buying a stable workhorse which is going to remain well supported for several years, immune to possible detours in the state-of-the-art.

If you want to perform communications in the background while you process words in the foreground, you can either go the 80286/80386 Micro Channel OS/2 route, or buy a spare, cheap PC and plonk it under the desk. It may sound crude, but its incredibly cost effective, fault tolerant and versatile.

Many corporate users and enthusiasts are buying PCs for home, and for these it is not so much the MIPS per dollar, but the absolute number of dollars which counts. Don't bother telling an enthusiast that a $10,000 80386 system actually works out more cost effective than a $1000 8088. You may be right, but it's a question of whether he's got the ten grand in the first place.

In the following pages, we take a close look at seven low cost PC systems. There are remarkable similarities between the systems, as the hardened skeptics would expect. But there is also a remarkable divergence, given the competitiveness of the market and the commonality of their roots.

Basics

The machines we looked at were the Atlantis Budget PC Turbo ($985), Rod Irving IBM XT Compatible ($795), MicroDOS ($899), Commodore PC5 ($1295), Uni-x Super 10 XT ($942), Technology Interface FTC Turbo XT ($1195) and the Atronics International PC Turbo ($999). All of the machines are 8088-based PCs. Cheap 8086 machines are, for some reason, quite rare. Each will be referred to by the name of the Australian representative.

The most notable and predictable feature of all of the machines is that they are largely made in Taiwan, which is now the PC capital of the world. Some claim otherwise, for example, Atlantis reckons its machine is built in Japan, yet the markings on the circuit boards clearly indicate otherwise, with the motherboard, display adaptor and multifunction board all being stamped in Taiwan. The Commodore machine has a more varied background, featuring components from Japan, Hong Kong and Taiwan.

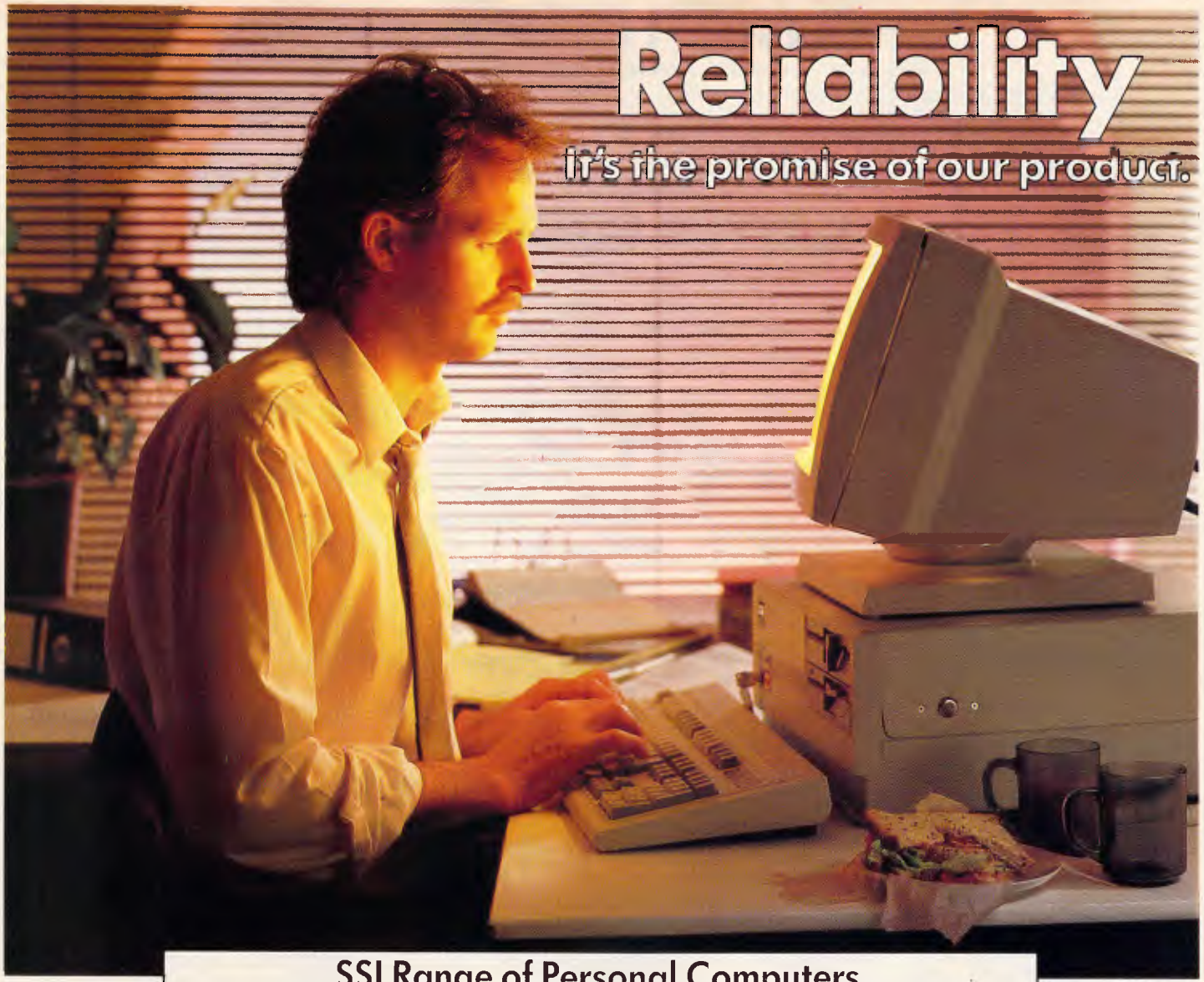
Some PC buyers are reluctant to purchase Taiwanese machines, but the truth is that there is no good reason to hesitate. Moreover, it is becoming increasingly difficult to buy a machine built anywhere else. Even many of the big names are actually Taiwanese machines with new badges. Pulling off stickers and peering under badges can be quite instructive in this business.

When you look at what a PC is built from, you basically come up with a case, power supply, keyboard, monitor, disk drive, a few cables and some etched circuit boards with integrated circuits soldered on to them. The most critical components in terms of performance and functionality are obviously the circuit boards, and here the functionality is instilled into the ICs. No matter what type of PC you purchase, it will inevitably contain a very cosmopolitan collection of ICs from places such as San Salvador, Malaysia, Singapore, Japan and Texas. Even true blue IBM machines contain this diversity. It is caused by supply and pricing fluctuations in the multi-billion dollar semiconductor industry, and is quite an accepted thing.

Many years ago, semiconductor manufacturers started a policy of 'second sourcing'. This meant that when one manufacturer originated a design for a new and exciting chip, they would make the design available to their competitors. This strategy was aimed at improving the market acceptance of a new chip, as manufacturers building equipment based on ICs would place serious consideration on the guaranteed availability. The practice still exists, although competitiveness places its future under some doubt.

The upshot is that it doesn't really matter where a particular chip comes from. It is most likely manufactured using the same masks as the original designers use, and so long as the fabrication plant employs adequate quality control, will be a faithful and long serving chip.

The next issue is the design which connects the various integrated circuits



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Others	call
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TOSHIBA	
Toshiba P321	call
Toshiba P341	call
Toshiba P351	call
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together. As anyone who has designed digital hardware will know, there isn't a lot to it. By maintaining IBM compatibility, the designer commits himself to working with a 'family' of chips which are inherently matched to work together. An Intel programmable timer is designed to go with an Intel 8088, Intel DMA controller, clock generator, interrupt controller and memory chips. All in all, it's pretty hard to get the basics wrong.

These interconnections are then designed into copper tracks on a printed circuit card. This is more tricky, and some layouts will be better than others. However, everybody contemplating the task has a marvellous head start — they can take a peek at everybody else's PCB layouts. From there, unless amazing mistakes are made in the area of track width or proximity, the end result is going to be much the same as most other products. Thanks to Intel.

Some exceptions exist. For example, a display adaptor board is in many ways more complex than a complete motherboard. These boards utilise Motorola chips which are not part of the 'family', and offer the prospect of one or two wrong turnings for the designer. The other major area of divergence is the utilisation of VLSI components. Many manufacturers are moving to VLSI to lower their component count and simplify the PCB layouts. This naturally means that the traditional IBM design cannot be employed. It then becomes a question of putting one's faith with the VLSI chip designer. Again, this is becoming a well accepted approach with companies like Chips and Technologies doing very nicely out of the deal.

From there, it comes down to a question of component quality. If a manufacturer went out of his way to buy inferior components to lower his costs, then the end result would be a lemon. However, with trading names like Efficient, Vigor, Previous, Shiten and Hedonic, it's hard to worry too much.

Disk drives are in a class of their own. Being mechanical assemblies, they are more likely to wear out with use and develop intermittent faults. There are also hundreds of different ways to build a disk drive. While it is possible (and common) to manufacture PCs in your back yard, the same is certainly not true of disk drives. Most Taiwanese machines utilise Japanese disk drives, built by large, recognised corporations.

So, there is really no good reason to be turned off buying a Taiwanese machine. Although it might be worthwhile recounting what happened when lightning caused a power fluctuation in an office full of Olivetti M24s and Taiwanese clones. The Taiwanese machines all rebooted and the users lost their work. The M24s, well, they 'just kept on tickin'.

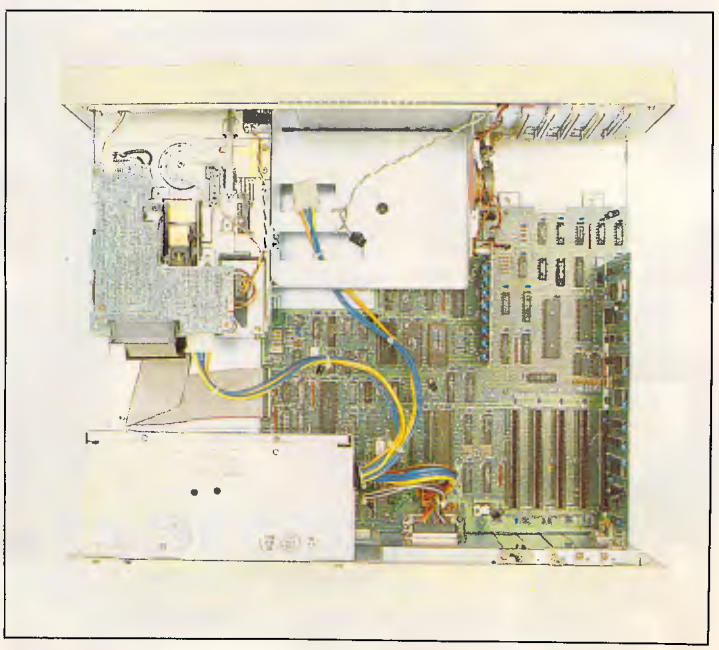
Processor

All of the machines examined run 8088 processors, or compatibles. The Atlantis and Technology Interface machines sport an 8088 manufactured by Fujitsu under licence from Intel, and can be considered identical to a real 8088, as Intel undoubtedly supplied the fabrication masks. The MicroDOS and Commodore PC5 run an 8088 made by NEC. The Uni-x contains a NEC V20, manufactured by Sony.

This is all rather interesting, as the two NEC processors are real 8088s rather than V20s, and the only NEC V20 among the bunch was actually made by Sony.

The V20 is a slightly different kettle of fish. As well as fabricating real 8088 processors, some time ago NEC set out to design its own 8088 compatible CPU. This would allow NEC to sell millions of chips without paying licence fees to Intel. The V20 was designed from the ground up, based only on the specifications for the pin-out and instruction set of the original 8088.

Being an original design, NEC was free to make various enhancements, some of which may have been a natural consequence of taking different approaches. Some instructions were made to execute in fewer clock cycles, the end result being increased performance. Thus a V20 running at 4.77MHz will outrun an 8088 running at the same clock speed. Some vendors claim that the V20 doubles the performance of the 8088, but this is not quite true. The performance profile is different for each instruction type. Some instructions, such as integer multiply, do go twice as fast which is of



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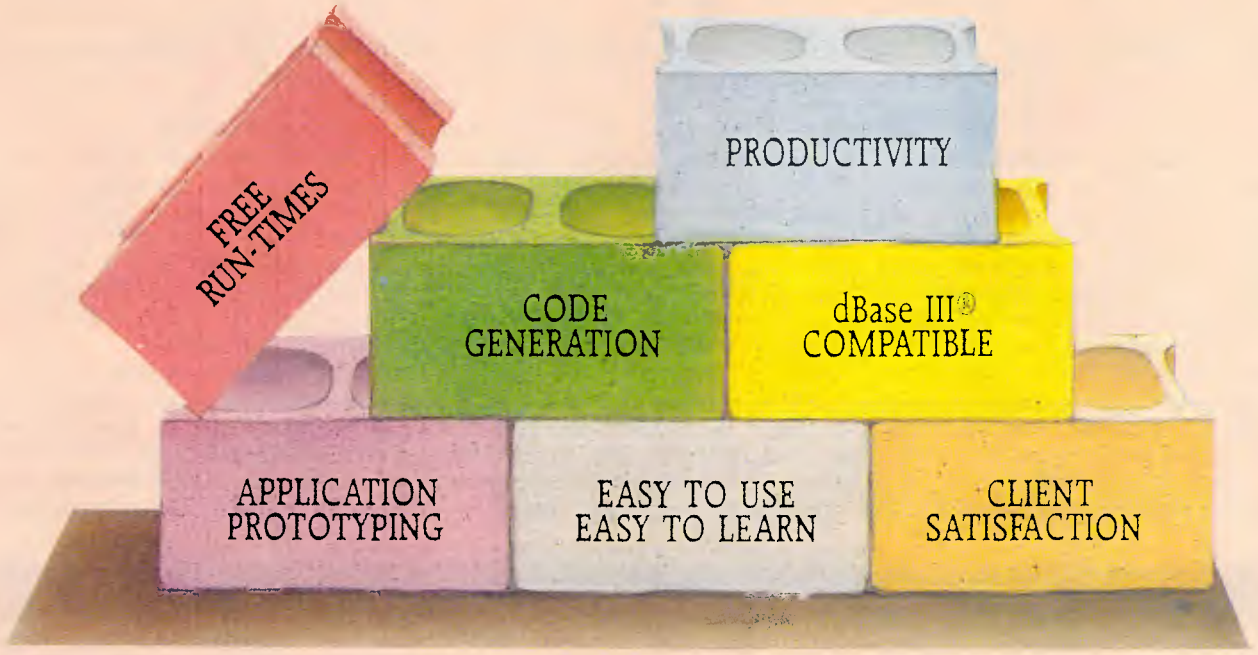

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great benefit to applications which perform intensive array indexing. Others provide only a marginal improvement, and others offer nothing. Thus the actual boost delivered by a V20 depends on the instruction mix being run. Overall, one can expect around a fifty per cent increase in performance.

There are some people who avoid V20 processors, as it seems that NEC interpreted a few of the unspecified areas of 8088 behavior in a slightly different way. While this is certainly cause for concern, these same areas have been interpreted differently by Intel themselves between the 80286 and 80386 processors, and so most application developers tend to avoid them anyway. The classic example is pushing the stack pointer onto the stack. Some processors increment SP first, and then push while others do it in the opposite sequence. Either way, PUSH SP is not really a very sensible thing to do.

All of the machines examined provided a standard PC clock rate of 4.77MHz as a minimum, although the Uni-x delivered higher than standard performance even on this clock rate by virtue of the V20. The Atlantis and Atronics machines provided a turbo mode of 8MHz, while the Rod Irving, Technology Interface and Uni-x featured a turbo mode of 10MHz. All of the turbo machines except the Atlantis allow the speed to be selected either through a front panel switch or through the 'Control Alt Minus' keyboard sequence. The Atlantis only provides keyboard access. The standard 4.77MHz mode is traditionally provided to deliver performance identical to the standard IBM PC. This used to be a major consideration when games were written with hard coded delay loops. These loops would be set to provide appropriate speed on an IBM PC, but could prove too fast to play on turbo machines. There was one well known education package which used to pose questions and give the user a couple of seconds to respond. On fast machines, this program would flash the question on the screen for a fraction of a second and then declare that the user had taken too long to answer. Quite entertaining. Similarly, many software anti-piracy mechanisms were speed dependent, and it was sometimes necessary to run at standard PC speed until the software booted, only then switching to turbo.

This is less of a problem in these enlightened times. Most software utilises the system timer to generate delays and security packages tend to be immune to speed dependencies, except on the fastest of 80386-based sys-

Table1: Features

	Atlantis Budget PC Turbo	Rod Irving XT Compatible	MicroDOS	Commodore PC5	Uni-x Super 10 XT	Atronics PC Turbo	Tech. Interface FTC Turbo XT
Price:	$985	$795	$899	$1295	$942	$999	$1195
Processor:	Fujitsu 8088	8088-2	NEC 8088	NEC 8088	Sony V20	8088-2	Fujitsu 8088
Clock rate:	4.77/8	4.77/10	4.77	4.77	4.77/10	4.77/8	4.77/10
Standard RAM:	256k	256k	256k	512k	640k	640k	640k
BIOS:	Award	Phoenix 2.27	Phoenix 2.27	Phoenix 2.03	Award	Phoenix 2.27	AMI
DOS:	—	Microsoft 3.2	Falcon 3.1	Microsoft 3.2	—	Falcon 3.1	—
Serial ports:	1	—	1	1	1	1	1
Parallel ports:	1	1	1	1	1	1	2
Real-time clock:	Y	Y	Y	N	Y	Y	Y
Games port:	Y	N	Y	N	Y	Y	Y
Free slots:	6	6	6	4	6	6	6
Floppy disk:	MITAC	Chinnon	—	Chinnon	Mitsumi	NEC	Toshiba
Power supply:	150	150	150	170	135/150	150	150
Keyboard:	AT-style	AT-style	AT-style	PC-style	AT-style	PS/2-style	PS/2-style
Display adaptor:	CGA	CGA	CGA	Combined	CGA	Hercules	Hercules
Monitor:	—	—	Amber	Mono	Amber	—	—
Keylock:	N	Y	N	N	Y	Y	Y
Reset button:	N	Y	N	N	Y	Y	Y
Turbo button:	N	Y	N	N	Y	Y	Y
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tems. Most vendors seem to be abandoning security disks anyway.

Performance

A number of extensive benchmarks were run on each machine. Initially, the Norton SI system performance index was obtained in both turbo and non-turbo modes, if applicable. The index returned is supposed to be the power of the machine relative to the standard IBM PC. Thus a score of 1.0 means identical performance, and 2.0 would mean the machine goes twice as fast. Norton SI is notoriously inaccurate, and has even been known to fluctuate on the one machine. Nevertheless, we include its measurements because many people tend to swear by it.

A series of tests were then run to gauge various aspects of processor performance, and all were run in turbo mode. The figures shown are the elapsed seconds required to run the test, as measured by the machine's system timer. The timer was first checked with a stop watch to ensure everything was above board. The 128k NOP loop tests processor performance in a straight line, measuring almost exclusively the instruction fetch and decode times, plus the effectiveness of any instruction look ahead cache which may exist. The integer add and multiply tests check the most common arithmetic operations, and the string sort and move evaluates the efficiency of the word and byte string instructions. The instruction mix test runs a typical mixture of instructions, and is indicative of the performance level one could expect in everyday usage.

The standard *APC* tests were then run. These were written in Turbo Pascal and the same code run on all machines. They also provide a good overall indication of performance, and are timed with a stop watch. Recent nefarious goings-on in the industry have shown that a stop watch test is an essential component of any in-depth benchtest.

In general, all of the machines provide a base level of performance exactly equal to the IBM PC, except for the Uni-x, which is around 60 per cent faster even at 4.77MHz. The two fastest machines are the Uni-x and Technology Interface, with the Rod Irving coming close behind. All of these offer a 10MHz turbo mode. The Uni-x is fastest overall, providing a 50 per cent boost over the Technology Interface due to the V20.

Most interesting of all, there is almost a three fold difference in performance between the fastest and the slowest, and the fastest is the cheapest and the slowest is the most expensive. Although, we shall see later that the pricing does not work out quite that simply.

Storage

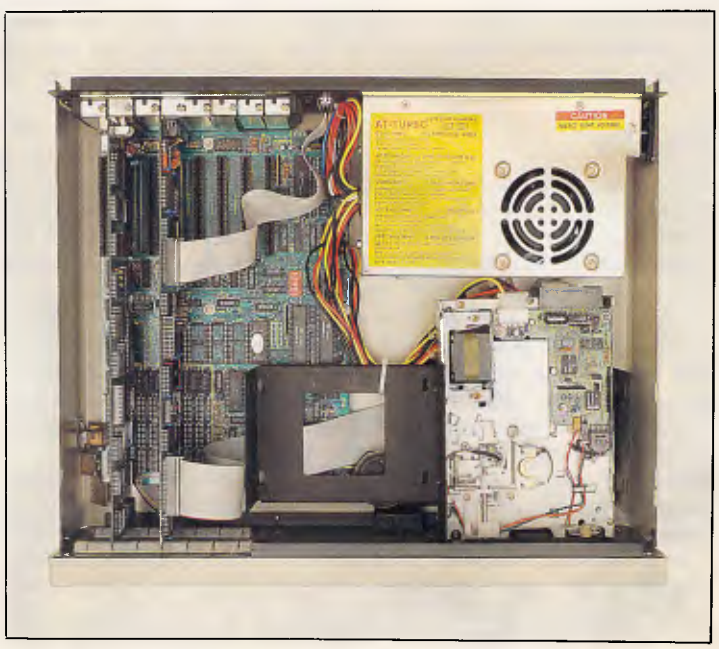
Quite a variation exists in the amount of RAM delivered as standard. The Atlantis, Rod Irving and MicroDOS are all provided with 256k, while the Commodore sports 512k and the Uni-x, Atronics and Technology Interface are delivered fully configured to 640k.

Memory chips are so cheap these days that it is hardly a consideration. The only expense arrives when it is necessary to install additional boards.

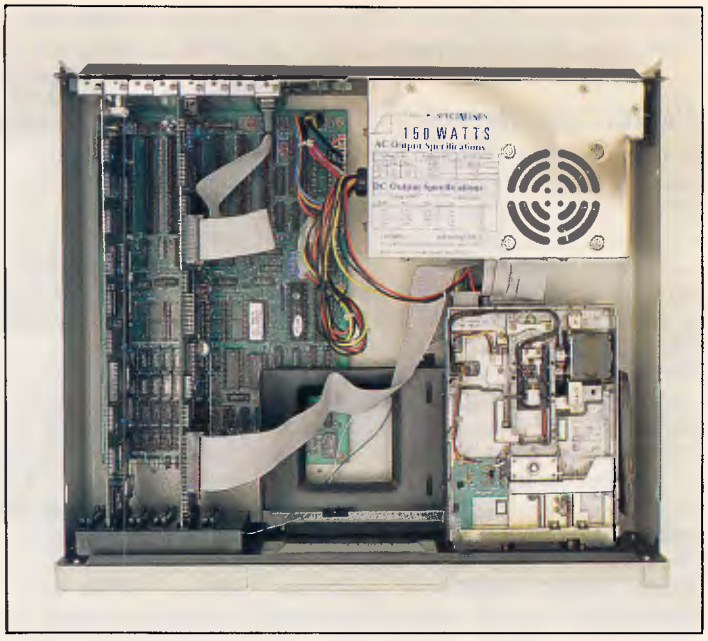
The MicroDOS and Rod Irving machines include three empty banks of chip sockets, allowing memory to be expanded up to 640k simply by the addition of 27 RAM chips at around two or three dollars each. Many dealers will throw in additional chips as part of the bargain, unless their price has been slashed to the bones to begin with.

All of the machines provided a single 5¼in 360k double sided double density disk drive, compatible with the original PC drive. This standard has now been superseded several times, and 3.5in drives with capacities in excess of 1Mbyte are now the strategic way to go. Nevertheless, the ancient 5¼in DSDD drive is still a force to be reckoned with. There are no known software vendors who do not still produce their wares in this format, and the situation is unlikely to change for many years to come. The Technology Interface machine is pictured with dual drives, but the prices refer to a single drive system.

The Atlantis PC was delivered with a Mitac drive, while the Rod Irving and Commodore featured Chinnon devices. The Atronics revealed a NEC drive and the Uni-x contained a Mitsumi, although subject to availability it may also be provided with Mitsubishi or NEC drives. The MicroDOS drive was



The MicroDOS machine has the lowest overall price for a complete functioning system



A five per cent discount card from Atlantis comes in handy for future upgrades

unidentifiable and the Technology Interface machine contained a Toshiba.

The benchmark results also show the average speed of the disk drive. This was measured by performing 1000 random sector reads via DOS interrupt number 25h. The average time for each read was then calculated. Most of the drives provided a similar level of performance: around 220ms per read. The only machine with a great variation was the Commodore, with an average access time of just over 300ms. The skeptics might argue that Commodore used the same team responsible for its C64 1541 drive, but the problem more likely lies in the controller.

Display

The prices listed are not an accurate indication of the cost of the machines, as some are delivered with monitors and some without. The MicroDOS includes A tilt/swivel amber screen; the Commodore comes with a monochrome monitor from Taiwan; and the Uni-x is delivered with a nice INTRA tilt/swivel amber screen. The others charge extra, and generally supply either Samsung or Sakata monitors. Later, we make an attempt to normalise the prices of the seven machines based on the features they provide as standard.

All of the machines were supplied with display adaptor cards as standard. The Atlantis, Rod Irving, MicroDOS and Uni- all feature CGA compatible adaptors, while the Atronics and Technology Interface contained a Hercules compatible card and the Commodore featured a card apparently capable of monochrome, Hercules, CGA and Plantronics compatibility. The Rod Irving was a little unusual in that the CGA card also provided a printer adaptor.

The choice of display adaptor is largely a personal one. It all depends on what you plan to do with the machine, and how you rank the relative merits of each option. The CGA adaptor is capable of graphics and colour, but is often only connected to a monochrome screen. If you are lucky, this will mean grey scales instead of colour, but can often mean an unintelligible display, depending on the colours used. The best option is to connect a colour monitor to a CGA, but colour screens cost at least $300 more than monochrome. CGA uses an 8 x 8 character matrix which becomes quite tiring to read for extended periods. Additionally, the CGA scrolls more slowly than other alternatives and some software generates 'snow' when it accesses video memory directly.

A straight monochrome display adaptor and monochrome screen provides the best character font and best screen speed, but is totally incapable of performing graphics. For this reason, many vendors provide a Hercules compatible card which delivers the advantages of monochrome while retaining graphics ability. The graphics, however, is not CGA compatible, and so you must run software which has been specifically customised to support the Hercules. Most popular packages do, but there will inevitably be some which do not as Hercules is not an IBM standard. Hercules compatible display adaptors generally need additional software to work well. For example, Microsoft GW-Basic will not perform graphics, and so you must use a special program called HBasic. Taiwanese Hercules cards usually do not come with all the utilities, and some tend to be better than others in terms of compatibility. The Atronics card was one of the better ones, while the Technology Interface card was a little weird, demonstrating some of the basic compatibility problems such as the screen flashing when it is not supposed to.

The best all-round option is EGA, as it provides a good character quality, the highest graphics resolution and a wide choice a colours. The catch is that any good advanced adaptor, while not expensive on its own, requires a very costly monitor. Going the EGA route can add $2000 to the cost of your system.

If you are primarily interested in text and expect to only occasionally generate graphs from popular software packages, then a Hercules may be the best way to go. On the other hand, if you can see yourself playing games from time to time, rarely do word processing, and would like to try your hand at graphics, then the CGA may be best. If you have no idea what you want to do, then CGA probably provides the greatest number of options.

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patibility problems to be designed into the hardware. It is, however, easy for problems to arise in the software, particularly the ROM BIOS firmware.

This ROM provides the interface between DOS and the hardware, although applications often are obliged to call the BIOS directly due to inadequate DOS facilities. Whereas DOS is generally available to all PC manufacturers directly from Microsoft, the BIOS is entirely the property of IBM and it's not about to let it go.

Some Taiwanese manufacturers have been known to steal IBM's BIOS, obliterating the copyright notices and slightly changing portions of the code. This almost never happens these days, mainly because there is a viable alternative in the form of Phoenix. Phoenix is one of the great success stories of the clone industry and specialises in the production of IBM compatible BIOS firmware. The firm protects itself by dividing its programmers into those who have seen the IBM BIOS and those who have not. The two groups are kept carefully away from each other, and Phoenix wins its court cases.

The Rod Irving, MicroDOS and Atronics machines all use Phoenix BIOS version 2.27. The Commodore uses Phoenix version 2.03, under licence to Commodore which has made a few changes to it. Unless Commodore has managed to really botch it up, all of this firmware can be approached with great confidence. Its most obvious modifications lie in the copyright message and an annoying burble the machine emits when booted. The Technology Interface FTC uses an FTC BIOS from AMI, whoever they are. The other two machines use the Award BIOS, which is also a known name and has been used enough for most problems to be ironed out. You really only need to worry if the BIOS has been home grown by the same people who bolt the disk drives on.

The Commodore and Rod Irving PCs are delivered with Microsoft MS-DOS version 3.2, complete with GW-Basic. The real thing and, as such, accompanied by good documentation and all the trimmings. The MicroDOS and Atronics products come with Falcon DOS 3.1. This is really MS-DOS, but 'OEMed' through Falcon, just as the M24 comes with MS-DOS OEMed through Olivetti. One can only assume that Falcon exists so that small Taiwanese manufacturers may be supplied with MS-DOS without the trouble of signing an agreement with Microsoft.

The Falcon manual is an abbreviated form of the standard Microsoft work, and is therefore intelligible. Falcon DOS includes some good OEM extensions, including the popular WHERE command to locate files in directory structures, a rename directory command, a bad sector isolation command and a facility to park hard disks.

The Atronics also comes complete with a Basic interpreter called ERSO Basic. This would be something to be a little more wary of. ERSO Basic is supposed to be a GW-Basic compatible, and seems to provide all the major features. The Uni-x and Technology Interface PCs are not supplied with DOS, and neither is the Atlantis although it may be purchased for $150 complete with Basic.

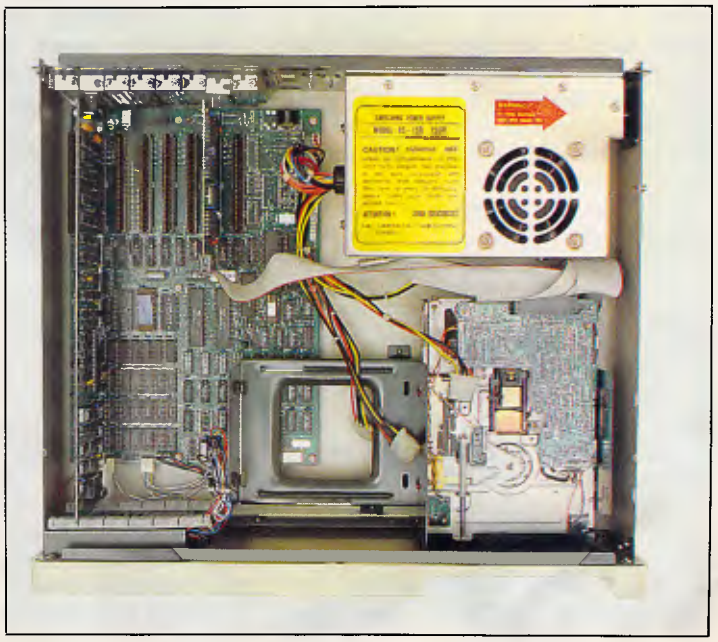
Very few PC owners have any use for a Basic interpreter these days, and with any luck Basic may gradually disappear altogether. DOS, however, is an essential required by almost everybody.

The Commodore PC5 comes complete with Borland International's SideKick pop-up desk utilities and Able-One, an integrated applications package. Some buyers are actively discouraged by bundled software, as they feel they are paying for something they don't really want. In most cases, bundled software adds very little to the purchase price and is probably best considered a give away.

The Atlantis machine is supplied with four disks of public domain software including a bare bones spreadsheet program, word processor and utilities. A plastic card offers five per cent discount to any future purchases from Atlantis and access to public domain bulletin board systems.

Ports & slots

All of these machines offer eight expansion slots, of which six are free and one can only support three quarter length boards. The exception is the Commodore PC5, which only provides five slots in total, of which four are



The Rod Irving XT features the Phoenix BIOS 2.27, Microsoft's MS-DOS 3.2 and GW-Basic

Build-it-yourself Uni-x XT comes in first on the performance index

free. In these days, when all the essential ports are included in the machine, the number of free slots is not as important as it used to be.

All of the machines provide a serial port, parallel printer port, battery backed real-time clock/calendar and games adaptor; except for the Atronics which has two serial ports, the Technology Interface which has two printer ports, the Rod Irving which does not have a serial port or games adaptor, and the Commodore which lacks both a games port and battery backed clock/calendar. The most serious omission among these is in the Rod Irving PC, as a serial port is of use to just about everybody. The port could be added either by purchasing a card which provides only that function, for about $100, or by adding a full blown multi-function card.

If it seems remarkable that the machines provide such a similar array of ports, then it may start to make more sense when you know that the Atlantis, MicroDOS, Uni-x, Technology Interface and Atronics machines all use the same (or very similar) board to do it. This board provides all the ports, clock and floppy disk controller in a single slot. The Rod Irving PC uses a different board, and the Commodore has gone completely its own way.

For disk expansion, all of the machines provide space for three additional half-height devices or two half-heights and one full-height. The exception to this is the Atronics which, due to its small footprint, has only enough space for two half-height devices and may present some problems in accessing the bottom most device. In all cases, this provides more than enough scope for the addition of a hard disk or second floppy which could be run from the existing controller card. Some users may wish to add their hard disk in the form of a 'hard card', in which case device accommodation is not a consideration.

Of cases & keyboards

If these machines are starting to blur uncontrollably together, it is here that they start diverging. Slowly.

Six of the seven machines present themselves in a traditional PC-sized case in standard livery. The Atronics, however, goes out on a limb by offering a smaller footprint. It does this by increasing its height a couple of centimetres and manages to reduce the width by around 13cm. The front panel lights and switches are arranged in an original style and the overall effect is rather pleasing, being more reminiscent of an M24 than an IBM PC.

Most of the machines provide a 'flip top' lid, allowing easy access to the internals. The Taiwanese machines originated this feature (I think), and it is perhaps the greatest single breakthrough in clone design. It is also a very handy feature for anyone who needs to poke around inside their machine every couple of weeks. The exception is the Commodore, which hides beneath a traditional screw down top, affixed by an unheard-of total of seven screws, including two on the side.

The Atlantis, Rod Irving, Technology Interface and MicroDOS machines provide holes in the rear of the case for mounting additional 'D' type connectors. Many multi-function cards provide a staggering array of ports, and often come complete with additional back plane facades just to support the extra ports. This is often a waste of a slot, so the provision of 'D' type holes means that the additional ports can be mounted without obscuring a slot. Not a major feature, but a nice touch.

The Rod Irving, Uni-x, Technology Interface and Atronics machines all provide a key lock, reset button, turbo button and turbo LED indicator. Three of these are so similar in this respect that the only significant distinguishing feature is the colour of the buttons.

All of the machines are driven by a 150W metal box power supply, except the Commodore which boasts 170W and the Uni-x which may reveal either a 135W or 150W supply, depending on when you purchase it.

As far as keyboards are concerned, the prevalent trend would seem to be IBM AT-style layouts. The exceptions here are the Commodore, which has a traditional PC-style keyboard with a few relocated keys; the Rod Irving which is AT-style but lacks a scroll lock indicator; and the Atronics and Technology Interface machines, which provide the new IBM-style layout with 12 function keys and separate numeric and cursor pads.

Quality is a very subjective thing, and hard to convey from one person to another. One's viewpoint also changes

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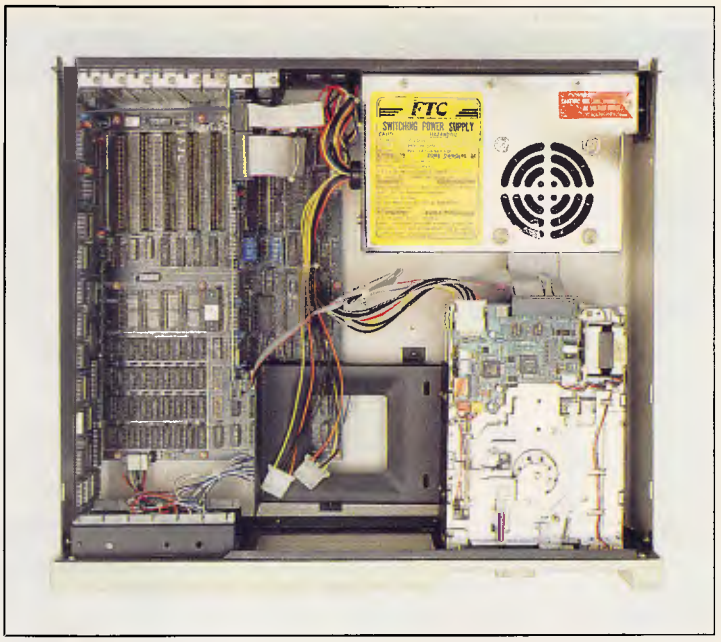

Technology Interface includes the new IBM-style keyboard with 12 function keys, separate numeric and cursor keypads

according to the number of hours spent at the keyboard. There are people who maintain that IBM PC keyboards are terrible because they are so 'positive' and 'clicky', and others who dislike 'squishy' or soft keyboards. All of the keyboards supplied were a little clattery, a little clicky and a little rattley, to different extents on different machines. It may be best to test it for yourself and have a poke at the machine of your choice, just to make sure you're not violently opposed to its style of keyboard. You may even find that the keyboard feel changes from production batch to batch.

Assembly & installation

The Atlantis and Rod Irving machines are assembled in Australia, and the MicroDOS is assembled in either Australia or Hong Kong, depending on supply and demand.

The Uni-x, on the other hand is assembled in the country of your choice. Just take it there, then assemble it!

Most of the machines are installed by unpacking, placing it on a desk, plugging in the keyboard and monitor, removing the disk protecting cardboard, applying power and switching it on. Pretty easy stuff.

The Uni-x, on the other hand is a different story. Lifting the top reveals not a hive of circuitry and cable, but rather a coven of blue and white striped boxes entitled 'Add-On Cards'.

The only component ready installed in the machine is the power supply. Apart from that, the case is entirely empty. The indicator LEDs must be glued into the front panel and plugged into the motherboard. The disk drive must be mounted, the switches connected, even the rubber feet have to be stuck on. A small box of screws, washers and brackets is included, allowing the motherboard to be screwed on to the bottom of the case via small pillars.

However, there is absolutely no soldering required. It can all be done with a screwdriver which Uni-x claims to supply with the machine. We couldn't find the screwdriver, and also couldn't find any instructions. Manuals are provided for each board, detailing its features and even the circuit diagrams. There was, however, no manual describing how to put it all together. No doubt full instructions are normally provided, and we just missed out.

Full installation, although simple, would be a reasonably lengthy affair, most likely taking two or three hours. We did it in about fifteen minutes, but the result was not a pretty one and we did have one or two . . . umm . . . 'left over' bits. Assembly without the instructions takes a few guesses, and the novice may be a little hesitant, even with the assistance of a manual. We would suggest that you enlist the assistance of a knowledgeable friend, or pay someone to put it together for you.

It is unlikely that the captains of industry will bulk buy do-it-yourself PCs. It is more likely that home buyers will elect to spend a few hours to save a couple of hundred dollars. Small or medium size companies which have a resident 'Gofa' could well consider the savings offered by self assembly. Uni-x offers a 90-day warranty.

Either way, assembling it yourself does serve to remove any 'techno-fear' from which you may be suffering.

Of incest & imports

The reason for the great similarity between many of these machines is to do with their upbringing.

Taiwan has companies which build power supplies, others which build cases or keyboards, others which make motherboards, and others which construct multi-function cards. Take a walk down any road in Taipei and you will pass all the manufacturers you need to put together an entire computer.

Taiwan also has other companies which buy components from the manufacturers and screw them together into computers. Thus the Taiwanese computer industry is, to a certain extent, all about combinations and permutations. This is why four different brands of computer have the same multi-function board, a different three have the same case, yet another three have the same power supply, two have the same display adaptor, two groups of two have the same screen, four have the same keyboard, and so it goes on. If you ever have the illusion that you're looking at the same machine, don't worry, you probably are.

There is nothing wrong with that, and it offers an opportunity for Australian companies to assemble their own com-

Table 2: Performance figures

	Atlantis Budget PC Turbo	Rod Irving XT Compatible	MicroDOS	Commodore PC5	Uni-x Super 10 XT	Atronics PC Turbo	Tech. Interface FTC Turbo XT
Norton SI — Normal	1.0	1.0	1.0	1.0	1.8	1.0	1.0
Norton SI — Turbo	1.7	1.9	—	—	3.7	1.6	2.1
128k NOP loop	6.21	5.98	10.11	10.16	4.77	6.20	4.84
Do nothing loop	5.93	5.44	9.94	9.94	4.45	5.99	4.62
Integer add	6.04	5.38	9.89	9.94	4.34	6.05	4.72
Integer multiply	5.99	5.16	10.00	10.05	2.69	5.98	4.78
String move & copy	6.59	5.88	10.72	10.76	4.17	6.59	5.16
Prime numbers	9.44	9.06	15.38	15.44	6.97	9.45	7.31
Instruction mix	19.50	17.74	32.02	32.13	12.03	19.50	15.30
Drive speed	212.5	218.9	212.6	303.0	235.5	212.6	210.6
IntMath	2.4	2.3	4.1	4.0	1.3	2.4	2.1
RealMath	24.1	23.1	39.6	39.4	18.3	24.3	19.4
Triglog	34.5	33.1	55.8	55.8	26.2	34.6	27.3
TextScrn	21.5	27.8	43.4	32.5	16.1	21.3	19.4
GrafScrn	2.6	2.8	4.6	—	2.1	—	—
Store	11.4	11.9	11.1	13.2	11.6	10.3	11.5

puters. All they need do is import the various bits and pieces, and do the assembly here. In fact, many computers assembled in Australia would involve a construction process identical to that of the Uni-x.

It does, however, cause problems when asked the brand name of a good Taiwanese computer. Everybody knows someone who has bought a clone and had nothing but problems, just as everybody knows someone else who bought a clone and swears by it.

The fact is, they're all much the same. Variations exist, but they tend to be minor and may even change from batch to batch. And it works to your advantage. The more times a particular board is badge engineered, the greater your confidence in that board can be.

Specifics

Having covered all of the above, there remain only a few miscellaneous comments which may be applied to specific machines.

The monitor supplied with the Atlantis PC, although not included in the price, did not work very well with the display adaptor. Scrolling displays, even just in DOS, caused a great deal of flickering and proved difficult to read. The Hercules-compatible card included with the Technology Interface PC also presented a few problems. Try before you buy.

The Commodore was perhaps the most different of all the machines. The motherboard was of a radical design built in Hong Kong, and the RAM chips were mounted on a vertical 'appendage board'. Like most Commodore gear, many of the labels were in German but the machine was actually a collection of Taiwanese, Japanese and Hong Kong components. The PC5 also had the keyboard connector plug on the front of the case, which is a very sensible place for it to be.

The Uni-x features a delightfully small motherboard. It has employed a VLSI component to replace the Intel 8253 timer, 8255 PPI, 8237 DMA controller and several other components. This reduced the component count and a simplified motherboard serves to reduce costs.

As far as documentation goes, most of the machines supplied the hardware manuals originally provided by the com-

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Table 3: Bangs per buck

	Atlantis Budget PC Turbo	Rod Irving XT Compatible	MicroDOS	Commodore PC5	Uni-x Super 10 XT	Atronics PC Turbo	Tech. Interface FTC Turbo XT
Standard price:	$985	$795	$899	$1295	$942	$999	$1195
Plus monitor:	$175	$175	—	—	—	$175	$175
Plus DOS:	$150	—	—	—	$150	—	$150
Plus RAM:	$100	$100	$100	$50	—	—	—
Plus RS232C port:	—	$100	—	—	—	—	—
Less bundled s/w:	($50)	—	—	($250)	—	—	—
Comparative price:	$1360	$1170	$999	$1095	$1092	$1174	$1520
Performance index:	1.64	1.81	1.00	1.00	2.66	1.64	2.09
Bangs per buck:	12	15	10	9	24	14	14

ponent manufacturers. These manuals are of very little use in every day life. System reference manuals were also included, except for the MicroDOS. Rod Irving's system reference manual was completely generic, and could have applied equally well to any of the machines. The Commodore PC5 had the best documentation, with the Atronics a close second.

Cost effectiveness

At first glance, it appears that the Commodore is the most expensive and Rod Irving is the cheapest.

However, not all machines provide exactly the same configuration. For example, many do not provide a monitor or DOS. To compare 'apples with apples', we have tried to standardise each machine to a similar configuration.

We have added $175 for the cost of a monitor to those machines which do not already include one, another $150 for DOS, $50 per 256k of RAM chips and $100 for an RS232C serial board. For the five per cent discount offered by Atlantis, we have assumed a value of $25. For the Commodore PC5, we have arbitrarily assigned a value of $250 to its bundled software. This is a difficult point, as every other adjustment is required in order to obtain a fully functional system. The bundled software is not essential, and few people would buy exactly those products. It comes down to how you personally feel about bundled software as to whether you want to cancel out our $250 adjustment.

As you can see, this evens out the prices somewhat, and even reverses the trends. We have then standardised the performance based only on instruction throughput, to come up with a figure which is relative to the standard IBM PC. This is similar to the Norton SI index, but more accurate. From this, we have calculated a 'Bang per buck'.

As you might expect, the do-it-yourself Uni-x comes up trumps with its low cost and relatively high performance. However, if you're not prepared to do the assembly work, then the machine would be out of the question.

The Commodore scores least, although it is the most complete machine of them all. If you want to avoid running all over town collecting extra bits and pieces, and are not at all interested in performance, then this machine would have its merits. Its rating depends greatly on the value assigned to the bundled software, and that is quite subjective.

All the other machines fall roughly in the middle, with the MicroDOS lagging slightly due to its unimpressive performance.

Of horses & courses

Finally, around this time we always think it's pleasant to find at least *something* nice to say about each product. So here goes.

The Commodore PC5 is the machine to buy if you're interested in a complete package at a budget price and have no interest in performance. It might suit the professional buying a machine for home who has a restricted budget, no time to rush around, and has a more powerful beast in the office.

The Uni-x is a good machine for the hacker, providing lots of power so long as you're prepared to put it together. Or, alternatively, you may be the sort of person who would end up pulling it to bits anyway. It is possible to purchase the machine (with the same internal components) fully assembled if you prefer, but costs $1922. Its CGA adaptor makes it particularly well suited to the hacker as there will be no problem with games. On the other hand, for reasonable performance at a reasonable price, there is always the Rod Irving machine. This becomes quite good value if you already have a monitor, don't need much RAM and are happy to buy an RS- 232C card.

For users planning a great deal of textual work and very few games, the Technology Interface or Atronics

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machines include a Hercules adaptor which provides adequate character resolution. The Atronics becomes particularly attractive due to its small footprint and stylish appearance. On the other hand, for buyers on a strict budget, the MicroDOS machine has the lowest overall price for a complete functioning system. Lastly, if you're planning to upgrade to a hard disk, printer and all the trimmings, then the five per cent discount card which comes with the Atlantis machine could prove very handy.

Conclusion

People often ask which is the best cheap clone to buy. The answer usually is 'it doesn't matter'. Hopefully this review will have demonstrated that there are common threads throughout all clones, and that most have their roots in Taiwan. Although we have highlighted the display adaptor as being an important component in matching your machine to your requirements, don't be put off simply because one of the machines listed here suits all your needs except comes with the wrong sort of adaptor. All of the distributors can provide virtually every type of display adaptor, and it would certainly be worthwhile giving them a call.

If I had to pick a winner from these seven machines, it would probably be the Atronics due to its footprint and presentation combined with a good level of performance. Hot on its heels is the Uni-x, just because of its price/performance ratio. From there, things tend to merge a bit, and the only other distinctive machine is the Commodore which appears to be the worst value of the bunch, but offers a different sort of value by coming as a complete package.

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pc-ditto

Designed from the start to run IBM PC-type business applications on the Atari ST, pc-ditto from Avant-Garde Systems is a cheap, easy-to-install but, above all, 'working' IBM emulator. Owen Linderholm assesses its appeal to ST owners who want to get 'serious'.

SPECIAL OFFER! Buy this $1200 pc-ditto IBM clone and get an Atari ST free!

This headline may sound like a computer buff's fantasy, but it could very soon become reality; the reason being that a US company has brought out an IBM emulator for the Atari ST. The astonishing thing about pc-ditto is that it *does* work and, indeed, works very well. This is especially impressive when you realise that the 68000 processor is being made to emulate an 8088 processor and a 6845 display chip and some other support chips and a ROM BIOS and . . . you name it.

The company which has produced this *marvel*, Avant-Garde Systems, is aiming the product at people who have an ST and a PC; but specifically those who use a PC in their business and an ST at home. As a result of extensive market research, Avant-Garde Systems developed an emulator designed to run business applications for the IBM on an ST. As the performance tests in this review show, it has achieved its objective admirably.

At present pc-ditto will run on any colour ST system, although it ideally requires 1Mbyte of memory and double-sided disk drives for best performance. This means that you can now get an IBM compatible for $1124: $999 for an Atari 520STFM and $125 for pc-ditto. And, as the headline above indicated, you get the Atari ST thrown in for free. Of course, it won't run as fast as other PC compatibles and it doesn't have an IBM standard keyboard or the 'Blue' seal of approval, but you can always get another 'badge' for it.

Installation

Contrary to expectation, pc-ditto is very easy to install considering the major task it has to perform. The program will run as it stands and will emulate a PC with a single floppy disk drive. If, however, you want to customise the set-up, a simple ST program called PC-DMENU.PRG will do it for you. This allows you to set up the disk drive configuration, video options, keyboard speed and repeat and display colours.

The disk drive option lets you install the program for a hard disk and one or two floppy disks. The floppy disk can

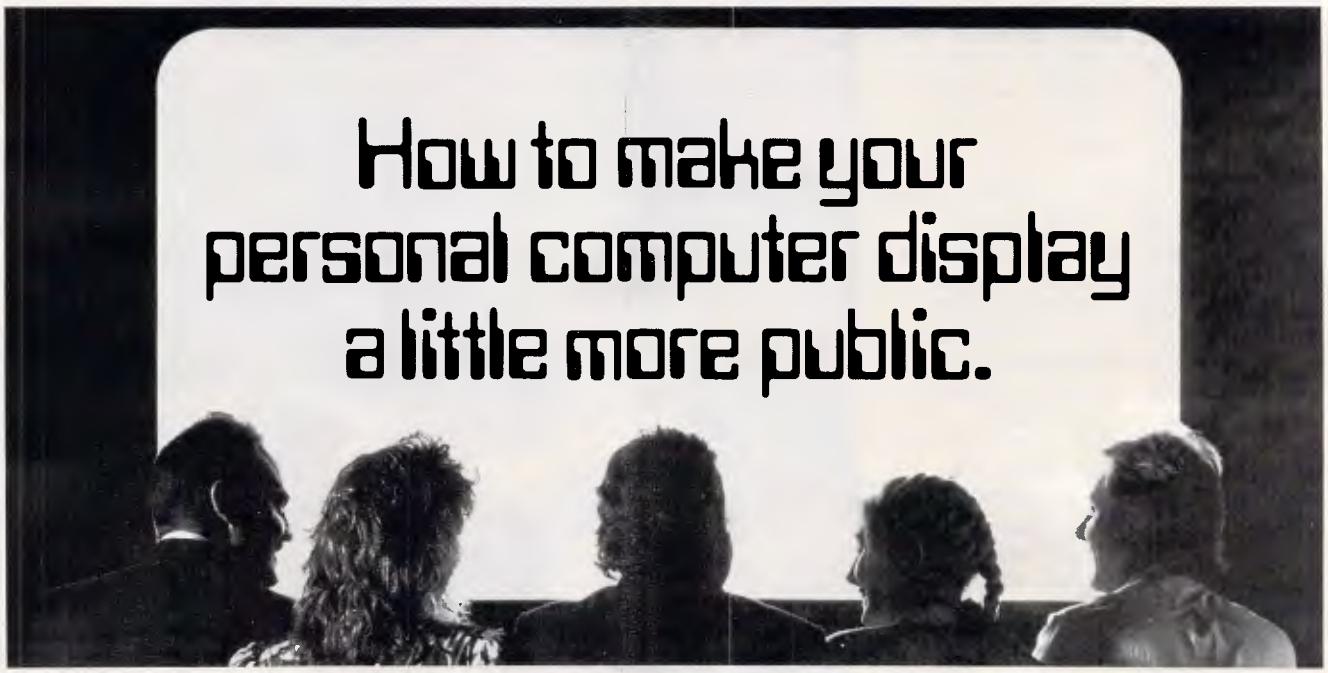
be either 3.5in or 5¼in if you have an external 5¼in drive (available in the US but not here in Australia as far as I know). The hard disk is automatically recognised and the program even recognises the partitions that have been created. At the moment the program can only access the first partition, but this should have been sorted out by the time the next version of the software is released.

The video options cover whether you want to emulate a monochrome or a colour screen. You can also set up which of the monochrome attributes should be emulated, such as blink or reverse. Emulating these attributes takes time, but you are allowed to ignore them to speed up the display. The keyboard set-up lets you indicate how quickly keyboard repeating should work. And, finally, the colours menu lets you set up which colours are displayed in the different modes, which is very important in 80-column text mode as this is where pc-ditto is least compatible. The 80-column text mode on the IBM uses 16 colours, and is emulated by pc-ditto in the Atari ST's medium resolution mode which only has four colours. It is important, therefore, to pick a set of colours which will work well. The default set for pc-ditto is black, white, red and blue; and this works well for most applications.

When pc-ditto starts up, the ST displays a copyright message screen, some system information and a request for you to start up the IBM PC's DOS or return to GEM DOS. This same screen reappears when you perform a PC reboot while an application is running. The system information is interesting because it tells you that you have 703k of memory available for applications whereas a PC compatible only has 640k. This is useful as it means that you can hold up to 703k of data in memory. Not all applications will recognise this extra memory, however, and on an Atari 520ST the memory available is reduced to about 200k. Also, the new Mega STs will still only be able to use up to 703k of memory because of the memory-addressing limitations of IBM PCs.

At this point, you can insert almost any 3.5in DOS disk for IBMs or compatibles, and pc-ditto starts DOS up. I say *almost* because not all versions of MS-DOS will work correctly. *All* versions of PC-DOS work correctly, but as individual manufacturers optimise MS-DOS for their specific machines, versions of MS-DOS differ and cannot be guaranteed to work correctly. However, Avant-Garde did promise me that all the most popular versions of MS-DOS will be supported. I only had one version of MS-DOS available on a 3.5in disk, MS-DOS 3.2 for a Toshiba T1100 portable. This worked fine, except that for some reason, it wouldn't access the hard disk: perhaps because the T1100 doesn't have a hard disk?

Two IBM PC programs are supplied with pc-ditto: SPEEDY3 and QWICKEYS respectively. Both are public-domain utilities: the former speeds up the screen while the latter speeds up the keyboard. The keyboard is one of the big problems for pc-ditto since the ST has a very different keyboard to the IBM. pc-ditto remaps the keys that aren't on the ST keyboard to spare ST keys, and provides an overlay card to identify the keys. Both programs are robust and worked successfully with all the software I tried, significantly speeding up several programs. They are good utilities for any IBM or compatible that needs to have the screen or keyboard operate more quickly.



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pc-ditto works with all standard IBM 3.5in disks and, with an add-on 5¼in drive, it can read standard IBM 5¼in disks. There is no problem with reading and writing any of these disks. In fact, early versions of DOS can only access 360k 3.5in disks, and Avant-Garde has provided a driver to let these versions of DOS format and access the higher capacity 720k 3.5in disks.

There aren't any special commands in pc-ditto. Once it is running, it is exactly the same as using a PC — except when you press CTRL-ALT-DEL to reboot the DOS. In this case, pc-ditto gives you the option to either reboot or to return to the ST's GEM environment.

How a 68000 emulates an 8088

The basis for emulation is that one processor must be able to correctly imitate the functions of another, with the difficulty of this task depending upon the differences and similarities of the two processors involved. In this case, the 68000 has to fully emulate the instructions of an 8088 and the consequent effects on, say, memory, registers and data bus. This is difficult since the two processors are fundamentally very different: the 8088 is an 8-bit processor with a fairly complex instruction set, and it is coupled to some fairly idiosyncratic hardware within the IBM PC.

This makes the task of the 68000 very tricky. And it is only because the 68000 is a 16-bit processor operating at high speed that it can manage it at all sensibly. What Avant-Garde has provided is a program that not only emulates the 8088 but also as much as possible a program that maps the environment of an IBM PC onto the very different hardware of the Atari ST. For example, the serial port on an ST is connected differently, will be placed at a different hardware address, and will have different hardware controls, all of which must be made to 'appear' the same as on the IBM serial port. Also, Avant-Garde has had to emulate the BIOS of the IBM PC using a piece of 68000 code. Instead of using a currently existing BIOS, such as Award's (the result of which would have been dreadfully slow), Avant-Garde has cloned the BIOS using 68000 code to increase speed. Since so much IBM software runs under pc-ditto, it has obviously succeeded very well.

pc-ditto's code also emulates various parts of the hardware that are in an IBM PC but not in an Atari ST, an example being the 6845 video chip. There is a short public-domain program that will produce 130 colours on the screen by mixing existing colours and by directly accessing the 6845 chip. This program uses the PC's 16-colour text mode and so has only four colours available to it when working on the Atari ST. Thus, it doesn't produce 130 colours, only eight or so, but the emulation of the 6845 chip obviously works correctly. It is only the video capabilities of the ST in the 80-column text mode that let pc-ditto down.

Understandably, Avant-Garde wasn't willing to discuss how the emulator worked in detail, but the company did say that it had been optimised for standard business use activities. In other words, screen updating is quick, keyboard response is somewhat less good and arithmetical calculations are poor.

In use

The proof of the pudding is in the eating, so the saying goes. So, how well *does* pc-ditto work in emulating an IBM PC? The answer is *very well,* somewhere around the 95 per cent mark. I have seen several PC compatibles which work less well with PC software, and the big problem isn't particularly *what* it will run but *how quickly.* To give you a brief and slightly misleading idea, the Norton Utilities' SI program rated pc-ditto at 0.3 or three tenths the speed of an IBM PC, while PC-Tools rated it even worse at 15 per cent for the processor and 25 per cent for memory. However, for many applications pc-ditto certainly seems to perform better than these records state. I wrote the first half of this review using pc-ditto and NewWord 3, and the program was noticeably slower than a PC but definitely *not* more than three times slower, let alone six times worse. The program was useable, even though it struggled to keep up when I was typing at high speed. Experiments show that with slow editors you might lose some characters when typing fast, but that fast editors are quite able to keep up.

Some indication of the tricky nature of speed timing on an emulator can be seen from the 'Benchmarks' table. Comparing pc-ditto with an IBM PC under Basic makes pc-ditto seem very much worse. It is about seven times slower, except for the screen-writing tests which are five times slower. Then, comparing Turbo Pascal on an IBM PC with Turbo Pascal on pc-ditto shows pc-ditto to be only one and a half or twice as slow as the IBM PC on writing to the screen, but up to ten times slower on trigonometric calcula-

Benchmarks

BASIC	ATARI ST (ST-Basic using 3.5in floppy)	PC-DITTO (GW-Basic 2.02 using 3.5in floppy)	IBM PC (Basic A using external hard disk)
Intmath	1.5	44.6	6.2
Realmath	3.5	56.7	8.2
Triglog	7.9	373.8	47.0
Textscrn	44.8	445.0	100.0
Grafscrn	92.7	253.1	49.0
Store	56.0	149.5	17.2
PASCAL	**ATARI ST (TD1 Modula-2 using 3.5in floppy)**	**PC-DITTO (Turbo Pascal 3.0 using 3.5in floppy)**	**IBM PC (Turbo Pascal using external hard disk)**
Intmath	0.045	0.43	0.18
Realmath	0.43	34.3	4.0
Triglog	6.0	565.0	56.2
Textscrn	6.2	115.6	75.4
Grafscrn	40.0	8.9	5.0
Store	15.0	31.5	4.9

All timings in seconds. For a full explanation of the APC Benchmarks, see the November 1986 issue.

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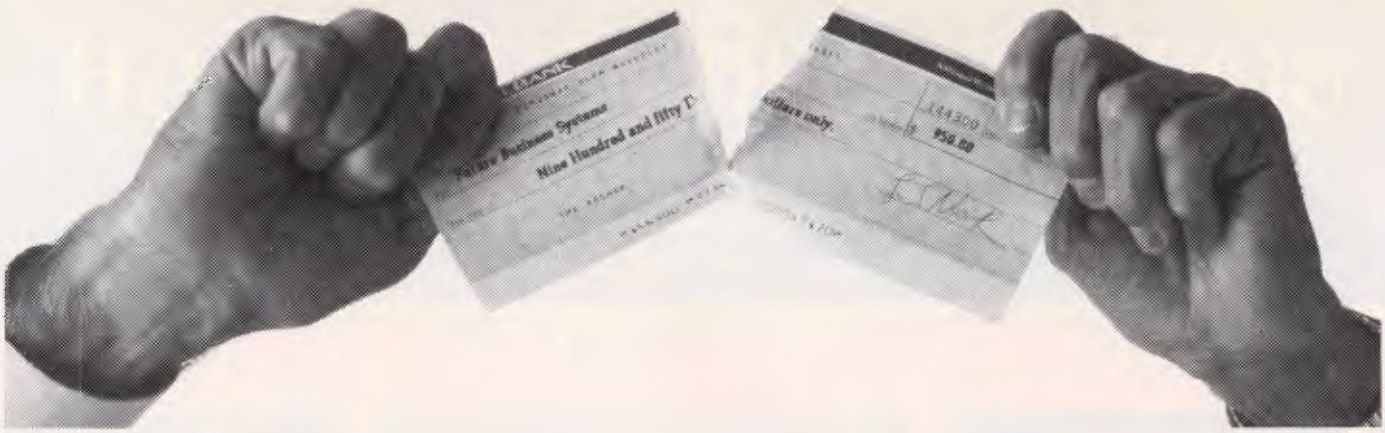

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tions. Even stranger are the results when you compare the Benchmarks for pc-ditto running Turbo Pascal and GW-Basic. Turbo Pascal is significantly faster, except in the 'triglog' Benchmark where it is slower. The Benchmark comparison with plain ST programs is less interesting but still shows some anomalies. What is going on? How can Turbo Pascal under pc-ditto be much faster than GW-Basic, except in one case where it is much slower?

The answer is related to the parts of the emulation which Avant-Garde has optimised. Quite obviously, screen timings are better than average for both text and graphics. This reflects the fact that Avant-Garde specifically optimised pc-ditto's screen-writing code. Conversely, it has obviously done nothing to speed up real mathematical calculations and this only makes them look worse.

This still doesn't explain why Turbo Pascal was so much slower than GW-Basic for the 'triglog' Benchmark. The answer must lie in the way these programs calculate trigonometric functions. GW-Basic may well calculate them all itself using integer approximations as much as possible, while Turbo Pascal may make use of any routines it can find in the BIOS, or may use the more advanced and tricky arithmetic instructions of the 8088. (Incidentally, all the Benchmarks for pc-ditto were run with the SPEEDY3 program in place since it comes as a standard part of pc-ditto.)

I tested more than the usual full range of *APC* test software on pc-ditto. Let me give you the list of what *wouldn't* run first: an arcade game Zaxxon; DESQview 2.0 (although version 1.2 works); MS-DOS version 3.2 for the Toshiba T1100; and Stargate, another arcade game. Occasionally the system crashed at other times when I was running several memory resident programs, and trying to do such things as examine which memory-resident programs were in memory with a program called MAP.

I'll only tell you the more *unusual* things that worked since the list is very long. Firstly, I demonstrated why people won't get into a car I'm driving (apart from the fact that I haven't passed my test) by trying to optimise the Atari hard disk using PC-Tools and pc-ditto *without* taking a back-up first. Fortunately, my faith was vindicated when PC-Tools ran beautifully and speeded *not only* DOS access to the hard disk, but also ST TOS and GEM access when using the ST as an ST.

Here is a list of software I tried that worked: SideKick, PC-Outline, PC-Write, NewWord, Lotus 1-2-3, Turbo Pascal, GW-Basic, Turbo Basic, Turbo C, QuickBasic, Eureka!, ProComm (though only at up to 2400 baud, not above), Norton Utilities, PC-Tools, Xtree, and the game Digger . . .

Some of the things that impressed me when using pc-ditto were how the internal clock had been emulated, and how the program coped with potentially very difficult tasks such as compiling large programs. Eureka! displays a time count while iterating towards a solution and this time count on the screen was completely accurate. Not bad considering that the ST doesn't have an internal clock!

The list of software that Avant-Garde has tried runs to six pages and includes hundreds of packages. Without doubt, almost all standard business packages will run.

Problems

Not surprisingly, there *were* problems

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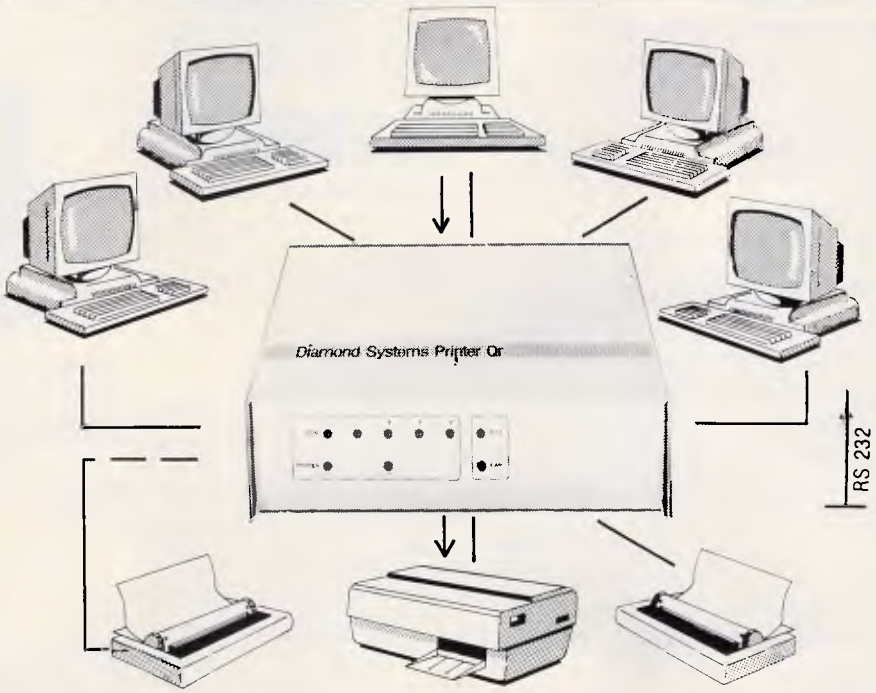

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with pc-ditto, although none of them were insurmountable. When changing resolutions from graphics to text, the ST sometimes generates problems with the 80-column text display. Switching resolutions again usually solves them, but it is an irritating phenomenon. ProComm worked fine with pc-ditto but could only up and download files at speeds of up to 2400 baud, above which the machine crashed. Fortunately, accessing online systems is only done at speeds of 2400 baud or less at present, so in practice this shouldn't be a problem.

Finally, programs using the DOS ANSI.SYS driver will only run very slowly. This is because using ANSI.SYS considerably slows down pc-ditto.

Documentation

The documentation accompanying pc-ditto is pretty dreadful, but this doesn't mean that you won't be able to get the program running. pc-ditto is *so* easy to use and straightforward that a manual is almost unnecessary, but nevertheless for a manual it is unclear, short and not of much use. Fortunately, it does indicate that you should look at the file README.1ST on the distribution disk. This turns out to be a useful list of files, disk information, and problems and solutions. The description of how to back up pc-ditto is vague, but, as far as I can make out, you are quite safe in just copying the disk by whatever means you normally use.

The rest of the manual deals with starting pc-ditto, problems, customising it and high-capacity 3.5in disks.

Conclusion

pc-ditto is an attempt to plug a gap in the market that no-one has yet tried to fill. Although there is plenty of demand for an IBM emulator, there may not be much demand for an IBM emulator that works slowly.

But pc-ditto works, unlike other previous 'emulators'. If your purpose is to access files from an IBM PC and make minor adjustments, evaluate data, edit files or perform other fairly light tasks, then pc-ditto is ideal. It isn't, however, a replacement for a high-powered PC. Be warned, don't try to do any desktop publishing using pc-ditto!

pc-ditto will also be very interesting for ST owners who want to investigate the world of the IBM PC. For very low cost you will have access to world-wide best sellers such as Lotus 1-2-3. It is now possible to own a machine that can run Apple Mac software, IBM PC software and Atari ST software, and all for not much more than $1000.

END

No details were available regarding local distribution of pc-ditto at the time of going to press. Details will be published in a subsequent issue of APC.

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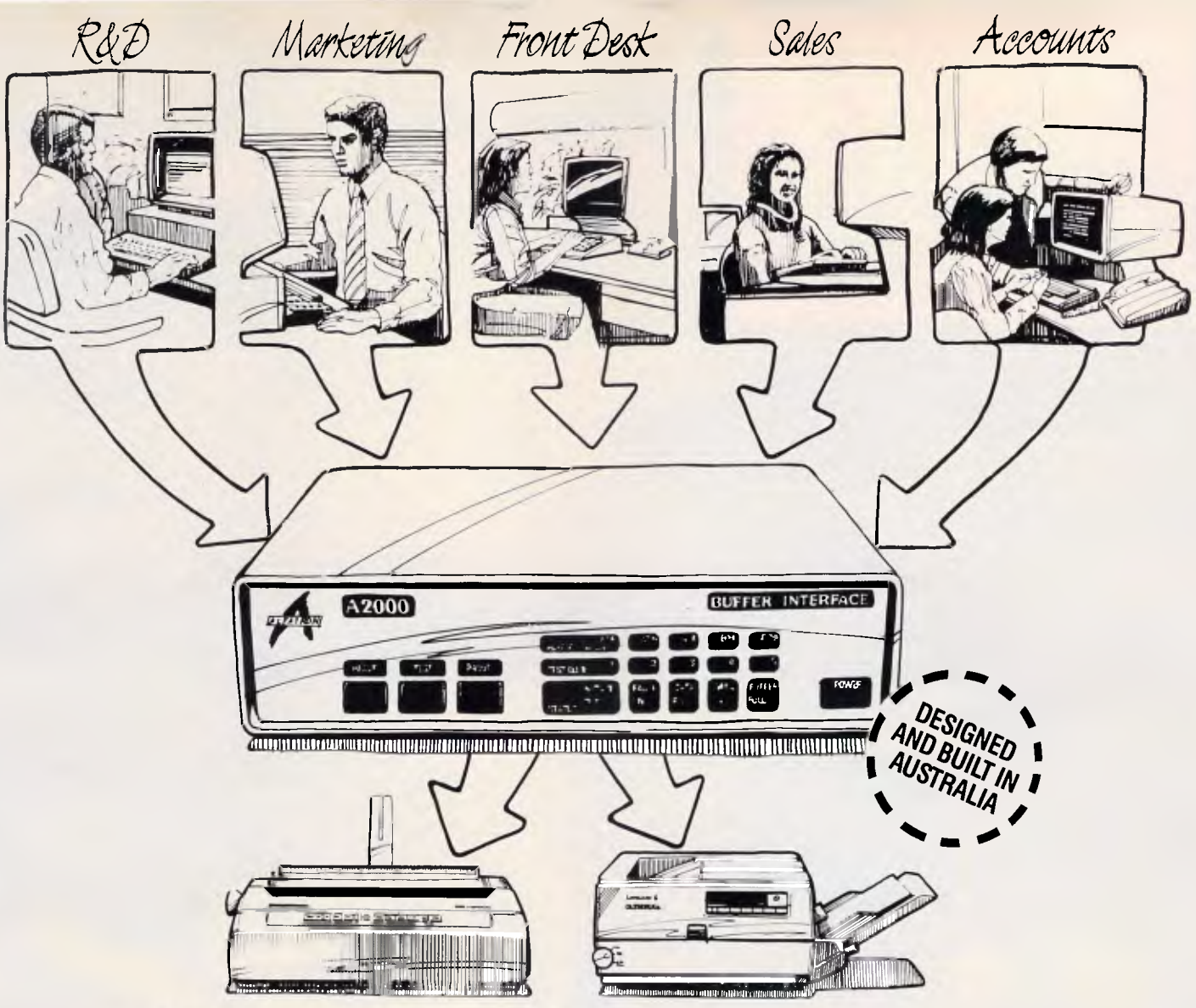

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II Blu

The long-awaited system to turn an Apple II into an industry compatible PC is soon to be launched in the US. Neil Munro checks out a pre-release version of the II-Blu.

By the time MS-DOS had replaced CP/M as the standard operating system for personal computers, Apple II owners were reputed to be the largest single group of CP/M users. Now Austek Microcomputing Ltd (AML) is hoping that history will repeat itself with its II-Blu MS-DOS system.

II-Blu is a system level product consisting of both hardware and software which allows MS-DOS based software to run in an Apple II+, IIe or IIGS operating environment. But unlike the unorthodox implementations of CP/M in Apple II micros, II-Blu allows the user to access and create standard MS-DOS software and files on standard MS-DOS format disks.

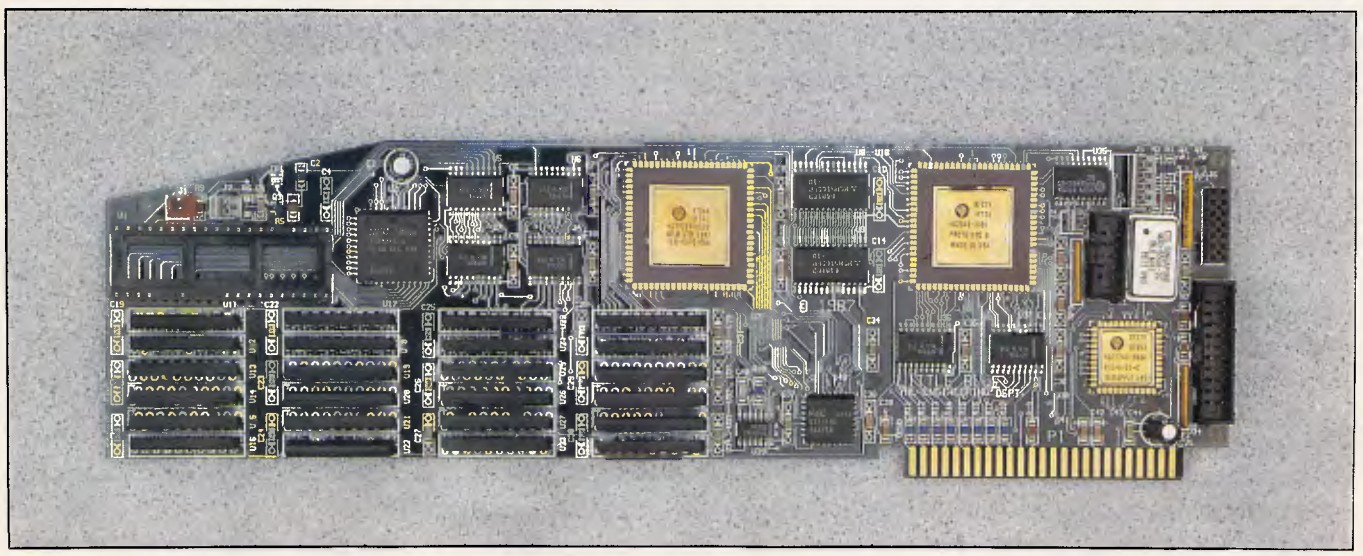
The minimum requirements to run II-Blu are: an Apple II+, IIe or IIGS, Apple ProDOS, at least 64k of RAM, IBM PC-DOS (or MS-DOS) 2.00 or greater, one Apple disk drive (5¼in or 3.5in), an Apple-compatible composite video monitor, and a PC/XT-compatible keyboard (II+ only).

Hardware

The hardware aspect of the II-Blu system consists of a card which plugs into any spare Apple II slot. The card features an 8086 microprocessor operating at 7.2MHz, and a spare socket is provided for an optional 8087 maths coprocessor.

Fully configured, the card can carry up to 640k of its own RAM, bypassing the Apple's RAM for greater speed. The Apple II processor and peripherals carry out the task of emulating all the ports available on a PC-compatible.

This allows the 8086 to operate at full speed when accessing memory and slow down only for the I/O operations carried out by the Apple II's processor. In practice, the I/O speed reduction is not noticeable because most I/O operations are usually slowed down by the peripheral with which the processor is communicating.



In fact, the II-Blu is quite fast in operation and runs about two to three times faster than a conventional PC. In speed tests it checked out at 3.5 on the Norton Utilities index.

II-Blu I/O emulation is carried out

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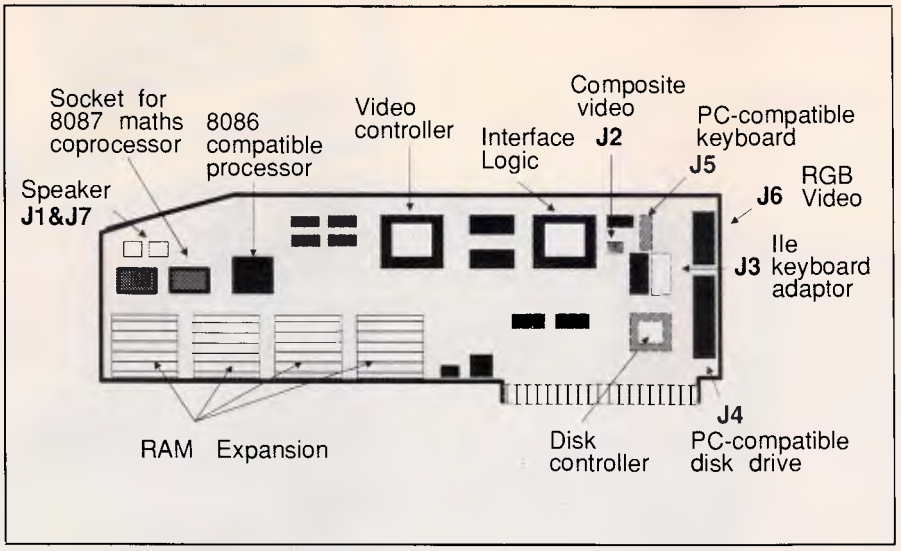

II-Blu card for MS-DOS on Apple II

transparently to the 8086 microprocessor, and hence, MS-DOS. The system's hardware and portware takes care of translating the peripheral input and output tasks into ones that the Apple II can handle with its own peripherals.

Those peripheral devices that the Apple II is incapable of emulating are built into the II-Blu card. These are devices such as a CGA, an MFM Floppy Disk Controller and the PC-compatible keyboard interface.

Obviously, the Apple keyboard lacks many of the PC's special keys. Installed in an Apple II+, MS-DOS operation will require a PC/XT compatible keyboard to be attached. For the IIe and IIGS this is not necessary because the closed Apple key enables function key emulation.

Installation

The II-Blu prototype which arrived on my desk consisted of a card, a 3.5in system disk and a battered 360k Teac disk drive. I put the card into slot 7 of the IIGS, plugged the II-Blu video plug into the GS RGB outlet then plugged the GS monitor and MS-DOS drive onto the outlets on the II-Blu card. It took only a couple of minutes.

With the Blu system disk in the GS boot drive and a copy of PC-DOS 3.30 in the MS-DOS drive, I switched on the power. The II-Blu ProDOS disk booted and came up with a desktop displaying BLUE.SYSTEM. Running this utility booted the PC-DOS disk in the Teac drive.

The screen briefly went blank, and before long the Apple IIGS was displaying the familiar A> prompt. The screen display looked as it does on any other

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MTBF	20,000 Hours	
MTTR	30 Minutes	
Environmental	Operational	Non-Operational
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MS-DOS PC, with Apple's undernourished text font being replaced by the thicker PC text characters.

This already schizophrenic Apple IIGS, (dual 8/16-bit), had now become a tri-system PC. I was tempted to dig up an old Apple CP/M card to make it a quartet, but resisted the urge.

Being suspicious of add-on systems ever since the days of Apple CP/M, I was pleasantly surprised by what I saw on the screen and the way the system operated.

Both text and graphic-based software operated as normal and the system's colour display, via the II-Blu CGA and IIGS RGB monitor, was excellent. The image and colours were as stable, defined and saturated as they are in normal GS operation. Rerouting the RGB outlet through the II-Blu card made no difference to the monitor display in normal Apple II mode.

'. . . the II-Blu is quite fast in operation and runs faster than a conventional PC.'

DOS drives

The only things which set II-Blu PC operations apart from other PC clones are the disk drive configurations and the cross-system transfer software. But neither of these differences represent disadvantages to the user.

You can connect up to four floppy disk drives directly to the one drive port on the II-Blu card. Daisy-chained via DB19 connectors, up to two standard 360k MS-DOS drives and up to two GS/Macintosh Apple Disk 3.5in drives can operate in conventional MS-DOS mode.

If a disk drive is plugged into the II-Blu disk controller, the system assumes that the drive is a Standard drive. 'Standard drives' use the MFM disk encoding technique. This MFM file format is compatible with disk drives on IBM PCs and compatibles.

Apple's new platinum-coloured 3.5in disk drives can be connected to the II-Blu card because they are capable of reading and writing either Apple GCR or IBM MFM formats. The only thing these Apple drives cannot do is format disks in MFM format for interchange with other PC systems.

Obviously, most users will be content with connecting just one or two MS-DOS drives to the II-Blu, in most instances. However, temporarily plugging a 3.5in drive into the back of one of the 5¼in drives could be handy for transferring programs or files to or from a 3.5in MS-DOS formatted disk.

Of course, the 5¼in MS-DOS drives are capable of formatting disks in MFM format.

ProDOS drives

Although I had only a single MS-DOS drive to work with, the system enabled me to use the ProDOS drive attached to the Apple disk controller as a pseudo MS-DOS disk drive. To do this I had to put in a ProDOS formatted disk in the Apple drive and then format it, using the normal FORMAT.COM utility on the PC-DOS disk.

This procedure produced a pseudo MS-DOS disk which functioned normally. The II-Blu system had allocated this pseudo drive as C>, and showed no prejudice towards it in operation. To try out various software packages, I copied disks onto this C> drive and pretended it was a hard disk.

Back in normal Apple II ProDOS operation, the reverse also applies — the MS-DOS disk drives can be used as 360k pseudo ProDOS drives. With a II-Blu system installed, any and all disk drives attached to the Apple II can be used in both MS-DOS and ProDOS modes.

As a bonus, the RAM installed on the II-Blu card becomes a 700k RAM disk which is recognised as an Apple memory expansion card by Apple II programs.

Control panel

A software Control Panel is built into the II-Blu system and can be accessed at any time via the Shift and Caps Lock key.

This panel allows the user to adjust hardware settings including printer interface, communications equipment and the optional maths coprocessor chip. It also allows the user to configure floppy disk drives and map to II-Blu's ports to a PC's ports.

This Control Panel also allows an Apple-compatible hard disk to be installed for use under MS-DOS. Partitioned, ProDOS and MS-DOS can both share the same Apple hard disk.

Utilities

Special MS-DOS software utilities are provided with the II-Blu system. The APLCLOCK.COM program sets the MS-DOS real time clock. It reads the

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Apple ProDOS compatible clock on the IIGS and other II computers, if present. An AUTOEXEC.BAT file can be used to automatically call up this utility at first boot.

AMOUSE.SYS is a driver which allows an Apple mouse to emulate the Microsoft bus mouse. This mouse driver is placed in the root directory of the MS-DOS boot disk. AMOUSE.SYS can then be added to the CONFIG.SYS file on that disk.

But perhaps the most useful utility of all is TRANSFER.EXE. This utility copies files across the ProDOS/MS-DOS boundary — in both directions.

The program can be used in two ways. The first is to provide the source and destination path names on the same command line when calling the program. This runs the program, transfers the file and then quits back to the system prompt.

For example, to transfer an MS-DOS text file called 'MYFILE' on a disk in drive A> to a ProDOS disk called /DISK1/ in any Apple ProDOS drive, you would type:

A>TRANSFER MYFILE /DISK1/MYFILE(TXT)

The system will look in all the drives for the named ProDOS disk and then copy the file across in ASCII text format.

Transferring a file from ProDOS to MS-DOS is just as easy with the ProDOS file being named first.

This system to system transfer technique is the easiest and the fastest I've seen. It took no longer to execute than a COPY command.

A second way to transfer files is to call up the menu-driven program itself. This is the recommended way until the user becomes familiar with the program's operation. Within this program there is a Help screen which explains what the utility is all about.

Documentation

The alpha draft of the manual which accompanied the II-Blu card and drive was well laid out and explained the system's functions in non-technical terms. A brief overview of MS-DOS was included in the manual's appendix.

Conclusion

There is no doubt that there is a market out there for a system of this type. The II-Blu system has been well designed and works quickly and efficiently.

With a II-Blu card installed, an Apple user would have access to the world's two largest libraries of software — Apple II and PC/XT programs. Unlike the Apple CP/M implementations of the past, PC/XT software does not have to be converted or changed in any way for use with II-Blu.

Imagineering is examining the system with a view to distributing it here in Australia, but no decision has yet been reached. It seems that establishing a local price is the main sticking point. Imagineering believes it will only be viable if it can retail the product at under $1000.

With an installed base of over three million Apple IIs around the world, the market potential for a system such as this is enormous. Let's hope that AML opts for low-price/high-volume sales.

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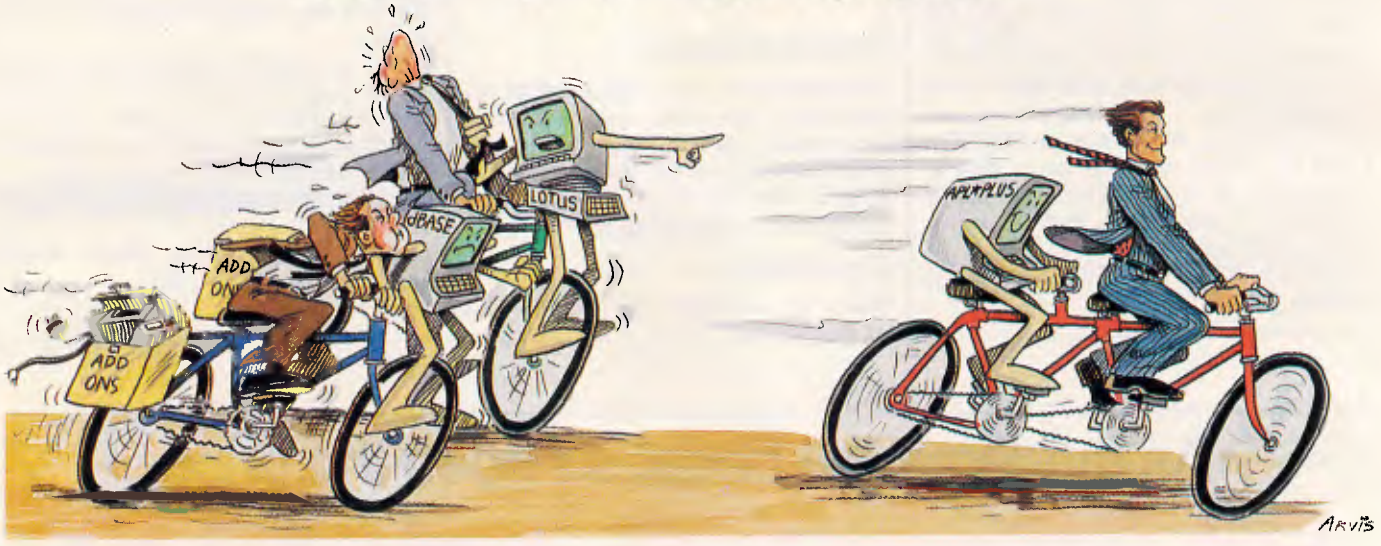

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Page Printers

New technologies help laser printers and their cousins cost less and produce better results, Rick Cook explains.

Today's page printers have two problems. The first is obvious: price. At a time when a very good printer costs less than $1500 and a less capable unit can sell for under $500, laser printers start at $3000 and go up quickly.

The second problem is resolution. For traditional computer-printing jobs, the 300-dot-per-inch resolution of current-model page printers is more than adequate. However, the advent of page printers has spawned new applications — notably, desktop publishing — where 300dpi is not always good enough. Traditional graphics-reproduction methods for typesetting and photography use resolutions of 1000 to 2400dpi.

Help is coming on both fronts, thanks to new technologies such as LED, liquid-crystal-shutter, and ion-deposition imaging, and to traditional market forces such as volume production and changes in the design philosophy regarding printer intelligence. In this article, I'll survey the present technology and look at some of the developments that promise to make page printers even more powerful and versatile and, in some cases, less expensive.

How a page printer works

Most page printers use electrostatic forces to create a page image from rasterised digital information and to transfer that image in the form of toner onto a piece of paper.

The heart of an electrostatic page printer is a drum or belt coated with a photoelectric substance that develops a positive or negative charge in response to light. The usual coatings

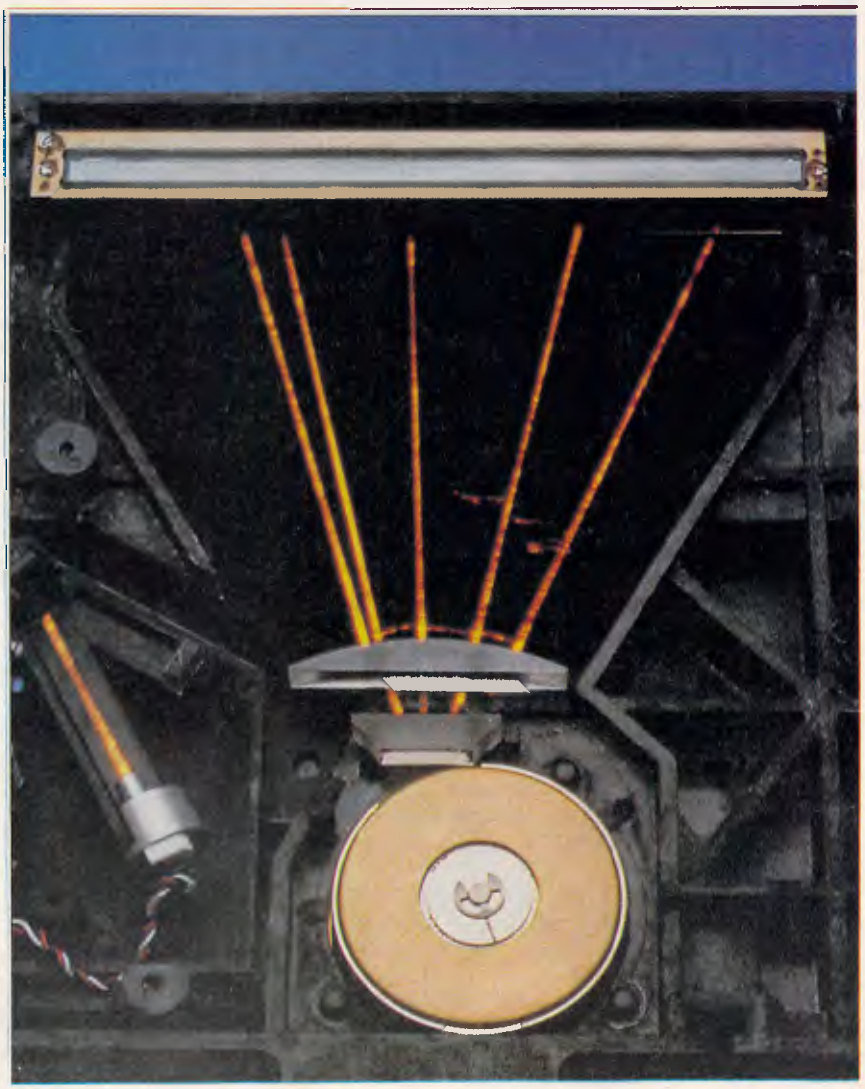

Photo 1 Inside a laser printer. This photo was taken using timed exposures on a laser phosphor card, creating a visible trace of the invisible infra-red beam (Photo courtesy of Xerox)

are selenium and some organic compounds. A beam of light (or an array of individual light sources) 'writes' an image onto the drum one row of dots at a time (see photo 1). As each row of dots is written out, a stepper motor advances the drum by one row and the light source writes out the next line of the image.

The result is a 1000-volt electrostatic image of the page on the drum, against a background potential of about 100 V. As the drum rotates, it passes over a reservoir of toner, finely divided particles of an organic compound that is susceptible to static charge. The charged areas on the drum attract and hold the toner. The toner-laden image on the drum is then brought into contact with a sheet of paper that has been charged to an even higher potential, usually about 2000 V, by means of a corona mechanism. The toner jumps to the paper in the same way that bits of lint will jump up and cling to a vinyl comb. Heated rollers fuse the toner to the paper to produce the finished page, and the paper-handling system passes it to the output tray.

After transferring the image onto paper, the drum rotates past a discharge wire to eliminate any remaining charge. Then a scraper assembly removes the last traces of toner, leaving the drum clean and ready to receive the next image.

Fig 1 illustrates the entire system (for a laser printer) schematically, but don't be misled: the process is not simple. A good laser printer is a tightly coupled system of electronic, chemical, optical, and mechanical parts. This intricacy and interaction of technologies is largely responsible for the laser printer's high cost.

Consider just one element: the image drum (or belt, in some designs). The drum must rotate smoothly, precisely, and eccentrically. If it is out of round or mounted concentrically, the light will be out of focus on the surface at some points, and any spot of toner left at that point will be too large. Furthermore, if the drum does not advance smoothly and accurately, the rows of pixels will be blurred or misplaced. Getting the required precision from the drum movement takes a good stepper motor, quality bearings, and a drum manufactured to close tolerances.

Because these active elements have to be so closely matched, manufactures buy them as preassembled 'engines' from one of the OEMs, such as Canon, Ricoh, and Kyocera. The end-product manufacturers then add a controller, a paper-handling mechanism, and other components to make a complete printer.

Kinds of page printers

Laser printers were the original page printers and are still the most widely used variety. They have been available for about 10 years, starting on printers for large computer systems and filtering down to microcomputers. Today, laser-printer technology is widely available and generally well understood.

These printers use a laser beam to write the image onto the drum. The laser isn't aimed directly at the drum. Instead, it is aimed at a rotating mirror, usually with 8 to 16 faces, that scans the beam across the face of the drum, turning on and off according to the digital information coming from the rasterised image. The controller synchronises the scanning beam and the drum-advance motor with the flow of rasterised information.

Small laser printers that produce fewer than 10 pages per minute generally use a laser diode to produce the beam. Faster printers use a more powerful helium-neon or argon laser; the power of the beam determines how quickly the laser can charge the individual points on the drum.

Compared to other kinds of page printers, the biggest design challenge associated with laser printers is their optical system. To work properly, the laser printer's beam must be equally strong and precisely focused at every point along the scan line. It must also be aligned with the drum and synchronised with its rotation.

Any scanning beam is subject to what are called cosine-fourth losses, named for the function that describes them. (The losses are proportional to the fourth power of the cosine of the angle between the beam and the scanned surface). As a result of these losses, the beam is weaker and more diffuse at the edges of the scan than at the centre. Laser printers use a complex lens system designed to compensate for these losses. Likewise, the faces of the rotating mirror need to be precisely aligned and perfectly flat. Any irregularity will cause misalignment of a row of pixels.

Finally, the optics have to be held in precise alignment with the drum and each other. Vibration or misalignment can ruin a laser printer's print quality. (This is one of the reasons laser printers are so heavy, but transformers needed to produce the high voltages also contribute weight.) If a laser printer's optical system gets knocked out of alignment, it is not simple to repair; the unit generally has to go back to the manufacturer.

Although the laser-beam design is the most common approach to writing an image on the electrostatic drum, other designs are available and offer certain advantages. One type of page printer uses a row of LEDs, one for each pixel in the row, to write the image to the drum.

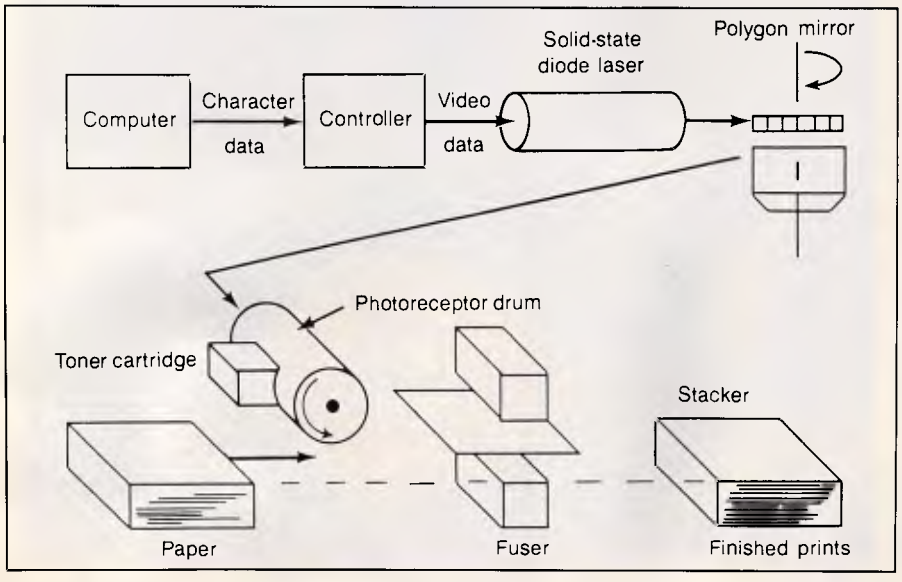

Fig 1 A schematic diagram of a laser printer. Raster-scanned light from a laser is deflected by a mirrored cylinder to expose the surface of a photoreceptor drum. The charged areas attract toner to the drum, which is then transferred to paper and fused on by heat

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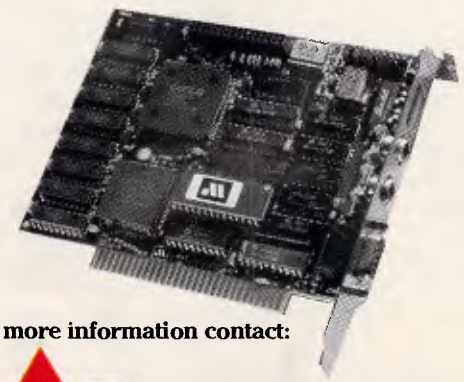

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LED engines are made by NEC and Sanyo at the low end (less than 10ppm), Kentek and Agfa at the medium range (more than 12ppm), and Kodak at the high end (up to 92ppm).

A third variation is the LCS printer, which has a row of liquid-crystal 'shutters' in place of the diodes. A powerful fluorescent bulb provides the light, and pulses of electricity open and close the shutters to write the image. Fig 2 shows an LCS print head.

Because LED and LCS printers use fixed, multiple light sources rather than scanning a beam across the drum, they are optically simpler than a laser printer. Alignment is easy to maintain, and you can replace the print bar (the part that holds the LEDs or LCSs) in the field in a few minutes.

This optical simplicity is somewhat offset by the need to drive each light source individually, which increases the electronic complexity. Most LED and LCS printers multiplex the control signals to cut down the number of signal lines. However, this means that all the light sources cannot be on at once — the printer has to write different sections of the scan line at different times. In some designs, the light bar is mounted at an angle to the drum's rotation to let it write to only part of the drum at once.

In both LED and LCS printers, the number of elements in the print bar determines the resolution. The difficulty of packing the light elements densely enough to achieve high resolution is one of the reasons LED and LCS printers came later than laser printers. In the case of LED printers, the devices must be packed onto LSI chips. For instance, the NEC engine uses LEDs built on chips with LSI technology, 128 LEDs per chip. In the LCS printers, the shutters had to be much smaller than previous applications had demanded (see photo 2).

The LCS design poses an additional problem: the heat from the light source tends to distort the cells in the array. The solution has been to minimise the light intensity and to engineer the print bar to handle the strain.

A close relative of electrostatic printers is the ion-deposition printer, which uses a beam of charged particles (ions) rather than a beam of light to write the image on the drum.

Like LED and LCS printers, an ion-deposition printer uses a row of elements to write to the drum. The elements are conceptually similar to a triode vacuum tube with ions flowing from cathode to anode, regulated by a grid. Unlike other page printers, these printers do not use heat to fuse the toner to the paper. The drum is much harder than the light-sensitive ones used in laser, LED, and LCS printers, making it feasible to cold-fuse the toner particles onto the paper by means of a pressure roller. As a result, the printer generates less heat. Fig 3 is a schematic illustration of the ion-deposition design.

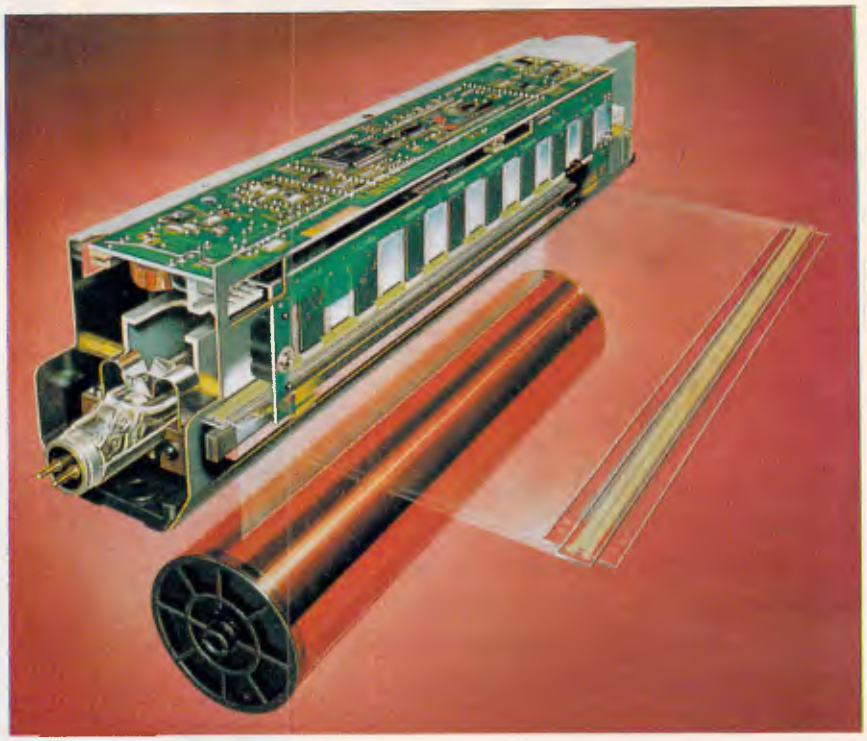

Fig 2 The print-head assembly of an LCS printer. The fluorescent bulb in the head provides light to the shutters, which open and close according to commands from the controller, charging selected dots on the photoreceptor drum (Figure courtesy of Taxan USA)

Ion-deposition technology offers a number of advantages in medium-to-high-speed printers, most notably durability. In a laser printer, 500,000 copies per drum is considered excellent performance, and some printers will do only 15,000 copies before the drum needs replacement. By contrast, C.Itoh claims that the drum on its ion-deposition printer will print between one and three million copies before it must be replaced. These printers have fewer moving parts than laser printers — contributing to the design's reliability.

Moreover, the drum's hardness lets it stand up to harder scraping than is possible with an electrostatic drum. More of the excess toner particles are removed, resulting in fewer 'freckles' on the pages.

Ion-deposition printers are basically volume devices. Although the technology could be used in a desktop printer, it tends to be more expensive in low-volume applications than electrostatic systems. Furthermore, because the rollers have to press the toner onto the paper, ion-deposition print has a shiny ('calendered' is the technical description) look that some people find objectionable.

Cutting costs

One way to cut the cost of page printers is to build a lot of them. As production increases, economies of scale set in and the cost of making a page printer drops. Copiers are made in much larger numbers than laser printers, one of the main reasons a plain-paper copier sells for half the price of a laser printer.

Other page-printing technologies, such as LED and LCS, can also push down prices. Currently, LED and LCS printers are no cheaper than laser printers. But laser printers have been made for longer and in larger volumes than LED and LCS designs. Manufacturers claim LED and LCS prices will drop as they move farther along the learning curve and production increases.

The declining cost of electronic components, especially RAM, helps, but so much of a printer is electromechanical that prices probably won't drop as rapidly as they have for computers.

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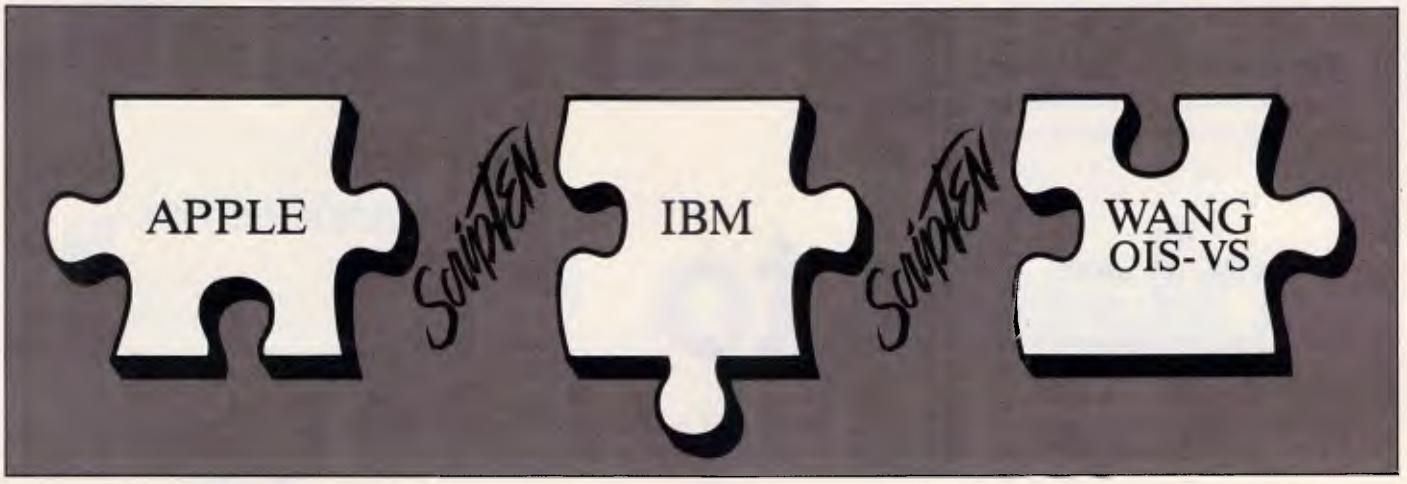

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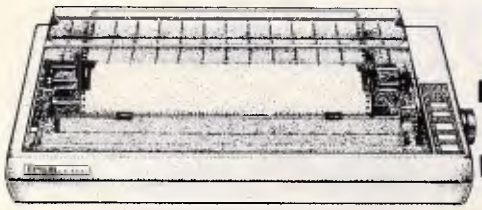

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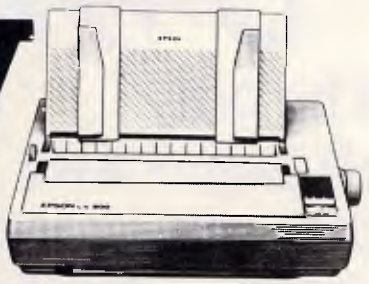

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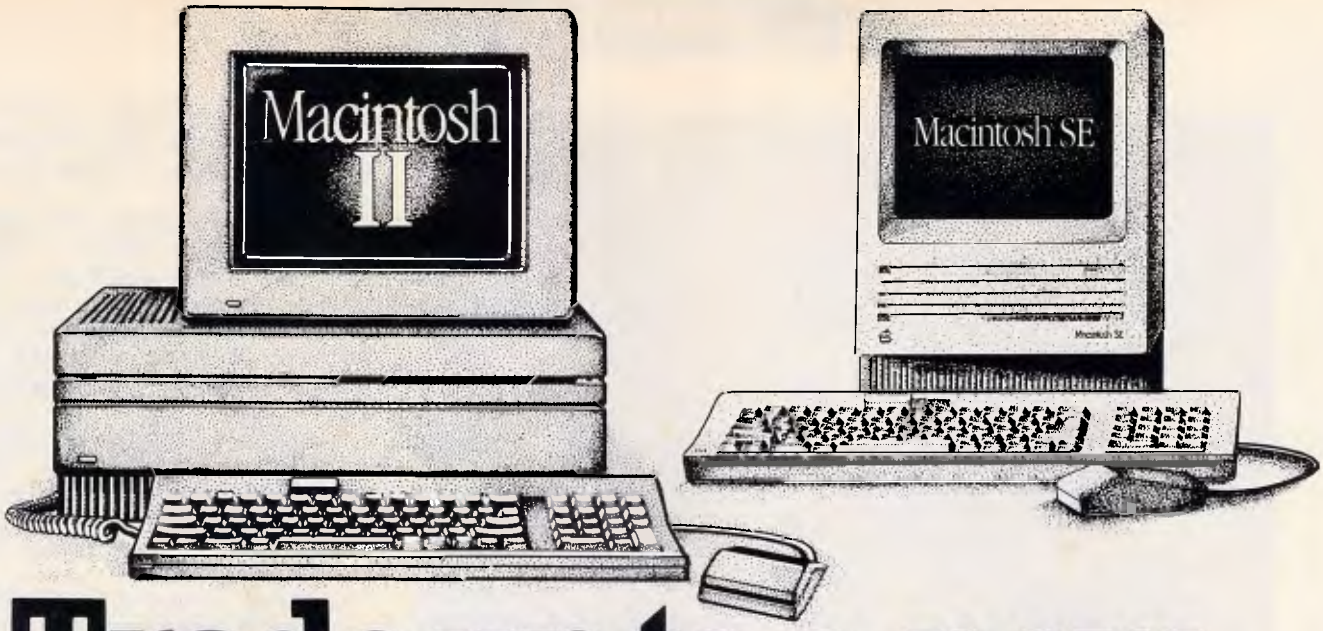

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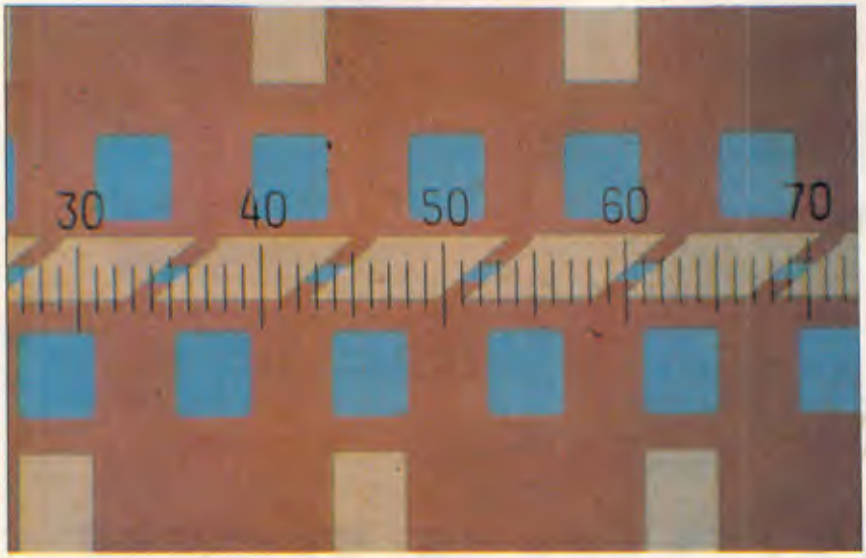

Photo 2 A photomicrograph of part of a shutter array on an LCS print head (Photo courtesy of Taxan USA)

Another way to cut the cost of a page printer is to reduce its intelligence. Moving the rasterising and image-storage components from the printer to the computer reduces the cost of the printer significantly. The amount of actual savings to the user depends on whether the computer's main processor and memory are used to control the printer, or whether a full-featured computer-on-a-board must be added through an expansion slot. For example, Atari's laser printer (see July *APC* — Ed) uses a separate controller box between the printer and the computer. Apple is also reportedly taking this tack (ie, taking the intelligence out of the printer) with its new design for a laser printer that will supposedly list for between $4500 and $6000. IBM's Personal Pageprinter ($16,587) uses a similar approach.

On the negative side, when the computer handles the control functions, a complete bit map of the page must be passed to the printer for every copy of the page printed. Without a fast communications channel, printing will be slow. Some companies, such as Electronic Form Systems and TallITree, use a video interface to keep the speed up. IBM's Personal PagePrinter uses a video interface. The least expensive way is to use a serial or parallel interface and just accept the slower speed.

Increasing the resolution

Aside from lower cost, what users want most from a page printer is higher resolution.

At 300dpi standard resolution, the page printer falls in an uncomfortable middle ground. The quality of text and graphics on a 300dpi page printer is superior to that from other kinds of computer printers but not as good as the typeset material found in books and magazines. Traditional typefaces can only be approximated on a 300dpi device (see the accompanying box 'Page Printer Typography'). In particular, half-tone images suffer on a page printer (see the accompanying box 'A Grey Area for Page Printers–Photography').

Fig 3 A schematic diagram of an ion–deposition printer. A modulated ion source (top) similar to that in a triode electron tube generates the ions, which are directed onto the drum, forming a latent image. The image attracts toner from the cartridge, which then is pressure–fused onto paper passing between the drum and a pressure roller (Figure courtesy of C.Itoh Electronics)

The minimum resolution on typesetters today is about 1200dpi. If inexpensive page printers could print at that resolution, they would be much more useful. In fact, doubling the current resolution to 600dpi would be good enough to handle most graphic-arts jobs.

As a printer's resolution increases, so does its cost of manufacture. The individual dots have to be made smaller, and their placement must be more precise. This is true for both vertical and horizontal resolution.

Increasing horizontal resolution requires better optics, especially on laser printers, because the effects of the cosine-fourth losses become more significant; at higher speeds and densities, the power level is more critical. Increased resolution also requires more precise control of the light source. On a laser printer, that means more accurate mirrors and more precise scanning. LED and LCS printers need more elements in the print bar and the ability to turn the elements on and off more quickly.

The accuracy of the drum-advance mechanism basically determines vertical resolution, since the drum must advance by one pixel for each new row of pixels. That means a better stepper motor and other components, as well as more precise electronic control.

Another consideration is the size of toner particles. Generally speaking, the smaller the average size of the toner particles, the higher the printer's resolution can be. However, the smaller the particles, the harder they are to control. A page printer is basically an electrostatic material-handling system where the material handled is toner. Ideally, there should be no charge anywhere except where the printer puts it, there should be no attraction among toner particles, and the particles should not move except in response to applied static fields.

In practice, however, toner particles are attracted to each other, they adhere to the drum, and they are influenced by stray electrostatic forces within the printer. The particles seep into other parts of the printer. All these effects get worse as the toner particles get smaller.

The traditional solution is to use a wet toner in which the particles are suspended in liquid. This method is used by high-resolution electrostatic printers like laser phototypesetters,

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but it is messy and adds complications of its own. New toner formulations and better toner-manufacturing processes are another possible approach.

The paper becomes a factor as resolution increases. One of the reasons laser phototypesetters achieve such high resolution is that their output is printed on very glossy stock. The smooth surface makes fine detail possible. But the quality of paper supplied to most office page printers isn't nearly as smooth; thus, the page printer's output isn't as good at comparable resolutions. Apart from the cost of ultra-smooth paper, the paper-handling mechanisms used in desktop page printers depend on the surface roughness of the paper to get a grip. Paper on very smooth stock requires different, more complicated methods, such as vacuum gripping.

As resolution increases, the electronic components of the printer become more expensive. Doubling the resolution to 600dpi from 300dpi means quadrupling the amount of RAM needed to store a page image to 5Mbytes from 1.25Mbytes. Furthermore, the controller must either work twice as fast to lay down twice as many dots per scan line in the same time or slow down the laser beam, increasing the time required to print a page. While the electronics costs don't increase in proportion to the mechanical costs, the increases are significant.

Intrinsically, there is no reason a desktop page printer cannot match the resolution of phototypesetters — if the buyer is willing to pay the price. For example, Varityper now makes a small 600dpi laser printer that costs about $33,000.

A sample of its output appears in Fig 4. Judge for yourself whether its 600dpi plain paper output differs significantly from the 1200dpi phototypeset output used for *APC*'s body text. (Call AM International on (03) 561 1444 for more details — Ed.)

Some phototypesetting machines are basically specialised laser printers, but they are even more expensive.

One factor holding back the development of high-resolution personal desktop page printers is that the manufacturers aren't sure that enough users are willing to pay the price. So far, the small page printer market has been highly price-sensitive, and the makers aren't sure most users will pay for higher resolution. Varityper's printer, for instance, is aimed at the typesetting market.

The coming printers

No one kind of page printer is going to give users everything they want. There are too many basic conflicts and trade-offs. Instead, you will probably see a range of desktop page printers with different mixes of price and features.

At the low end will be inexpensive 300dpi printers with print speeds of 5ppm or less and street prices between $1500 and $2500. These printers will rely on the computer's processor and memory for control. Due to memory constraints, they will probably not be able to print full-page graphics and will not use a page-description language (PDL). They will probably be limited to A4 paper and might handle only certain weights of paper. You might see the first of these by the end of the year, although the very inexpensive examples are probably two years off.

The next group of printers will offer higher print speeds and more features for a higher price. They will include a PDL, full-page graphics, more flexible paper-handling, and a variety of bells and whistles. These printers will probably start at about $4000 and run to to $12,000 or more, depending on features. These printers are essentially refined versions of today's page printers. In that sense, they are already available.

Above that will be the high-resolution page printers. Except for their 600dpi resolution, they will be much like the preceding group of printers. Prices for high–resolution printers will probably start at around $15,000. It will be at least a year, more likely two, before these desktop high-resolution page printers appear.

Finally, there will be desktop colour page printers. These will probably come in at around $30,000 and won't be available for at least two years.

One thing is certain. Users want fast, quiet, high-resolution printing. That being the case, page printers of all sorts are going to proliferate for the rest of the decade.

Fig 4 Sample output from AM International's Varityper VT600

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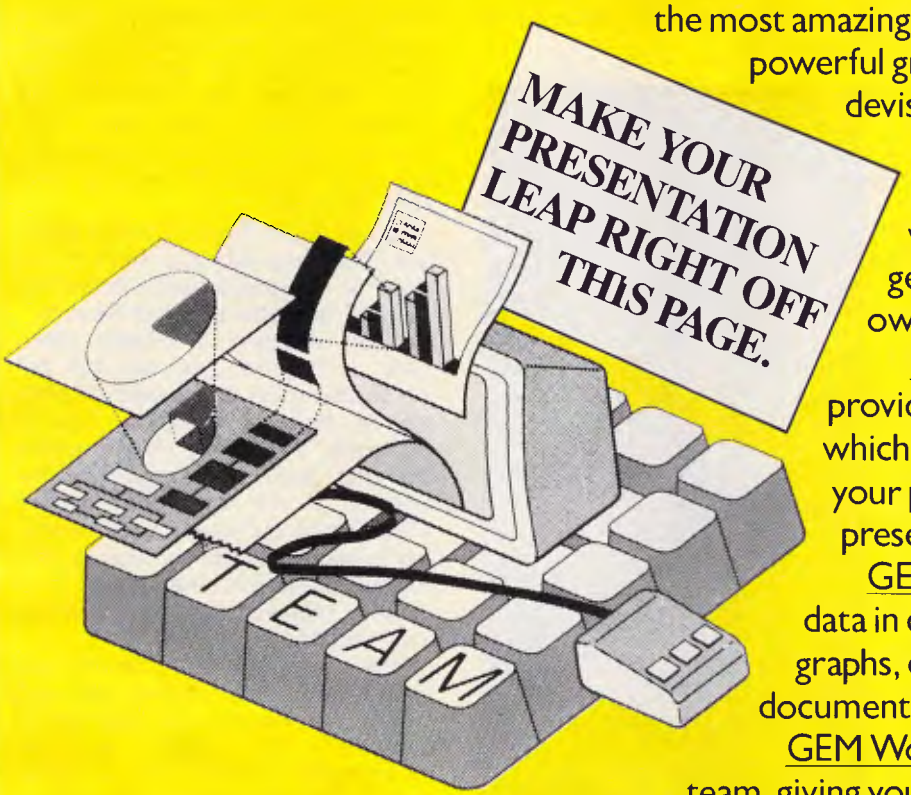

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A grey area for page printers — photography

Photographs are a challenge for today's page printers. While text printed at 300dpi might look beautiful to the casual observer, photographs rendered at the same resolution are decidedly second-rate. The reason for this is best summed up in two words: continuous tones.

The typical black-and-white photograph consists of continuously varying tones of grey. An artist attempting to copy a black-and-white photo can recreate the greys by mixing varying amounts of black and white paint on a palette. Of course, that solution isn't feasible in mechanical reproduction systems such as printing presses, which work with only one shade of ink. Because of this fundamental limitation, photographs and other continuous-tone images must go through a process known as screening before they can be mass-printed.

Photographic screening

In the screening process, a grid of dots or lines called a screen is placed over the photograph, and a new photograph is made. The resulting halftone has no grey tones; instead, the grey regions are approximated by means of black dots that vary in size and shape. The density of the screen (ie, the number of dots or lines per inch) along with certain other factors determines how well the halftone reproduces the original's gradual changes in tone: higher density allows more gradual changes. Newspaper-quality halftones are typically made with an 85-line screen (ie, 85 dots or lines per inch); magazine-quality uses a 100 or 133-line screen.

Digital approaches

The same process can be simulated on a computer. First, the photo is digitised. A scanner moves across the photo just as a print head moves across a page, but, instead of printing, it reads the grey level of the image at fixed intervals. Each sample reading is stored as a number in a given range.

To reproduce the digitised image, the computer creates a bit image made up of small two-dimensional cells. The sampled grey levels are mapped into these cells. To reproduce a grey level from the digitised image, a corresponding percentage of pixels within that cell are turned on. For instance, if an 81-dot region is to have a grey level of 25 per cent, 20 of the dots inside the cell are turned on.

Fig A A Laserport simulation of a 100-line screen, based on a digitised photo provided by Adobe Systems

Resolution vs. shading

To allow for smoothly varying tones, small cells are needed (just as with the small dots in the halftone screens). But the smaller the cell, the fewer dots can be placed inside it. This, in turn, limits the number of discrete shades that are possible within a cell.

For instance, to approximate a 75-line screen requires 75 cells per inch. At 300dpi, a page printer can place just 16 (ie, 4 by 4) dots inside such a cell, yielding only 16 possible grey levels. Note that the resolution is now 75 cells per inch — the image will have only 75 discrete regions per inch, instead of the 300dpi resolution when only two grey levels, black and white, are represented.

Some printers come with software to accomplish this kind of halftone simulation. Adobe Systems' PostScript, the PDL used in Apple's LaserWriter and certain other models, provides screen for setting the cell size, setscreen for controlling the method of filling pixels inside each cell, and settransfer for applying further transformations to the grey level inside each cell.

The net result of this software-simulated halftoning still falls short of the result of true photographic halftoning. The problem is the shape of the dots.

If you examine a printed photo under a magnifier, you will find that the shape of the dots varies depending on their surroundings. This is especially true along edges where the dots tend to elongate in the direction of the edge. This makes edges stand out much more clearly. Since edge definition is vital to perceived sharpness, the result is a major improvement in effective image quality.

Page printers generally cannot vary the shape of their smallest dot, and thus, at the lowest level, they cannot duplicate the effect of the photographic halftone. At a higher level — the cells made up of dots — page printers can vary the way the cell is filled in, but this approach operates at the expense of resolution.

One solution to this problem is to use a higher-resolution laser printer, so that the cells can be smaller and still represent a large number of discrete grey tones. This is effective but also expensive.

Smaller dots

DP–Tek has taken a more direct approach to the dot-shape problem. The company manufactures a Canon-engine controller called Laserport. Laserport combines a software package (for simulating the halftone process as explained previously) and a custom controller that actually varies the shape of the laser's dots.

DP-Tek claims that the Laserport controller can produce the equivalent of a 100-line screen print on a standard Canon print-engine laser printer, when driven by an IBM PC AT or comparable computer. (Fig A is a Laserport simulation of a 100-line screen, using as input a digitised photograph provided by Adobe Systems.)

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According to DP-Tek, the Laserport system is based on two elements: the controller's ability to produce dots in any needed shape and the company's rasterisation process, which mathematically models the effects of screening a photograph.

Dp-Tek originally developed the system because it had to put in a system to prepare a computerised Multiple Listing Service book. The books show real-estate agents the houses available for sale in a particular area and usually include a photograph of the house as well as the description. Because the books are updated frequently and issued in fairly small print runs, this was an ideal application for a laser printer — except for the photographs.

"The computer industry has always used standard graphics techniques," says Alan Frazier, DP-Tek's president. "We took the same approach at first, but we couldn't get a satisfactory quality level. Finally, we spent a lot of time looking at dots."

According to Frazier, one of the most important parts of developing the system was modelling what happens when a photograph is screened; in other words, when light is reflected through a variable-density screen from an image. The development work was done on AT-class computers in C and Pascal and later optimised and converted to assembly language for run-time packages. This was combined with a proprietary controller that can vary the shape of dots.

The company is closemouthed about the details of the process. All Frazier will say about the way the controller works is that "in electronics, states are rarely purely on or off." Presumably, the controller varies the intensity of the printer's laser beam and/or the scan rate and drum-rotation rate to vary the shape of the dots. Fig B is an enlargement of a 300dpi test pattern produced by Laserport, showing the system's ability to vary the dot size over a wide range.

The controller fits in the computer's case and works with the printer's resident controller. When the printer is printing text or graphics, the Laserport controller stays in the background. When it has to print a photograph, the Laserport controller handles it. The company claims that Laserport is transparent to the software that works with the laser printer.

The Laserport software includes drivers for the printers, modelling software to duplicate the effects of screening a photograph, and a set of high-level picture-printing commands. To print a picture, the user or the application program must tell Laserport where the picture is to go on the page and the name of the file containing the picture image.

The DP-Tek controller is sold to OEMs for incorporation into their systems. One customer is Chorus Data Systems, which uses it with its Photobase graphic database.

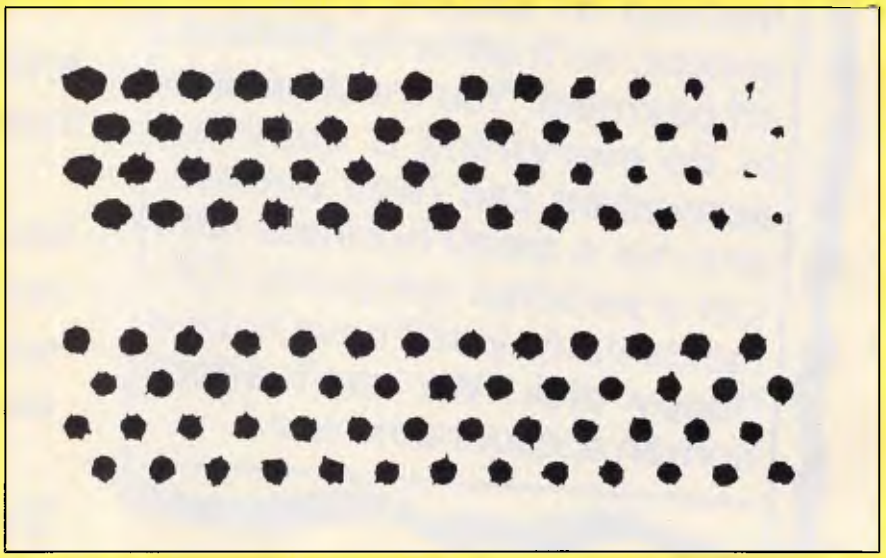

Fig B An enlargement of a 300dpi test pattern produced by Laserport, showing the system's ability to vary the dot size over a wide range

Page printer typography

Laser printers are producing a revolution in typography. Type designers are adapting existing type styles to laser printers and designing new type styles to capitalise on the strengths of image printers and minimise their weaknesses.

The first mechanical composing machines, such as the Linotype, provoked a similar revolution when they appeared in the 19th century. The rigid mechanical spacing of the letters and the limited number of characters available in typesetter magazines forced designers to modify their type families. For example, italic fonts tended to become wider to match the spacing of regular fonts.

Phototypesetting precipitated another, smaller revolution in the 1950s. Rather than handcrafting each font in its own point size, typographers could design a single font and then use optics to produce a range of smaller and larger fonts. In some cases, the substitution of optics for hand design has resulted in a lowering of typographic quality.

The onset of digital type in the 1970s and 1980s has brought with it the promise of a return to the high art of typography. Having characters stored digitally brings all the power of CAD to the hands of the type designer. Page printers have brought the world of digital type to the personal computer desktop.

Typefaces and fonts

Type is classified according to families. A family is a group of alphabets that are stylistically related. Within each family are several typefaces — alphabets sharing the same characteristics. Times Roman, Times Roman Bold, and Times Roman Italic are all members of the same type family. Typefonts are examples of a typeface in a particular type size. For instance, 24-point Times Roman Bold is a font, but Times Roman Bold is a face, a member of the Times Roman family. What computer people commonly call a typefont on a laser printer is really a typeface, since it comes in several different sizes.

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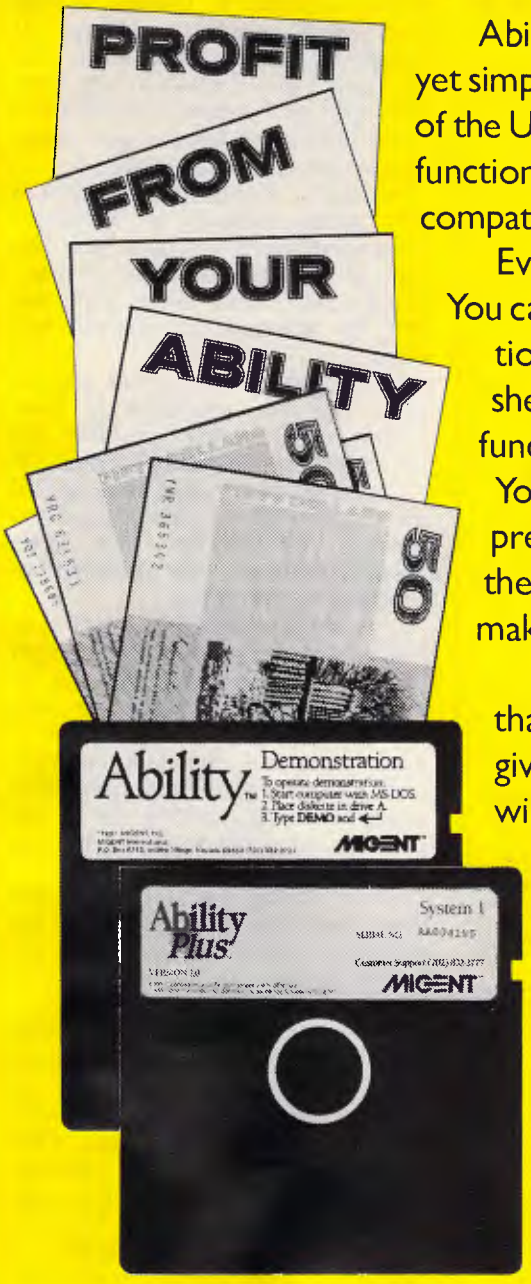

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The distinction between typeface and typefont is important because there is more to the different fonts in a face than enlarging and reducing the type. This is especially true with laser printers.

Low-resolution typography

A type designer working for laser printers has two interrelated problems. Fig C illustrates them.

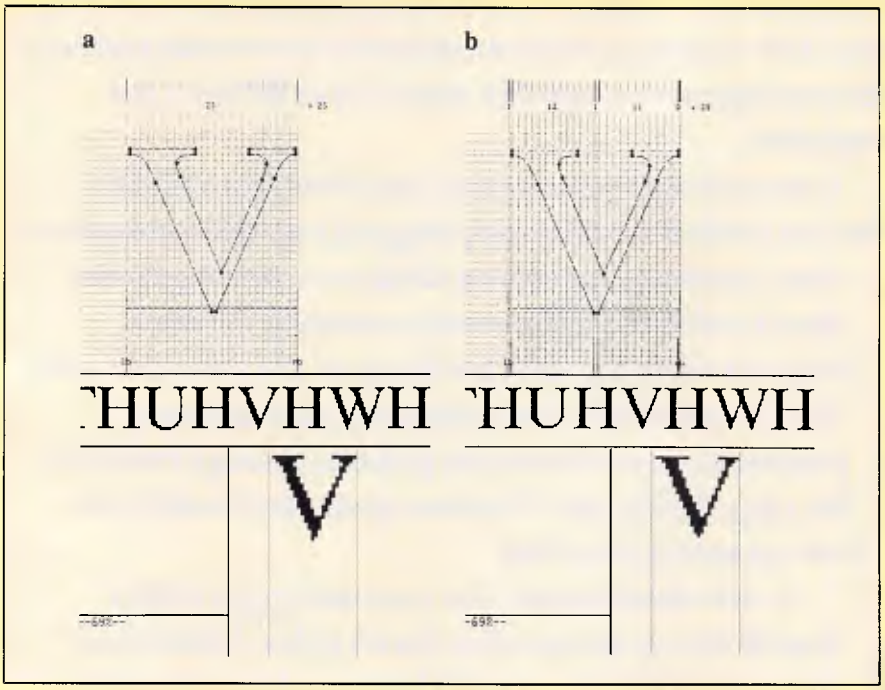

Fig C Examples of typographic designs that are hard to duplicate on a 300-dpi page printer: (a) Before optimisation: Note the uneven base-alignment of U, V, and W, caused by the slight descent of the curved and pointed bottoms of the characters. (b) After optimisation: Bitstream's Fontware corrects for the variations by moving the outlines. These corrections will be made automatically until the point size is large enough to allow the resolution to be aesthetically displayed (Figures C,D, and E are courtesy of Bitstream)

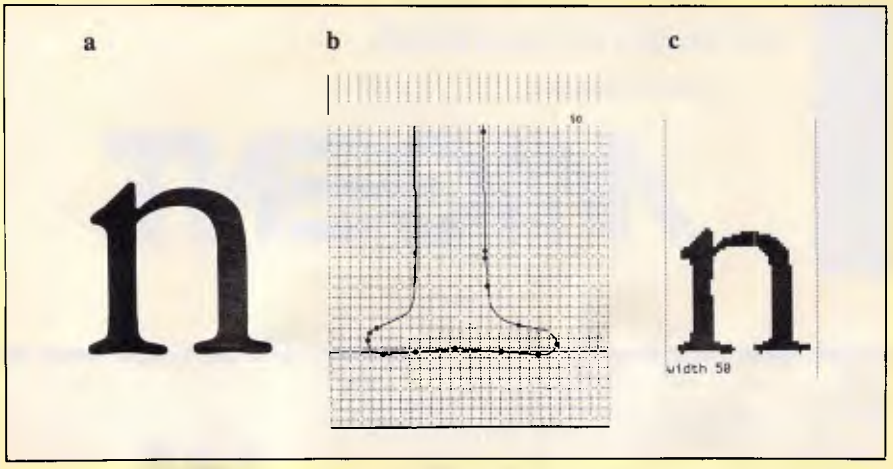

*Fig D Some type styles are not representable at resolutions below 800dpi. The lowercase **n** (detail **a**) from Garamond #3 has wavering strokes and serif features that cannot be fit to conform to the grid (details **b**). To get the effect of a finely wrought typeface using 300dpi, designers often trick the eye by adding dots where they don't belong (detail **c**)*

The first one is that some faces don't work well at 300dpi. For instance, a face with slight angles in its long strokes will cause trouble. The classic example is Optima, a face with gently slanting verticals. At 300dpi in common book sizes, this produces a jarring break in long verticals, such as the stem of a *d* or and *l*. Italics from many families give designers trouble for the same reason.

The lower resolution can interfere with subtle features of typefaces. Garamond, a common book face, has cups at the top and bottom of many strokes. At 300dpi, those cups are hard to reproduce in common font sizes.

The second problem is that, even in fonts that are adaptable to laser printers, the coarser resolution requires adjusting the letter shapes. For example, in many faces, the points of the *w* and *v* extend slightly below the baseline. At 2000dpi, this looks elegant. At 300dpi, the extension becomes crude and jarring.

A related consideration is font size. Relative letter spacing and weight (ie, thickness of strokes) tend to change with the size of the font. Details that cannot be reproduced in small sizes are important in larger sizes; without them, the type looks wrong. Similarly, spacing that is appropriate for small sizes is often too loose in larger sizes.

This is nothing new. Type designers have always had to adapt fonts to the method of typesetting. But today's bit-image printers require more adaptation than previous innovations.

The correct, but not universally practised, process of adapting a typeface to a laser printer starts with an idealised version of the face at very high resolution. This is as close to the original type design as possible, without any compromises for reproduction or resolution. Typically, before a type foundry begins adapting a typeface, a type designer must 'clean up' the letter forms to correct for adaptations that were made for the sake of other typesetting processes.

Once the idealised face is in hand, the designers can begin adapting the face for different fonts. A laser printer complicates this process because the resolution is so low. Information is lost when letters are reduced without any increase in resolution.For instance, a serif might disappear in the smaller typefonts, or a thin stroke may become exaggerated. As a result, type design for laser printers is in

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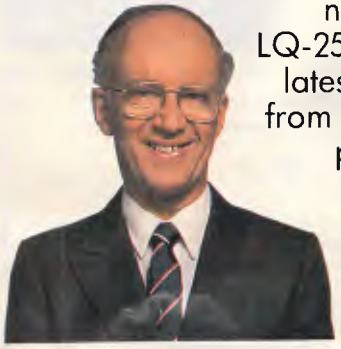

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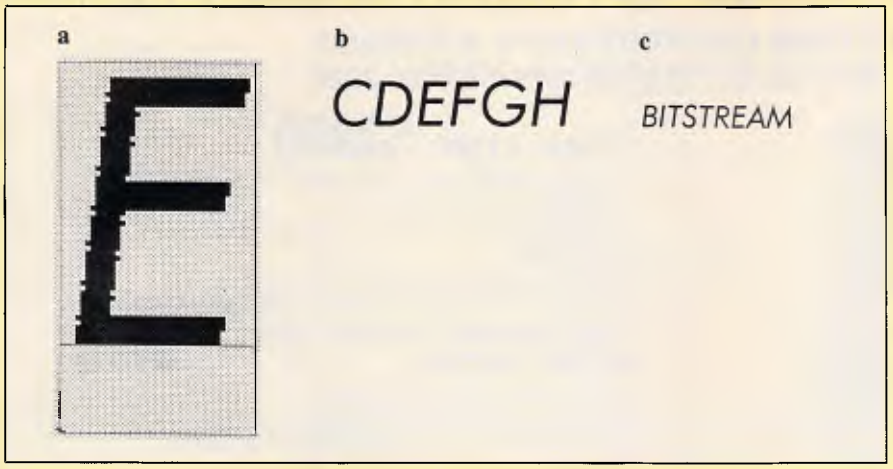

*Fig E Characteristics of some type styles are representable with manual corrections by designers working directly with the output technology. The uppercase E of Futura is enlarged at 12 times actual size (detail **a**) to show the serrated edge of the sloped vertical. At twice actual size (detail **b**), the serrations are still visible; but at actual size (detail **c**), the letters appear smooth and consistent*

part a matter of 'trompe l'oeil'. The eye must be fooled into believing features are present that actually aren't. The question facing the type designer is: which information can be lost without distorting the letter too much? In one case, it might be better to compress a letter. In another, the stroke might be widened or a serif might be omitted.

One common adjustment is to increase or decrease the width of the strokes (vertical lines) so they coincide with a pixel column. Curves are less of a problem because the pixels of a curved line naturally fall on different scan lines, and the roughness can be made to average out. The extreme points of curves must coincide with pixel columns or they will become flat or pointed.

If you examine an enlargement of a laser-printed font, you will often find dots that don't seem to belong. An *r* might have a dot that appears too high in the curved stroke, or a *d* might have a dot almost floating inside the enclosed space. Actually, these 'excess' dots are carefully placed to add weight or thickness at critical points and trick the reader's eye into seeing elements or details that are not there (see figures D and E).

The scaling is typically done algorithmically, at least in part. Type foundries usually have proprietary algorithms to change letter shapes as they enlarge and reduce their basic designs.

Once the face has been enlarged or reduced, a type designer usually optimises it to make the font look as good as possible. This can involve not just resolution and size; it can also depend on the nature of the printer that will output the type. For instance, not all bit-image printing engines have the same ability to reproduce thin lines. The amount of optimisation that is done depends on how well the algorithm represents the face in the new font and how much money the customer is willing to spend to get it right.

'No one kind of page printer is going to give users everything they want. There are too many basic conflicts and trade-offs.'

Adobe's PostScript PDL and Bitstream's Fontware system include algorithms for sizing faces effectively.

Bitstream has automated much of the design process with a program. Originally written in LISP on a Symbolics LISP machine, it is an expert system that chooses the best adjustments when scaling a face based on the rules used by Bitstream's type designers. Bitstream offers Fontware to OEMs so they can scale and fine-tune faces for their equipment themselves. The company plans to offer a run-time package to do the scaling on the laser-printer controller or the computer driving it. Hardware and software OEMs will be able to adapt the package to their equipment or software to give their users the same kind of control over their fonts. If a user needs a 22-point font, he or she can get something optimised for 22 points, not something designed for 24 points and scaled down.

Despite the problems involved in adapting faces to bit-image printers, there is only limited interest in designing faces, especially for 300dpi printers.

Matthew Carter, vice president of design at Bitstream, is adamant that good type is good type; it doesn't change over the centuries. Garamond, a very popular face today, was designed about 400 years ago. It is a mistake to discard one face and design a new one just to accommodate the limitations of a new technology, Carter claims, because the technology will have improved enough to handle the standard face before the new face catches on.

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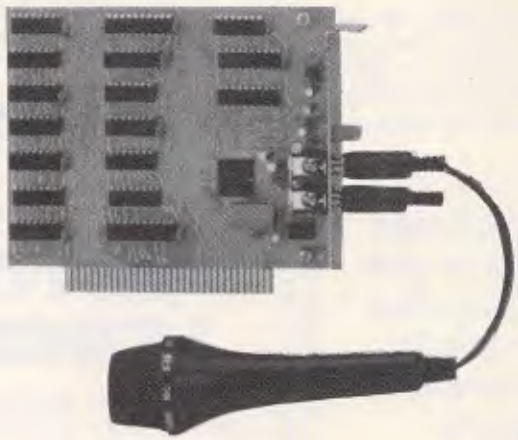

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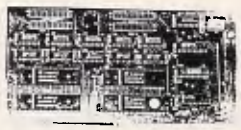

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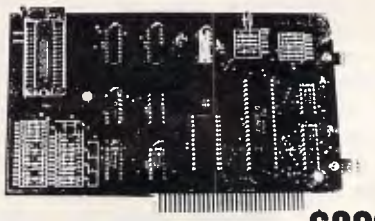

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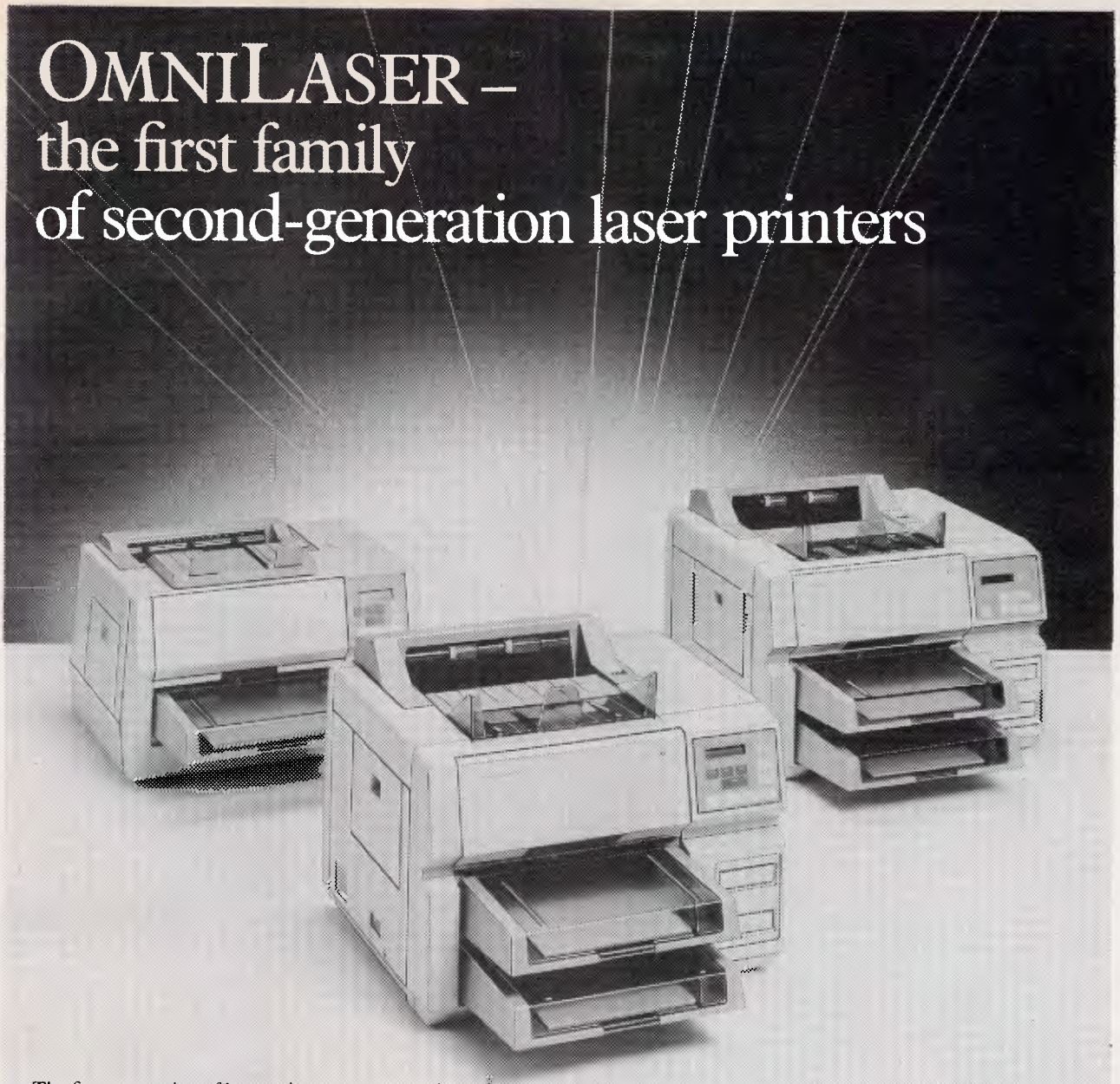

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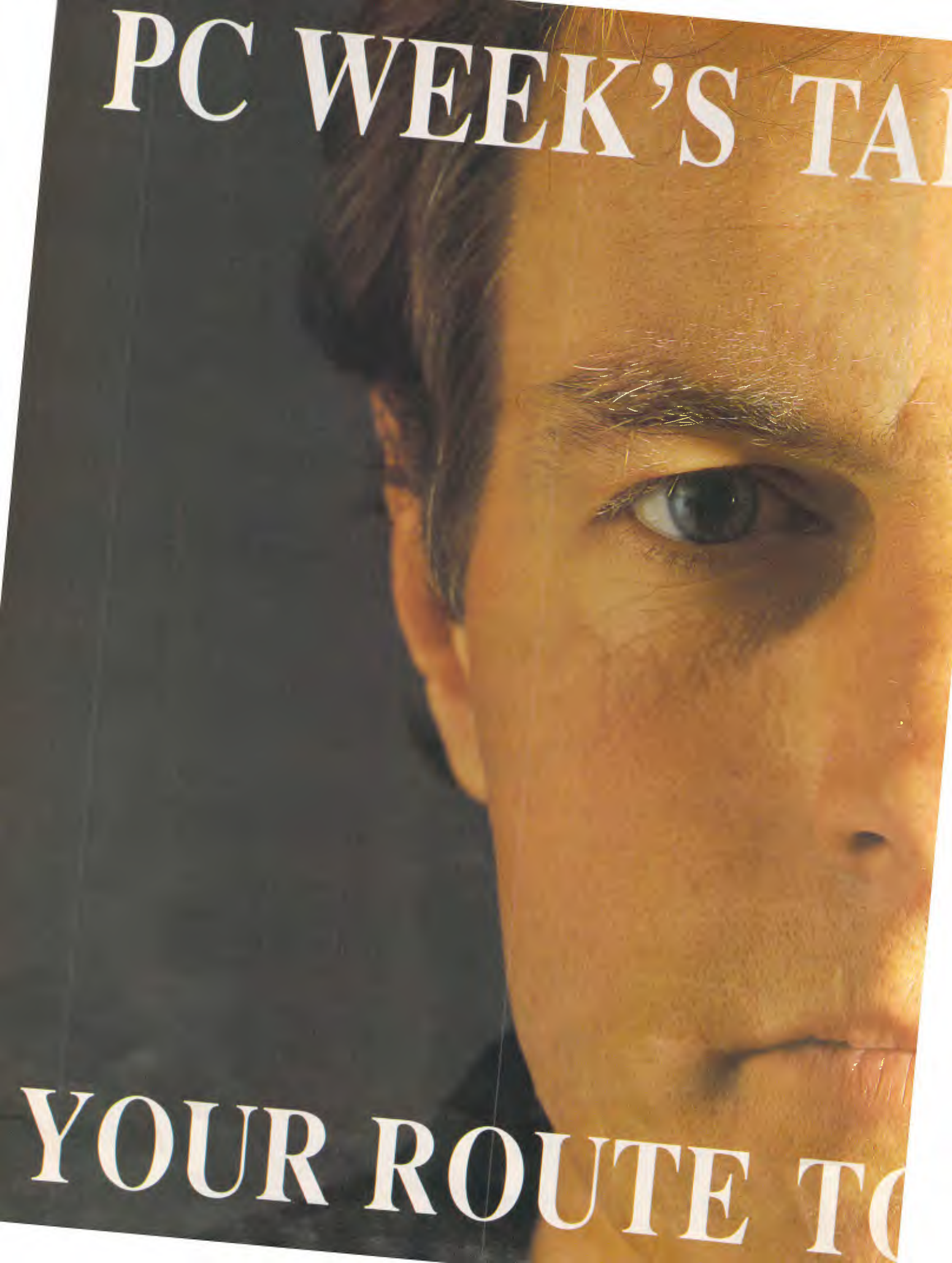
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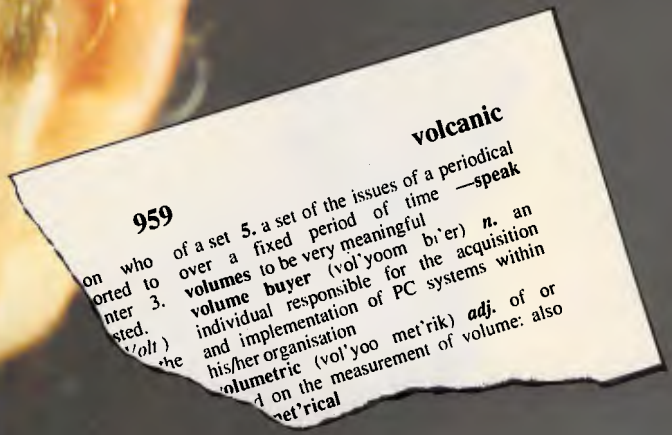

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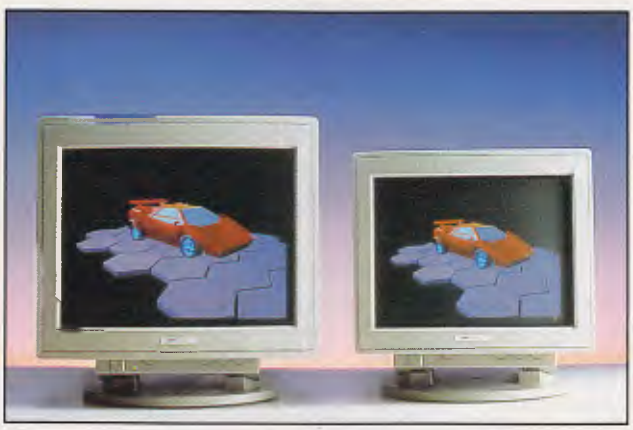
Seybold Desktop Publishing Show

We flew Brian Anderson to the US in September to report on the premier DTP event: the Seybold desktop publishing show. He facsimiled this report back to APC as this issue went to press (the modem failed us . . . again).

The second Seybold Desktop Publishing Conference was once again held this year in Santa Clara, California. The conference drew 2000 delegates from all over the world, while almost 10,000 visitors navigated their way through an ocean of scanners, full page screens, imagers, and fast silicon wizardry at the associated exposition of over 130 specialist vendors.

If there were a single theme which became clear from that week in the heart of Silicon Valley, it was one of standards, rationalisation, and the emergence of strong industry leaders. This is a young industry, in which John Meyer, one of the architects of Ventura Publisher, and now president of Ventura, described a three year period. He asserted that 1986 was a year of development, 1987 is a year of shake-out, and forecast that 1988 would be a year of maturing. We have seen some vendors quit the market (Studio Software, developers of the ill-conceived and flat footed Do-It), other products withdrawn (Harvard Professional Publisher), and an alignment of the remaining players into essentially one (and sometimes both) of two camps — Macintosh and PC.



SuperMac's 1024 x768 pixel colour graphics display for the Mac II — the basis of full-colour DTP systems?

Platforms

This was a show for two chips — the Intel 80386, under the covers of the fast PC clones, and Motorola's 68020, found in the Macintosh II and Sun. At every turn, on every table, and under every large screen were 80386s and Mac IIs. I only spotted one 8086 device at the show — a tired old Olivetti M24 at the Monotype booth running a sleepy demo of Ventura. 80286 machines were typically relegated to a subservient duty such as providing 5 and 12 volt power, and a chassis in which to plug a screen card or printer driver.

Desktop Publishing software is becoming sophisticated, and that sophistication is now being reflected by the type of processors on which the software is run. Functions which were previously available on separate products — text editing, layout, graphics — are now being integrated and offered as part of a bundled DTP solution. This integration is reflected by a seemingly insatiable appetite for large address spaces, and raw computing power. This is the environment in which both the 68020 and 80386 flourish.

Operating systems

If the 1987 conference was a showplace for two chips, then from a system developer's viewpoint, 1987 has been the year for a single operating system — that of the Apple Macintosh. While the PC world remains imprisoned within a 640k cell, the Mac developer has clearly enjoyed the open expanse of the 68020's 8Mbyte plus linear address space. It seems that developing software for the Mac II is like lining up for takeoff in a Cessna 150 on a runway built for a 747.

It is clear that MS-DOS is not a viable operating system for the next wave of DTP software, and lash-ups such as the Intel EMS option provide only a temporary and grubby solution. While the DOS world waits for the promises of OS/2 and Presentation Manager to materialise, Mac developers have climbed into a window of opportunity and have clearly outclassed DOS developers since the Mac II was introduced earlier this year.

This was evident in the type and

volume of new products shown on Mac IIs at the show. Cricket Presents (a presentation publisher from Cricket Software), Image Studio from Letraset, (first grey scale picture editor), and HyperCard from Apple (first practical implementation of hypertext) all provided a dazzling display of the Mac II's capabilities. During the show, Paul Brainerd, president of Aldus Corp, commented on the findings of recent market research related to their PageMaker product. "We found that both Mac and PC buyers made essentially the same use of our product," he said. "But there is a 20 per cent difference in the background of Mac and PC users. Sixty six per cent of Mac users have a graphics arts background, while only 46 per cent of PC users have the same origins. Furthermore, 85 per cent of Mac users send output to a LaserWriter, whereas less than 20 per cent of PC users have LaserWriter output."

It seems that in 1987, the most creative DTP applications were written for the Mac, and the most creative users bought DTP for the Mac.

Page description languages

At the Seybold Show last year, the debate was largely one of page description languages. Apple's darling, PostScript, was meeting challengers in the form of Xerox's Interpress, Imagen's DDL, and Hewlett Packard's PCL. Strategies were formed, alliances made, and battle lines drawn. Steve Jobs, in his now famous statement described Hewlett Packard's decision to support PCL as 'brain damaged'. Then suddenly, in April of '86, the battle was over. IBM had endorsed PostScript as its printer standard (and in the same announcement Microsoft Windows as its display standard). PostScript had won.

That is not to say the inventor of PostScript, Adobe, now has an easy ride. A year ago, Adobe's competitors were alternative languages. It now appears that a new battle is about to be fought. This time, the competition is coming from a number of PostScript clones which are beginning to surface. Headed by Control-C, Conographics, and Phoenix, the clone makers typically claim implementations which are supersets of PostScript. More features are provided, while all of the features of the real PostScript are maintained, guaranteeing 100 per cent compatibility with existing laser devices and software. As the conference convenor, Johnathon Seybold, has persistently reminded us however, manufacturing true PostScript compatibility is more than simply a matter of emulating the language. The real problem lies not in the implementation of the description language itself, but in providing true compatibility of fonts. How can a PostScript pretender guarantee that character shapes and widths are identical at the printer end to the real thing? That is not a trivial problem and may well be the toughest challenge for the clone makers.

This view appears to be supported by Paul Brainerd, who explained that Aldus had supplied the clone-makers with page layouts designed to test compatibility. At the same time Aldus would itself check out printers supplied by the clones. "To date, no printers have been offered for testing, indicating that the clone makers are not yet confident with their implementations," he said.

Large screens, colour and grey scales

While the DOS world is still having problems shaking off the 640k addressability limit, that white 9in Achilles Heel of the Mac is now history. A number of vendors now offer superb 19in screens for the Mac, in both paper-white and colour versions. SuperMac, for example, showed its top of the line 19in Trinitron colour monitor driven by a 1024 by 768 colour graphics card, and accessing the full range of the Mac II's 16.8 million colours, through palettes of 256 colours at a time. Large screen, colourful luxury comes at a price however, and in this case its $US1500 for the graphics card and another $US3700 for the monitor.

E-Machines showed off its Big Picture IQ — a 17in mono screen for the Mac II which displays 1024 x 808 pixels in 256 levels of grey, resulting in a true 300dpi photographic image quality.

In the PC world, large screens have been around for some time, and most vendors still base their offerings on the 19in Moniterm monitor, which is also found in the high-end Sun workstations. Ergonomic refinements such as tilt and swivel bases and non-glare coatings are evidence that this industry is maturing. Interestingly, some large format graphics controller cards are now doing more than just driving the display. DBM Corp has built a 1280 x 980 card which includes two serial ports, a parallel port, light pen interface, and even a clock-calendar. Renaissance GRX bundles a mouse interface onto its hi-res card. It seems as though the hardware vendors are now building a complete DTP hardware environment onto their display cards, just as the software vendors are beginning to bundle complete DTP functionality up at the front end.

Output devices: higher-res, faster and cheaper

We clearly live in a world of at least 300 dots in an inch.

Interleaf's Mac DTP entry

Perhaps the hottest single item at the Seybold DTP show was the announcement by Interleaf, of Cambdridge, MA, that its electronic publishing package would now be available on the Macintosh II. Previously, the same software had been available only to buyers of high-end Sun, or Apollo workstations, or the IBM RT PC. In the announcement, Interleaf president, David Boucher told a packed press conference that "Interleaf on the Mac II is possibly the most powerful program ever to run on a standard personal computer. Interleaf on the Mac II is a productivity tool that's going to place Macintosh computers directly in the corporate mainstream."

Unlike the current generation of PC-based publishing programs, Interleaf on the Macintosh II is especially appropriate for creating very long complex documents. Page layout programs require the user to create pages one at a time by moving text and graphics around by hand. Interleaf automates this process for multi-page documents, using the computer to lay out documents possibly thousands of pages long.

The software package would be sold in the US by both Interleaf, and through selected dealers. Interleaf announced that it had signed a VAR agreement with Apple to sell the Mac II as part of its product offering. Initial price was set at $US2495, but Boucher conceded that this price would fall as the package found its way to the end user through mail-order discounters.

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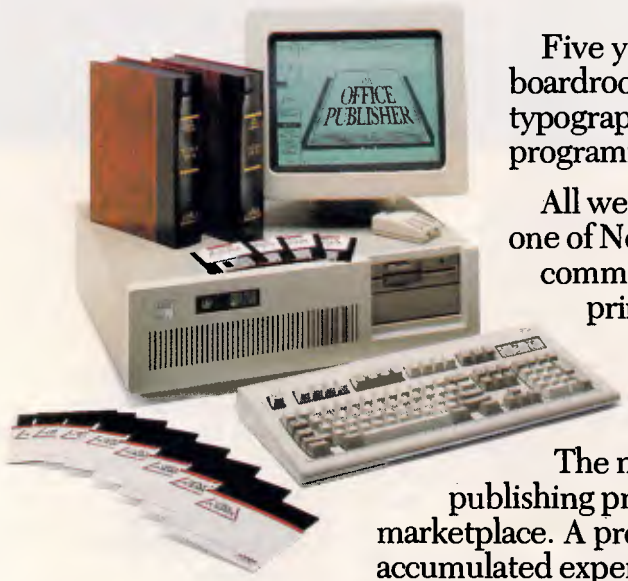
It's Time To Get Serious About Desktop Publishing.



Five years ago, in a Toronto boardroom, a select group of typographers, printers and computer programmers gathered for a meeting.

All were employees and consultants of one of North America's leading forces in commercial, electronic and instant printing – a company that for 20 years has been pioneering technological innovations in the printing industry.

The mission was to design a desktop publishing program for the IBM PC-based marketplace. A program that would take the accumulated expertise of its creators and translate it into a serious personal computer productivity tool. A program that would combine power, control, versatility and simplicity. A program the user could grow comfortably into for years, not out of in months.

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Desktop presentations

"The second wave — more than just pretty paper!"

That was how John Sculley (ex Pepsico marketing supremo, and now CEO at Apple Computer) described Apple's latest positioning in the explosive DTP market. According to Sculley, by 1990 there will be more than 65 million white collar workers in the US, and they would spend more than 70 per cent of their working hours in front of a VDT. Every working day there would be 15 million meetings, 8 million sales presentations, and 10 million classroom presentations. This creates a huge market in presentation materials, which would be dominated by 35mm slides.

Darragh Muldoon, president of Cricket Software, echoed Sculley's forecasts, and used the Seybold show to unveil Cricket's latest foray into the market: Cricket Presents. She described Cricket Presents as a fully integrated 'one-stop' desktop presentation solution that provides Macintosh users with the ability to create high quality presentations in colour, and to reproduce them on a wide variety of output devices. The package would be available from October 31, and would cost $US495.

Cricket also provides a new, optional Autographix device driver that would enable users to transmit images from their Macintosh, via modem, to any of the Autographix imaging centres throughout the USA. Images would be output to a wide range of materials, including 35mm slides, ink jet printers, and laser and thermal printers, and finished artwork would be returned to the client through an overnight parcel service.

Once regarded as a high-end output device, the 300dpi laser printer is now looked on as the base level of resolution acceptable to serious desktop publishing. No-one is expending any energy on improving character shapes and aesthetics at resolutions below 300dpi. Dot matrix printers are out, and lasers are in. Workhorse of the industry is still the Canon CX engine, which appeared at the show in one guise or another in most vendors' offerings. But things are starting to change here too. Canon has brought out a second generation engine called SX which, while still working at 300dpi, offers higher speed, richer blacks and a more consistent appearance.

A number of vendors are learning how to extract more resolution from the existing CX. For example, Tall Tree Systems, using its JLaser Plus card in a PC, is pushing the CX engine to 600dpi horizontal by 300dpi vertical for some specially written software applications.

The race is on however for more dots to the inch.

Nisho Electronics demonstrated the LN-2248 printer which is based on a 22-page per minute (ppm) Minolta engine giving 480dpi. Printware had its 720IQ 8ppm printer which images at 1200 x 600dpi. Varityper demonstrated the VT600 plain paper typesetter, at 600 x 600dpi, and Tegra showed the Genesis printer which images text and graphics at 500 x 1000dpi.

And while resolutions are going higher, prices are getting lower. AST Research demonstrated an 8ppm LaserWriter Plus-compatible PostScript printer which is on sale now for less than $US4000.

Where will it all end? The plain paper resolution war has started. The typesetting industry regards 1000dpi as being the lower limit of acceptability for professional imaging. So far, this value has only been attainable by high cost typesetters which expose laser light onto photographic material. These machines use expensive silver-based paper, which is developed, fixed, washed and dried in a wet chemical film processor. The industry is huge, and the incentives for plain paper devices to crack that elusive 1000dpi barrier are enormous. This is a war that has only just begun, but the final outcome is now becoming clear. The winners will be high speed plain paper imagers capable of resolutions exceeding 1000dpi, and delivering professional quality type and pictures. The losers will be silver-based photographic typesetters, and their associated support chemistry.

A year from now

And what do we think of the show next year (to be held once again in the Valley, in the first week of September)? The general consensus is that whereas 1987 will be remembered as a show for the Mac, 1988 is forecast to be the year of colour. We will see more high resolution colour screens, colour separations in DTP packages, and above all, the emergence of sophisticated digital colour-picture manipulation workstations. Whether Macintosh maintains its dominance over the PC platforms in this highly creative area is anyone's guess. There is no doubt that increasingly creative software will continue to surface for the Mac II, and it does seem that the 68020 chip has a natural edge over the 80386 in handling on-screen graphics. But OS/2 will hit the streets early in 1988, and that event will be the catalyst for a renaissance in PC-based DTP product development.

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Publishing on the IBM PC

Now that the market for desktop publishing has begun to grow in great leaps, four true WYSIWYG packages — GEM Desktop Publisher, The Office Publisher, PageMaker, and Ventura Publisher — are making their influence felt in a variety of applications. We pitch these four against each other in this exhaustive test.

After months of slow simmering, the PC desktop publishing market has caught fire. In 1986, 4000 desktop publishing packages were sold worldwide; estimated sales for 1987 are put at 53,000. And according to DataQuest, sales figures for 1990 are projected at more than 300,000.

The projected sales figures for the hardware that is used with desktop publishing software show similar expansion: CPUs used for desktop publishing are expected to jump from 4000 in 1986 to 53,000 in 1987 and to nearly 400,000 in 1990. Laser printers, 4000 of which were sold in 1986, are projected at 37,000 units in 1987 and 134,000 in 1990. And scanner sales, at 2000 in 1986 and 9000 in 1987, are expected to reach 134,000 in 1990.

Because an entire desktop publishing system requires special monitors, laser printers, and scanners, in addition to the software — with all the potential incompatibilities that that entails — the past few months have seen a profusion of announcements for complete desktop publishing 'solutions'.

One might argue that desktop publishing has been available for the PC for two to three years in the form of code-based packages, which act as front ends for high-end typesetting systems. But the explosion was ignited by the recent availability of another type of page layout for the IBM PC and compatibles.

These IBM PC packages strongly resemble their granddaddy, Aldus' PageMaker for the Macintosh. All of them share a what-you-see-is-what-you-get (WYSIWYG) display on which you can make and view adjustments in page format, font size, character spacing, and so forth. All also share the ability to import text and graphics created by other programs, integrate them into a single document, then print the results on a high resolution laser printer or phototypesetter.

Uses for desktop publishing

As laser printing and scanning technologies have become more sophisticated and less expensive — and as the disparate pieces of hardware and software have become more unified — more and more people are finding that it makes sense to bring publishing to their own desktop. Moreover, the availability of these packages for the past half year has led to a greater understanding of their uses.

While desktop publishing technology was first embraced by hobbyists, small businesses, and adventurous design studios, it has become increasingly recognised as the solution of choice for all types of companies, including major publishers, corporate communications departments, and professional designers and typesetters.

Clearly, PC users have moved beyond the popular perception that desktop publishing is synonymous with newsletters. Corporate users, for instance, now realise that reports have more impact when they are 'transformed' from typewriter fonts such as Courier to typeset Times Roman and Helvetica, are gussied up by ruled lines and boxes, and contain figures that appear on the same page they are referred to. Instant printers, designers, and freelance writers are also using this technology to offer typesetting to their clients.

Confusion and a few hurdles

But while buyers are gaining more savvy about the uses for desktop publishing, sorting out the packages has become more of a challenge. Vendors have caused a great deal of confusion in the marketplace by attaching the magic words 'desktop publishing' to all sorts of products in the hope of catching the wave of interest in publishing and riding it to new peaks in sales and profitability. Anyone out there with no experience with typesetting, page layout, and laser printing will be hard pressed to find his or her way through the advertising hype.

For instance, you could call a word processor such as XyWrite or WordPerfect, together with a package like Inset, a desktop publisher because it will give you multi-column text along with graphics. You'll also find quite a number of low-end packages masquerading as desktop publishers. These low-cost packages, however, are best suited to producing flyers,

since they offer just a few 'display type' bit-mapped type styles for dot matrix printers or low-resolution printing on a laser printer but cannot import text and graphics from other programs.

Also, code-based front ends to typesetting equipment often go by that moniker. While they don't meet our definition of DTP, these packages are useful for their purpose and even offer some advantages. Code-based products don't require the extra memory and graphics cards that you need to run WYSIWYG page layout packages, and their faster processing can make a significant difference when you are dealing with a large volume of text. On the other hand, code-based products tend to be more difficult to use than their WYSIWYG counterparts.

After a mad scramble last year by the major vendors to acquire ownership of marketing rights to page composition packages from independent programmers, few of the promised products have made it to market. Software developers are finding that it's not as easy as they had hoped to create a page layout package.

A true page layout package must be able to integrate all formats, support all fonts, and embody all the tools in a graphic artist's studio. Creating a complete page composition package is a much more ambitious endeavour than developing an 'integrated' package like Symphony, Framework, and Enable — all considered major innovations in their day. It's not surprising, then, that many of the products that were 'not quite ready' for review earlier this year are still under development. Other packages, which were brought to market quickly, have now been withdrawn following end-user criticism — Harvard Professional Publisher, for instance.

Meanwhile, the products that had the most promise eight months ago have gained a stronger foothold in the market. Among the packages that do qualify under our definition of desktop publishing, you'll find various degrees of text and graphics integration and typographical capabilities. GEM Desktop Publisher, for instance, which is tailored to a narrow range of applications, offers limited typographical controls and supports few file formats for imported text and graphics. The higher-end packages, such as Ventura Publisher and The Office Publisher, are suitable for a wide range of publications. They support many graphics programs and word processors and can satisfy the demands of professional designers and typesetters for precision and flexibility. But these greater capabilities are reflected in their prices. While GEM Desktop Publisher retails for $746, Ventura Publisher and The Office Publisher retail for $1750 and $1995, respectively (though many dealers are offering better prices).

The test procedure

In our testing and reviews of these packages, we have attempted to pinpoint the strengths and weaknesses of each of the tested packges for various types of applications.

To do so, we built a four-page newsletter and a long, all-text document using five different page layout packages. We started with PageMaker for the Macintosh as the 'control' in our tests, since that environment is the de facto standard for desktop publishing. We then produced the same two documents using PageMaker for the PC, GEM Desktop Publisher, The Office Publisher, and Ventura Publisher.

'As laser printing and scanning technologies become less expensive, more people are finding that it makes sense to bring publishing to their own desktop.'

To see how each of the packages handled different features, we designed a four-page newsletter that forced us to use nearly every command on the menu of each of these packages. Since short newsletters are not the only type of publication produced in corporations, we also tested flowing a long text file into each package.

By design, our short newsletter incorporated a variety of challenging elements, including the following features:

Imported text

The text for each article was imported from Microsoft Word (either formatted or saved as a text-only ASCII file). When you import text into page composition software, you should consider whether or not you can also import the formatting. GEM Desktop Publishing was the only one of these packages that required you to import straight, unformatted ASCII text, but the degree of formatting that the rest of the packages could import varied. Only PageMaker, for instance, could retain indents, tabs, and typefaces from a word processor.

The logo

The graphic 'BMI' logo was developed in one of three draw programs: MacDraw, GEM Draw, or Windows Draw. Although our specifications included applying a screen pattern to the logo, only PageMaker for the Macintosh was able to do so.

Line Art

The drawing of the building on page 1 of the newsletter was created in a paint program: MacPaint, Publisher's Paintbrush, or GEM Paint. You save the file on disk, and the package can just read it in. While the .PCX format from Publisher's Paintbrush is a widely supported one, GEM Desktop Publisher was unable to import such files. Instead, we used GEM Paint software for that package.

Scanned images

The newsletter incorporates two scanned images: the map on page 2 and the photograph on page 3 (stored as a 300-dot-per-inch high-resolution image file). We used a Microtek scanner and imported the scanned images directly into the page composition program except in the case of Ventura, where we saved the files in Publisher's Paintbrush format.

A 1-2-3 bar chart

We imported a bar chart from Lotus's 1-2-3, though for PageMaker for the Macintosh, we substituted a bar chart produced in Excel. All the PC packages except GEM Desktop Publisher were able to import these files. GEM requires you to use a conversion program for .PIC files, which is available from a third party but not included with GEM Desktop Publisher or with 1-2-3. We therefore left this part of the page blank in our printed examples. We used GEM Draw to create the chart for the timed printing tests, however, to get a fair comparison with the packages that could import the chart directly.

Column formats

The newsletter mixes one, two and three-column formats. All four packages were able to handle these formats easily.

Jumped text

Text for the lead article jumps from page 1 to page 4. A second article jumps from page 1 to page 3. We typed in the 'continued on page x . . .' line for packages that could not provide this automatically. None could.

Text wrapping

The newsletter calls for wrapping text around a graphic in three different ways. On page 1, two-column-wide

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text changes to one column to accommodate a graphic. On page 2, a graphic falls between two columns of text, forcing each into a half-column wrap. On page 3, the text is intended to wrap along the curved outline of a scan of a man's head. Every program allowed us to change the width of the text in order to wrap it, but only the three GEM-based programs (PageMaker, The Office Publisher, and GEM Desktop Publisher) also offered an automatic text-wrap feature (by opening text up around rectangular frames that contain graphics).

Drop caps

Two articles open with initial drop caps — that is, the initial letter in each article was enlarged and positioned so that it extended several lines below the first line of text. Ventura Publisher allowed us to use a menu selection. In other cases, we wrapped the text around the drop cap using the same techniques required for wrapping text around graphics.

Hairline rules

The design called for hairline rules between columns. We had to draw these as graphics in three of the packages. In the case of GEM Desktop Publisher, you could create rules using a menu selection, but the program offered no control over the width of the lines.

Running headers and footers

The running headers and footers on each page include graphics (shaded rectangles) and page numbers. All of the packages offered some way of entering the text of running headers and footers with automatic page numbering.

Tabs

Page 3 includes a table that calls for centre-tabbed headings over decimal-tabbed rows of numbers. All four of our packages support these tabbing requirements.

Printouts

All of these packages support PostScript-compatible printers, and we designed this newsletter for Apple's LaserWriter because of the nearly infinite range of typefaces and sizes this standard desktop publishing printer offers. The newsletter would have looked very different had we designed it to print on some of the other printers that are supported by these packages. The Hewlett-Packard Laserjet, for instance, offers a limited number of fonts, and you'd have difficulty using it for even the simplest graphics.

Other considerations

Besides the features listed above, in every program reviewed we examined and evaluated how the package handled leading (spacing between lines) and kerning (spacing between letters) — two features that are especially important to professional typesetters and designers. We also made note of the number of typefaces offered with each package and the differences between their handling of PostScript-compatible printers as opposed to how other output devices, such as the Hewlett-Packard Laserjet, handled them.

We looked at how each package handled overflow text or graphics that needed to be sized or cropped in order to fit on the page. We tried editing text in each package — adding and deleting written material to see how the package handled text adjustments across columns or across pages. We also tried repositioning text and graphics after a page was fully laid out.

'Informed buyers tend to favour those packages that already support their current word processing and graphics software. The more file formats supported, the more likely the success of that package.'

All packages must deal with files from a variety of other programs. Most packages will import text and graphics from other programs, then allow you to edit them within the desktop publishing system. Informed buyers tend to favour those packages that already support their current library of word processing and graphics software. Hence the more file formats supported by a page layout package, the more likely the success of that package in the marketplace. You'll find a listing of each program's supported file formats in the features table.

Once you begin to edit with these packages, you'll find that all share the ability to display a full-page view on the screen and an actual-size view, as well as making reductions and enlargements of the actual size. All four packages let you edit the page in every one of these views. All four let you edit text directly on the page layout. Some of the four show 'greeked' text in the full-page view, but every package shows text characters in closer views of the page. Screen displays may differ from file output because some packages show text in the font in which it will be printed, while others display only generic fonts on the screen.

Timed tests

Finally, we used a stopwatch to time a few procedures as a measure of the volume of work each package would be capable of handling in an average day. In some cases, these tests are no more than rough measures of an operator's subjective experience of 'speed'. In fact, the difference of a few seconds in opening or saving a file or turning a page may be a measure of the product's complexity rather than its inefficiency.

If you expect to produce a high volume of pages, you need to assess each product's printing speed as well as its processing time. For example, if it takes 30 minutes to print a single page — as it can when you use high-resolution scanned images — and you have only one available printer, you will be able to print only 16 pages during one 8-hour day.

The test environment

We used an IBM PC AT running at 8MHz with 640k RAM, a 30Mbytes hard disk, a Microsoft mouse, and an EGA card with Enhanced Colour Display. We chose this configuration because it is the most common one used in desktop publishing, rather than the most optimised system. Some of the packages also support a Hercules card and a monochrome screen, but we did not test this setup.

As you'll see in the following reviews, there are a few basic features that all these packges have in common, but there is a wide range of features that are not shared by all or implemented as well in every package. You'll find that each package has its own area of specialty that makes it well suited for certain types of documents but ill suited for others. No single package stands out as *the* solution for everyone, and a careful analysis of your own needs will be well worthwhile before you decide which package is best for you. You'll find the reviews that follow listed in alphabetical order by product name.

GEM Desktop Publisher

A low-cost alternative at $746, GEM Desktop Publisher, from Digital Research, is designed for offices with

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Model 4P – six Centronics ports let up to four computers share two printers automatically. Select the printer you want from your document or a switch on the front panel. Copy and reset functions. Auto and manual modes.

Model 4S – six serial ports allow up to four computers to share two printers (or plotters). Same features as the Model 4P.

Model 3S – the ultimate flexibility with one Centronics and three RS 232 inputs. PLUS RS232 and Centronics outputs. Share a parallel printer and serial plotter. Other features are the same as the Model 4P.

Model 2S – another flexible model, this time with two Centronics and two RS232 ports for input and two Centronics ports for output. Other features are the same as the Model 4P.

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modest publishing requirements. As a result, it purposely trades features for simplicity and ease of learning.

For instance, GEM Desktop includes no features for creating text or graphics within the package. Instead, GEM Desktop will help you lay out and edit only graphics imported from GEM-based graphics programs and .IMG scanner files, as well as text imported from ASCII files and MutliMate, WordPerfect, WordStar, GEM Write, and RFT-DCA formats (DisplayWrite, Microsoft Word 3.0, WordStar 2000, Lotus's Manuscript, Samma Word IV, PFS:Professional Write, and Volkswriter 3).

On the other hand, GEM Desktop Publisher makes the page layout process relatively simple. To begin with, the package uses the interface common to all products that run under GEM, which uses dropdown menus, scroll bars to move the image around the screen, and scrolling lists of options in a mini-selection box at the left of the screen.

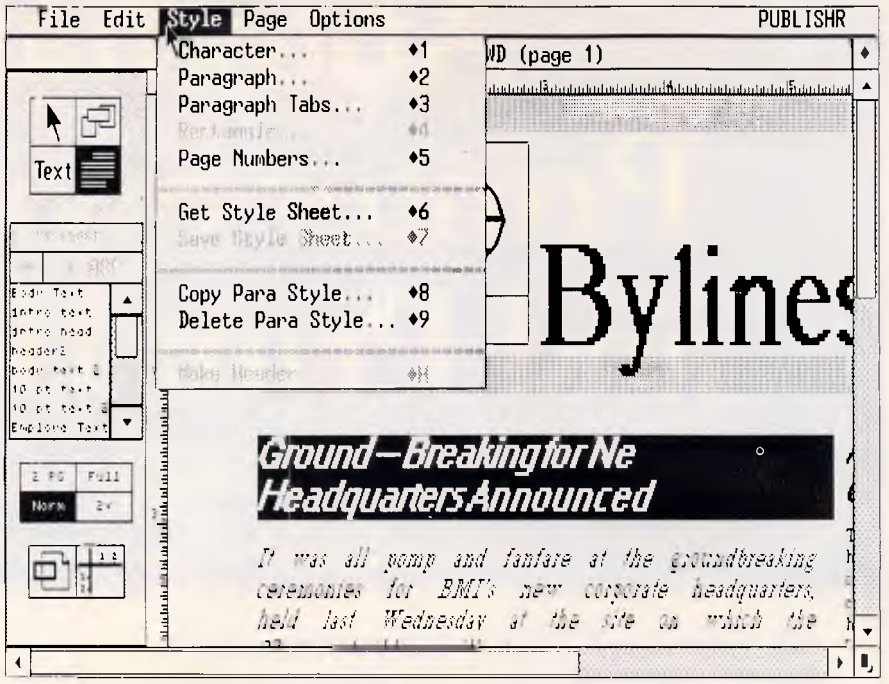
Extremely helpful, too, is the display of coordinates at the mouse pointer that indicate the position of the pointer on the page (from the top-left-hand corner) or the actual size of the rectangle that you are creating or scaling.

To lay out a page, you draw rectangles on the page and fill each one with text or graphics by selecting from a list of files that you've created using other programs. You can work in four different views of the screen — from full-page views of two pages at a time down to a 200 per cent enlarged view of a portion of a page.

GEM Desktop automatically repeats the arrangement of rectangles that you set up on the first page on subsequent pages, although you can easily override this default in order to customise a page. Its automatic page formatting allows you to create, in two or three steps, simple documents that repeat the same format on each page — three columns, for instance — with a continuous flow of text from one word processing file.

After flowing the text, you can go through the document and format text headings. To open up a space for graphics, you draw a new rectangle anywhere you wish within a column of text. The text in the first rectangle automatically wraps around the second rectangle.

To create more complex layouts, such as the newsletter we used for our performance tests, you lay out each page individually with rectangles for each text or graphics file. The page layout process is relatively simple and flexible.



Using a pull-down menu, GEM Desktop Publisher lets you create style sheets to set formatting definitions for headings and paragraphs within text. To change the font and format for selected elements throughout the document, you simply change the style sheet specifications

Although the page layout process in GEM Desktop is simple, the package offers few features that will allow you to create special effects such as hairline rules and boxed text. For these, you'll need to improvise. For example, text and graphics normally extend to the edges of each rectangle. If you'd like a margin of white space around graphics that are surrounded by text, you can draw two rectangles: one to hold the graphic and one slightly larger to push the text from the graphic's edge. Similarly, while you can't make a border around a rectangle, you can 'fudge' one by creating an opaque white box on top of a slightly larger black box.

Text formatting

Text formatting is one of GEM Desktop's great strengths. The package allows you to create style sheets that set formatting definitions for headings and paragraphs within text. In a style sheet, you assign a style name such as 'body text', 'heading 1', 'heading 2', 'caption', and so forth to each format used in the document. For each style name, you define the character format (typeface, style, size) and paragraph format (alignment, indentation, tabs, and line spacing).

Once you've defined a style sheet and imported the text, you format the text by selecting each heading or paragraph and clicking on the appropriate style name, which is listed in the mini-selection box on the left of the screen. Different documents can share style sheets, and you can change the font and format for selected elements throughout the document by changing the style sheet specifications.

Besides following the style sheet specifications, GEM Desktop also retains the formatting for boldface, underscores, italics, and tabs from supported word processing programs. You can also edit text and change format characteristics such as boldface and underscores within paragraphs by clicking or dragging the mouse to select individual words or phrases.

Your choice of typefaces depends on the fonts that you've loaded into the WTABLES.WID file, which is part of the GEM operating system. These include typefaces called Swiss (a serif font like Times) and Dutch (as sans serif font like Helvetica).

You have a choice of only the seven type sizes listed on the menu, from 7 to 72 points. The first three sizes are 7, 10, and 14; however, the sizes most

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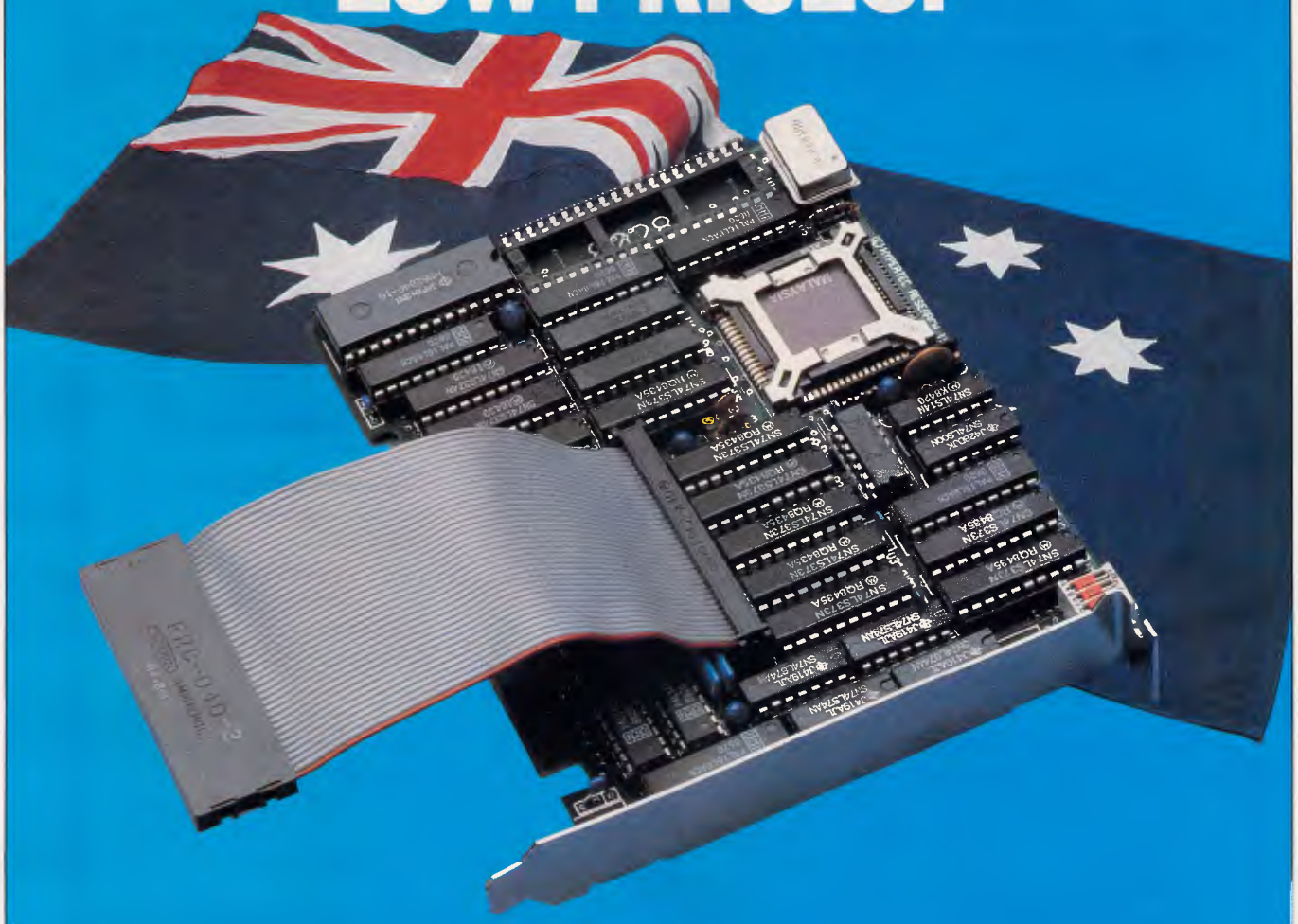

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commonly used in body copy (9, 11, and 12) are not included with the default GEM Desktop setup. You can purchase additional fonts and sizes that are available from font manufacturers (Adobe, Bitstream) and install them through GEM Desktop.

Except for the ability to create shaded rectangles, GEM Desktop Publisher has no graphics or drawing features. Instead, you import graphics. GEM Desktop automatically scales graphics proportionally to fit the rectangle into which they are loaded. You can also rescale a graphic by changing the size of the rectangle. If the rectangle does not have the same proportions as the graphic, the program will centre the graphic, leaving equal margins of white space on either side (or top and bottom) within the rectangle. GEM Desktop also offers a cropping feature that makes the image fill the rectangle completely by automatically trimming equal amounts from either side (or top and bottom) of the image.

You can set up a document for either letter-size or legal-size paper and print it in either portrait or landscape orientation.

All of the desktop publishing packages that run under GEM store each document as a series of files. For instance, a .GMP file stores the basic page layouts including the text and graphics, an .STL file stores the style sheet setting, a .WID file stores the width tables required for defining the widths and spaces between characters in various fonts, and .ASC files store information about the text used in the document.

You need not have all of these files on a disk in order to print the document, however. The Copy Print Files command allows you to copy the files required for printing (such as the .GMP file and an .IMG file for each scanned image used in the document) from the hard disk onto a floppy disk or into another directory for printing on a printer that's not attached to your computer.

At a glance

GEM Desktop Publisher, Version 1.0
Supplier: Micro Australia
Tel: (02) 809 6722
Price: $746
Requires: 512k RAM, two disk drives, DOS 2.0 or later.
In short: An easy-to-use package with limited features. You cannot add text or draw graphics from within the program. However, the GEM Desktop Publisher style sheets are incredibly useful. Not copy protected.

Installation

You cannot install or run GEM Desktop Publisher without the GEM operating system software (which is sold separately). Once you install the GEM operating system, it takes only a few minutes to install GEM Desktop Publisher. The installation program simply presents a series of questions about your equipment configuration and hard disk directory names and copies the program files and drivers from the master floppy disks to the hard disk (or to floppy disks, if you choose that option).

The 150 page manual includes a short tutorial that takes about an hour to complete and introduces the basic principles of the program.

GEM Desktop Publisher is a simple, effective tool for most business applications. It is easy to learn and easy to use as long as your design doesn't require effects that the package doesn't support. Moreover, the style sheets are an incredibly useful feature not offered by any other product in this price range (under $1000).

The Office Publisher

The Office Publisher is a recent release from a Canadian company, Laser Friendly, which is a spin-off of Print Three, the largest print shop franchise in Canada. Laser Friendly began developing the product three years ago as a typesetting system that would let customers use their PCs to prepare documents for printing on a high-end laser printer or typesetter at a remote location (such as a Print Three print shop). After building the guts of the system to run under MS-DOS, Laser Friendly incorporated the GEM operating environment with WYSIWYG page displays and dropdown menus.

Priced at $1995, The Office Publisher is clearly a high-end product. This flexible package, which offers a full range of typographic and page layout controls, also incorporates a number of features that no similar product has. Notably, it offers a powerful forms-design feature, the ability to edit im-

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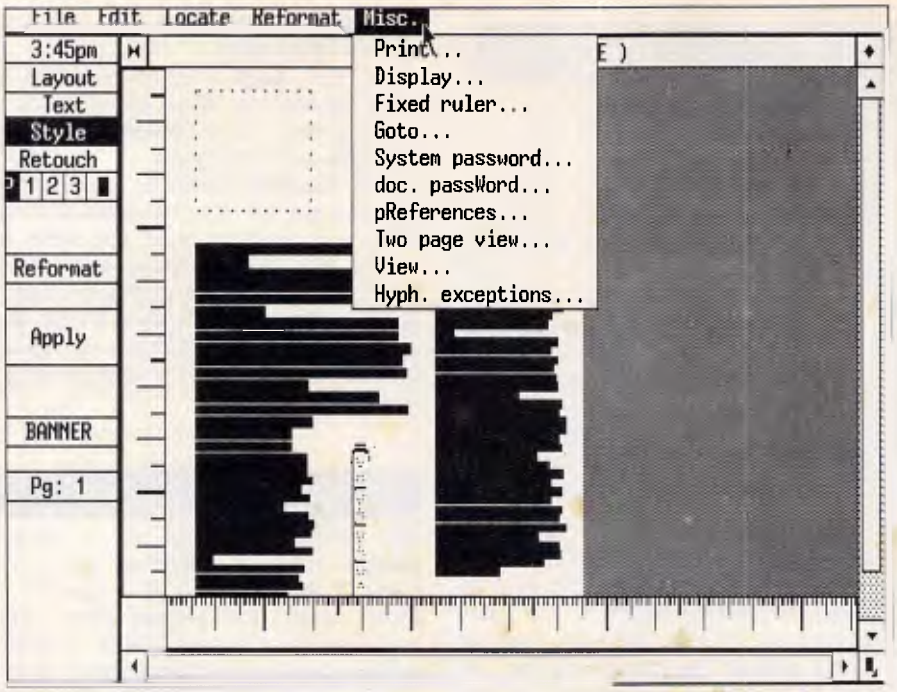

The Office Publisher's screen redraw is relatively slow compared with the other packages reviewed here, since the package refreshes the screen every time you change a view of the page. But you can speed up the process by suppressing the display of graphics and/or text

At a glance

The Office Publisher, Version 1.0
Supplier: Pantek Australia
Tel: (03) 836 9633
Price: $1995
Requires: 640k RAM, 20Mbyte hard disk, DOS 2.1 or later
In short: This package offers the features required by professional publishers. Features unique to this package include a powerful forms-design option, the ability to edit imported bit maps pixel by pixel, a floating ruler, and user-definable zoom settings. Not copy protected.

ported bit maps pixel by pixel, a floating ruler that you can move around on the page in addition to the rulers at the edge of the screen, and user-definable zoom settings.

You can use keyboard commands for many of the features and create text-only documents with simple formats without using a mouse. For this reason, a mouse is considered optional, but it would have been impossible to build our performance test newsletter without one.

The Office Publisher allows you to specify any page size up to 27 by 27 inches. You begin the page layout process by drawing rectangular areas on the page to hold imported text, typed text, or graphics. The package will automatically apply your first page layout to subsequent pages unless you choose to override this feature. You can also save a page layout as a separate file and use it later in order to format any other page or other documents.

Rectangular areas for text can have their own margins, columns, and borders. The simplest document design would require you to set up a single rectangle on the first page and carry it through the entire document.

More complicated page layouts, like those in our newsletter, require several rectangles per page. If you layer rectangles, the text in rectangles on lower layers will automatically wrap around those on higher layers. A particularly powerful feature is that you can rearrange the sequence of layers by entering 'priority' numbers for each layer in a dialog box.

Another powerful and timesaving feature is the package's automatic forms design. You can specify the line width and space between lines to create a horizontal or vertical grid of evenly spaced ruled lines in a rectangle.

'The Office Publisher offers graphics tools that are part of a library of special graphics objects, such as polygons, that you can modify and import.'

Viewing the page

The Office Publisher lets you zoom in and out among five different views of the on-screen page. It allows you to view any two pages on the screen simultaneously: they need not be left-right pages or contiguous pages.

While the on-screen text display accurately reflects the placement of printed characters, based on the printer you specify, The Office Publisher displays most fonts in one of the generic screen fonts available through GEM's screen drivers. However, Laser Friendly does package its own screen drivers and several Intellifonts (bit-mapped fonts from CompuGraphic) with The Office Publisher, and these bit-mapped printer fonts give you a more accurate screen representation of how the printed font will look.

The screen redraw, however, is slow compared with that of the other products we review here, and the package refreshes the screen every time you change a view of the page or call up a dialog box — a very frequent occurrence. You can speed up the process by minimising the number of graphics elements on the display (hiding the grid and the rulers, for example) or by using a menu command to suppress the display of graphics and/or text.

That the size of a single document is limited only by the space available on your hard disk has two potential drawbacks. First, any program with such large files will be slower in executing certain commands than will one with small files. Second, it's more difficult to back up files larger than 800k onto floppy disks.

Like most of the other packages, The Office Publisher stores documents in a number of files. A document can be composed of one or more page layout files, a style sheet file, individual text files, individual graphics files, and reference to forms and grouped objects from the object library.

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Templates of Doom is an amusing spoof of today's adventure B movies; and an excellent training device for Lotus *1-2-3*. It consists of a series of worksheets that test your knowledge of Lotus commands while you read through a story of the exploits of one of today's new breed of superheroes. The worksheets help sharpen your Lotus *1-2-3* skills in everything from global column width settings to range label prefixes, data query criteria, and @VLOOKUP commands.

The program That teaches Spreadsheets by making a game out of it.

The documentation is only six pages, but we found it sufficient for us to load and run the program. The program keeps score for a character whose name you invent. Hints are available via the ALT/H combination, although penalty points are added to your score if the program helps you. Even a TBIC (The Boss Is Coming) switch is provided to remove the *Templates of Doom* from the screen and display a fake, but realistic-looking, worksheet.

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To print a document on a remote printer, you can create a print file of the document (using the Print command in The Office Publisher). If the print file takes more memory than your 360k or 1.2Mbytes disks, you can use the DOS BACKUP command to copy the print file onto several floppies. At the remote site, you use the RESTORE command to put the print file onto the hard disk before printing. If you are seriously trying to produce a 32,000 page book (The Office Publisher's ultimate page limit), you will probably want to divide it into small sections anyway for distribution among the production team.

Text

You can type text directly into The Office Publisher or import it from other programs. While you can import any ASCII text file directly, you must convert text that has been formatted in a word processor before importing it to the page. The Office Publisher retains some formatting from word processors, such as boldface and underscores, but it automatically sets all imported text in the paragraph format, typeface, and size specified for the 'body text' style sheet. Style sheets can be saved as a file that any number of documents can share, and you can reformat an entire document by changing the style sheet.

Laser Friendly's style sheet implementation is unique and more flexible than that of our other review programs in several ways. For example, you can set up style sheet definitions that carry a different style specification for selected words or phrases within paragraphs. You can also view or print style sheet specifications, as well as keep a log of the changes you have made to the file — two features not offered by other programs in these reviews.

The package allows you to adjust point sizes from 5 to 252 (for printers that support that range) and change the leading in increments of tenths of a point. You can adjust letter spacing (kerning) manually or by simply activating the kerning tables; you can also define the size and positioning of superscripts and subscripts. You can use a wide variety of measures in setting up type specifications, including inches, centimetres, picas, points, ems, ens, or dots (300 or 1200 dots per inch). You can also skew text to any angle to produce customised 'italics' on PostScript-compatible printers.

Text is hyphenated using a hyphenation formula developed by Proximity that is said to be extremely fast and accurate. The package checks words against an exception dictionary to which you can add your own terms. If you choose to limit the number of lines hyphenated in a row, or if you select automatic widow and orphan control, The Office Publisher will issue a warning whenever it finds the conditions you specify, and you can intervene to fix the bad line break, page break, or column break.

The Office Publisher offers automatic generation of an index and table of contents based on flags that you can enter for index terms and heading levels in the text.

Graphics

The Office Publisher offers graphics tools for lines, rectangles, and polygons. These tools are unique because, unlike those of the other review packages, they are part of a library of special graphics objects, such as lines, squares, and polygons, that you can modify and import onto a page. You can edit these objects by moving the vertices (corners), combine several objects, and save modified versions in the same object library, but you cannot otherwise originate a drawing.

You can import scans and bit-mapped images from any PC paint program. The Office Publisher is the only page composition package we know of that lets you edit imported bit maps pixel by pixel, with the ability to zoom in to an area and work at 300 dots per inch. You can also select parts of a bit map and invert them or mirror them across the horizontal or vertical axis, or clip them and save them as a separate graphics file.

The package also supports object-orientated graphics from GEM Draw, as well as .PIC files from Lotus's 1-2-3 and Symphony. You can scale and crop all packages directly in The Office Publisher.

The Office Publisher comes on 11 disks. As with other page composition packages reviewed here, installation consists simply of answering a series of questions about your equipment setup and directory names.

The Office Publisher offers the full range of features required by professional publishers and could be a strong contender against other page composition programs in the price range. However, its success will ultimately be determined by factors such as product reliability and customer support. With all of its sophisticated features, The Office Publisher will take some time to learn, and new users will appreciate formal training and a '008 hotline' to knowledgeable problem-solvers which is shortly to be established by its Australian distributor, Pantek.

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PageMaker

Released for the Apple Macintosh in July of 1985, Aldus Corp's PageMaker is the grande dame of desktop publishing packges. It is also the de facto standard for desktop publishing features, having sold more than twice as many packages as any of its competitors. As a result, you can be sure that every other developer of page composition software for the IBM studied PageMaker carefully before finalising its programs.

The latest version of PageMaker, version 1.0a, adds an improved LaserWriter driver and fully supports file transfers between the PC and the Macintosh. (Version 1.0 supported transfers in one direction only, from the IBM to the Macintosh.)

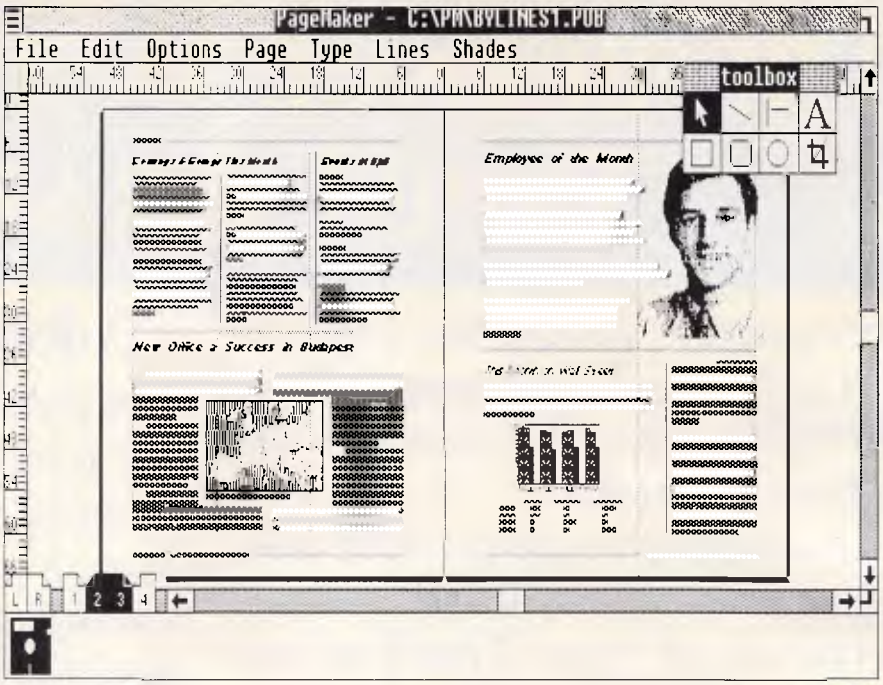
The latter addition further enhances PageMaker's unique ability to straddle both the PC and Macintosh marketplaces. The package looks and 'feels' exactly the same on both machines, giving PageMaker the advantage over all other PC page layout products of having an installed base of over 50,000 users who have already been trained on and are used to the Macintosh version.

PageMaker remains an exceptional page layout package in many other respects as well. For instance, PageMaker is the only available page layout package that runs under Microsoft Windows. (If you don't already own Windows, you can still run the package under an abbreviated runtime version of Windows that is included.)

Using the package

PageMaker's popularity is due in large part to its ease of learning and use. Installation takes about 15 minutes. A tutorial that includes six short lessons gives you a good, quick overview of the program's operation, while the 300-page user manual and the 150-page reference manual are easy to follow and serve as models for page design. The company also offers a free booklet of design tips and is in the process of producing a series of template packages and instruction guides that include design tips.

PageMaker allows you to work in up to four different views of the page and (optionally) to work on two facing pages at once. Text in smaller point sizes is 'greeked' in the reduced views of the page, but both the greeked and normal views of the text show accurate representation of the fonts used.



PageMaker allows you to work on two facing pages at once. Text in smaller point sizes is 'greeked' in reduced views of the page. PageMaker's built-in graphics tools, which let you draw lines, boxes, circles, and so on, are constantly displayed in a window on-screen

While the program lets you create documents up to 128 pages long, you will probably want to keep document files shorter so you can back up onto floppy disks. You can also compose a long publication of more than one PageMaker file, specifying the starting page number in the Page Setup dialog box for each file.

'Tremendously convenient are PageMaker's keyboard shortcuts, which speed up common commands such as bold and italic and increase or decrease the point size of selected type.'

To lay out a page with PageMaker, begin by defining general characteristics that apply to an entire document, such as the page size and margins. PageMaker is unique in that it does not confine you to predefined page sizes; instead, you can specify any page size up to 17 by 22 inches.

Next, you format the master page by specifying column guides and elements that repeat on every page, such as headers and footers. The column format set up on the master page will automatically apply to every page in the document, though you can also easily override these master settings on any page.

Once you've defined the margins and columns, you can type text directly onto the page, use PageMaker's built-in drawing tools to create graphics, or import text and graphics from a wide selection of other programs. Imported text retains all of the formatting from supported word processing programs, including margins, indents, tabs, and type specifications. However, since there is no link between the PageMaker file and the imported word processing files, edits made in PageMaker are not reflected in the original version of the document.

PageMaker gives you a great deal of flexibility in manipulating your page layouts. For instance, imported text can either flow into the predefined columns, or you can use the mouse to define an alternative space on the layout for it. Other packages, in contrast, require you to change modes or use dialog boxes in order to change column widths. The package then automatically hyphenates text — unless you turn this feature off.

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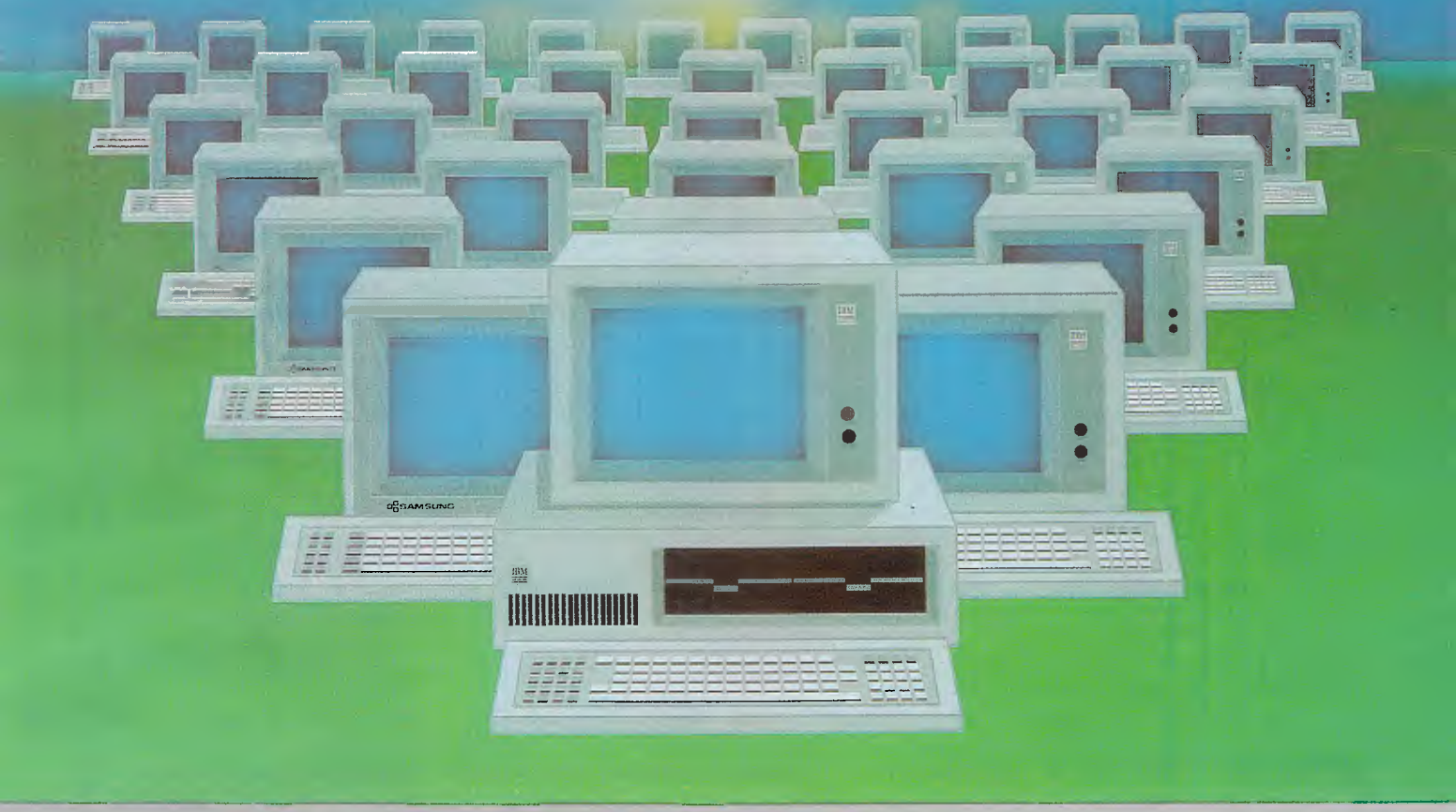

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DEALER ENQUIRIES WELCOME

But the price of flexibility is that PageMaker's process for laying out full pages is less automatic than that of some of the other packages. For example, unlike other packages that automatically fill whole pages or documents with text, PageMaker requires you to flow the text one page at a time.

Placing a graphic element on a page is as flexible a process as moving text in PageMaker. You place graphics onto the page in their original size, then scale and crop the image to any size you choose. You can also define a rectangular area into which to place the graphic. To wrap text around a graphic, you must break the text into several text blocks and use the mouse to change the width of each one. But while this process is both easy and flexible, it is more time-consuming than in the automatic text-wrap features that are offered by other programs.

To align objects on a page, you can use either the column guides, which appear as dashed vertical lines on the screen display, or position horizontal and vertical ruler guides. PageMaker is the only package that offers a viewable 'pasteboard' area on the screen where you can store text and graphics elements that have not yet been positioned on the page layout.

Text formatting

After you've placed text on a page, you can edit or change its format. Text can be any size between 4 and 127 points and can be printed in black or reverse type. PageMaker supports the full range of tabs (left, right, centred, and decimal) and offers three styles of tab leaders (dots, dashes, and solid lines) as well as allowing customised tab leaders. You can adjust the spacing between lines in half-point increments (thus making spacing less flexible than that of the other packages reviewed here). You can also control spacing between words and between letters of justified text, set up automatic kerning for text above a specified point size, and adjust the kerning between pairs of letters manually.

Tremendously convenient are PageMaker's keyboard shortcuts, which speed up common commands such as bold and italic and increase or decrease the point size of selected type.

However, while these keyboard shortcuts make quick changes a snap with PageMaker, its lack of user-defined 'macros', or style sheets, make the process of formatting long documents a tedious one indeed. For example, rather than allowing you to simply define a single-heading format that would apply to every page in a report, PageMaker requires you to repeat the formatting commands for each individual heading.

In addition, editing and formatting text with PageMaker is a relatively slow process compared to most word processing programs because the processing and screen redraw can take several seconds for each edit.

PageMaker's built-in graphics tools let you draw lines, boxes with squared or rounded corners, and circles or ovals. Lines can be set in black or white reverse type, available in eight widths ranging from hairline to 12 points, as well as nine patterns such as double hairlines, dashes, dots, and so on. Sixteen different fill patterns are available for solid objects (boxes and circles), including dot-screen patterns from 10 to 80 per cent. While these features are not as extensive as the ones offered by Ventura Publisher, they are easier

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This facility is usually only available with very expensive fax machines.

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At a glance

PageMaker, Version 1.0a
Supplier: InfoMagic Australia
Tel: (02) 858 4111
Price: $1795 (PC); $1295 (Mac)
Requires: 512k RAM (640k RAM recommended), one disk drive, one 10Mbytes hard disk, Microsoft Windows, DOS 3.2 or later.
In short: PageMaker's strengths lie in its flexibility for quick edits. It also features an intuitive menu structure and good graphics and layout features. But its lack of style sheets — plus the fact that it doesn't flow text from page to page — makes its use tedious for long documents. This product can share files with the Mac version. Not copy protected.

to use and should be adequate for most applications.

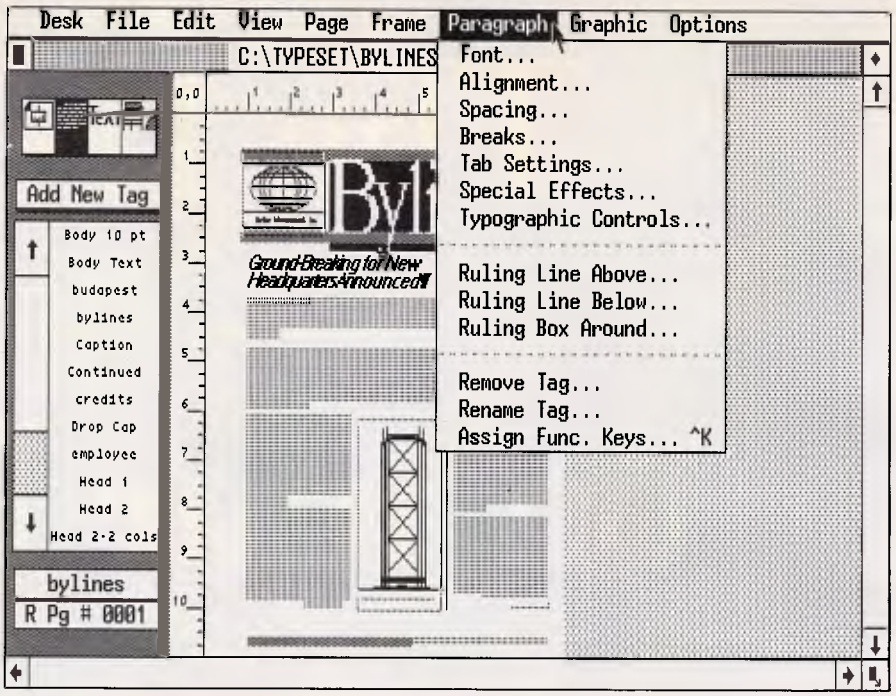
In its current incarnation, PageMaker remains one of the easiest page layout packages to learn and to use, while offering the same range of typographical controls as do more complex programs. Its intuitive menus make it easy for casual users to relearn the program quickly. Its graphics and layout features, pasteboard area, and flexible text-formatting capabilities make it a true designer's tool. However, its lack of style sheets and its inability to flow text from one page to another make its use tedious for long documents. But with all the support that PageMaker is receiving from hardware manufacturers — added to the momentum it has already gained after three years on the market — we can expect this product to be widely accepted and to continue evolving in response to the demands of the maturing market.

Ventura Publisher

The latest release of Ventura, Version 1.1, adds over 80 new features and eliminates some of the inconveniences of the original version, making this product more flexible than ever.

Ventura's latest offering includes a wide range of automated controls over text formatting, with options such as automatic numbering of pages, sections, footnotes, and figure captions. In addition, the new version has improved typographic controls, supports a wider range of sources for graphics and text, and can output to more printers at faster printing speeds.

If you're familiar with the GEM operating system, you'll feel comfortable with Ventura Publisher. The package runs under GEM and incorporates all of that environment's graphical conversions, including dropdown menus, dialog boxes, and a movable window with scroll bars. Although every menu command has a keyboard alternative, you need a mouse to draw graphics or position frames on a page.



You can define character and paragraph formatting throughout an entire document using style sheets you create with the menu above in Ventura Publisher. You can use these style sheets in any document and mark text to change its type specifications or paragraph format

> *'Ventura Publisher's latest offering includes a wide range of automated controls over text formatting, with options such as automatic numbering of pages, sections, footnotes, and figure captions.'*

Ventura allows you to work in a WYSIWYG view of the page in three views: actual size, reduced to fit the full page on the screen, or enlarged to a 200 per cent magnification. Version 1.1 lets you format pages up to 11 by 17 inches for PostScript-compatible printers or 18 by 24 inches for typesetters. Ventura Publisher now accommodates a string of up to 128 chapters, up from 64 in Version 1.0, containing from 150 to 300 pages, or 500k bytes each (up from 150k bytes). The limit on the number of text and picture files and style sheet tags has also doubled, from 64 to 128.

To create a page layout in Ventura Publisher, you draw rectangles, or 'frames', on a page. You can then either fill each frame with a text or graphics file imported from another program or type text in directly. Each frame can be divided into columns that automatically affect the layout of the text in the frame. And you have the option of leaving blank space around the text or graphics in the frame. This is important when you want to wrap the text of an article or document around a frame that contains a graphic or a sidebar of related text.

To add graphics or other text to a page, you can place a new frame for those elements atop an existing one. Text in the original frame will then automatically wrap around the new frames (unless you turn the feature off). You can leave white space between the wrapped text and the new frame's contents by setting margins.

Version 1.1 of Ventura Publisher adds the ability to tie a frame to a text reference. This allows you to anchor a

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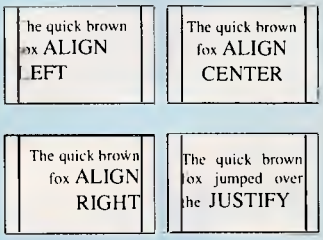
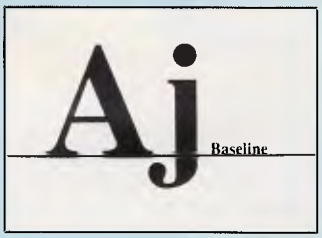
Glossary of desktop publishing terms

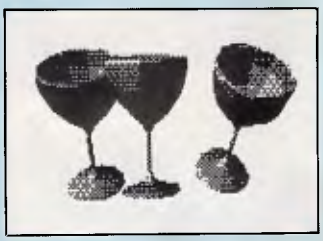
Alignment
How text lines up on a page or in a column: align left (flush left, ragged right), align centre, align right (flush right, ragged left), or justify (flush on both the left and right margins).



Baseline
The baseline of a line of text is the lowermost point of letters, not including descenders (the lower edges of 'g' and 'j' for instance).

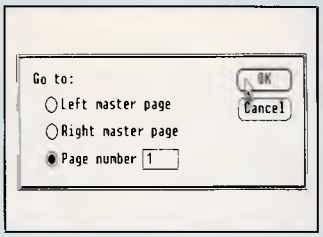


Bit map
Also called raster. A graphic image formed by a matrix of dots with a specific number of dots per inch. PC Paint, GEM Paint, Windows Paint, and PC Paintbrush are examples of packges that use bit-mapped graphics.

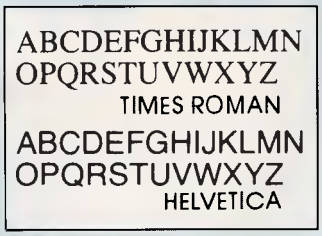


Clipboard
A holding place for temporarily storing the text or graphics under Microsoft Windows.
Crop
To trim material from the outer parts of a graphic image, thereby emphasising the main part.

Default
The initial setting of a value or option by the program. Default settings can usually be changed by the operator.

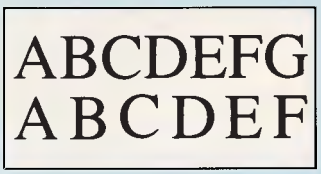


Dialog box
A window or full-screen display that appears in response to a command that calls for setting options.
Embedded codes
ASCII codes typed directly into a stream of text to identify type specifications; usually called 'embedded' to distinguish them from the invisible formatting codes created by some systems.
Flush
See Alignment.
Flush right, or right justified
Text in which lines end at the same point on the right margin; opposite of ragged right or left justified.
Font
One complete set of characters in the same typeface and size, including letters, punctuation, and symbols; 12-point Times Roman is a different font from 12-point Times Italic, 14-point Times Roman, or 12-point Helvetica.

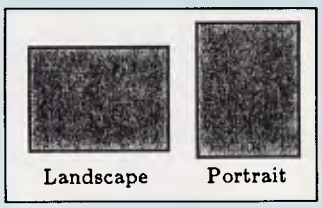


Footer
One or more lines of text that appear at the bottom of every page.
Generic font
A screen representation of alphanumeric characters on a screen that may not reflect what the final printed characters will look like.
Greeking
The conversion of text to symbolic bars or boxes that show the position of the text on the screen but not the alphanumeric characters.

Header
One or more lines of text that appear at the top of every page of a document.
Hyphenation
Hyphenation can be achieved in several ways: some programs let you insert 'discretionary' hyphens manually (hyphens that are visible only when they fall at the end of a line); some programs insert hyphens automatically based on a dictionary of words; some programs use a logic formula to hyphenate words. Usually, dictionary hyphenation takes longer than logical hyphenation but is more accurate.
H and J
Short for hyphenation and justification.
Icon
A functional graphic representation of a tool, file, or command displayed on a screen.
Inside margin
The left margin of a right-hand (odd-number) page; the right margin of a left-hand (even-number) page. The inside margin is often wider than the opposite margin to accommodate binding.
Invert
See Reverse.
Justified Text
Text that is aligned flush at both the left and right edges.
Kerning
The amount of space between letters, especially certain combinations of letters that must be brought closer together than others in order to create visually consistent spacing among all letters. The letters AW may appear to have a wider gap between them than the letters MN, for example, unless there is a special kerning formula set up for the AW combination.



Landscape printing
The rotation of a page design to print text and graphics horizontally across the 11in width of the paper. See also Portrait printing.



Laser printing
Used to describe printing with one of the toner-based laser printers that are available for PCs. Some typesetters also use laser technology in conjunction with their photochemical processing, but these are usually referred to as phototypesetters rather than laser printers.
Layout
The arrangement of text and graphics on a page.
Leaders
Dotted or dashed lines that can be defined for tab settings.

Item	Cost
Milk	$0.59
Bread	$0.99
Coffee	$2.99
Butter	$1.99
Eggs	$0.69

Leading
The amount of vertical spacing, expressed in points, be-

tween the baselines of two lines of text.

Which though I stay blameless, if it be no brings to all who wis whereof this whole di mony, if not a trophy.

Which though I stay blameless, if it be no brings to all who wis whereof this whole di mony, if not a trophy.

Line spacing
See Leading.

Orphans/widows
An orphan is formed when a short line — usually the last line of a paragraph — falls at the top of a column or page. A widow is formed when a single line — usually the last line of a paragraph — has fewer than an agreed-upon number of characters and hence does not meet the visual standards of the publication. Widows and orphans are generally considered not aesthetically pleasing by most publishers. Some packages let you set up automatic controls for the minimum number of lines that can be separated by a page break.

Phototypesetting
Producing a page image on photosensitive paper, as when documents are printed out on a Linotronic 100 or 300 typesetter. This process is sometimes referred to as cold type to distinguish it from the older method of casting characters, lines, or whole pages in lead, known as hot type.

Pica
A unit of measure equal to 1/6 inch, or 12 points.

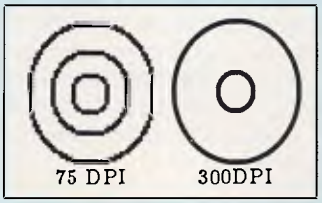
Point
Smallest unit of measure in typographic measurement. There are 12 points in a pica. 72 points in an inch.

Portrait printing
The normal printing orientation for a page: horizontal text on the 8.5in-wide sheet of paper. See also Landscape printing.

Postscript
A page description language used by Apple's LaserWriter and other high-resolution printers and typesetters.

Reverse
The opposite of the normal appearance of text or a graphic on the printed page. Normally, text and graphics are black on a white background. When reversed, they are white on a black background. Graphics can also be reversed. This option is called 'invert' on some systems.

Resolution
The number of dots per inch (dpi) used to represent an alphanumeric character or a graphic image. High-resolution images look smoother and have more dots per inch than do low-resolution images. The resolution of images displayed on the screen is usually lower than that of the final laser printout. Laser printers print 300dpi or more, typesetters print 1200dpi or more.



Roman
Upright (nonslanted) text styles, as distinguished from italic.

ABCDEFGHIJKLMNO
PQRSTUVWXYZ
abcdefghijklmnopqrs
tuvwxyz
UNIVERS 55 ROMAN

Rules or ruled lines
Black lines of various styles that can be drawn on a page and set to various thicknesses.

Ruler
Rulers displayed on the screen that show measures against the page layout in inches, picas, or millimetres.

Running heads
See Header.

Sans Serif
Typefaces without serifs, such as Helvetica, Avant Garde, Geneva. See also Serif.

ABCDEFGHIJKLMNOPQ
RSTUVWXYZ
abcdefghijklmnopqrst
uvwxyz
AVANT GARDE GOTHIC BOOK

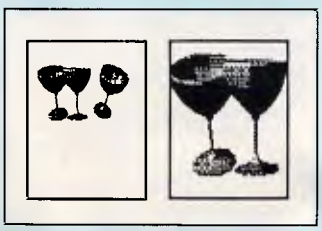
Screen
Grey tone usually identified as a percentage: a 100 per cent screen is solid black; a 10 per cent screen is light grey.

Script
Typeface designed to look like handwriting or calligraphy, such as Zapf Chancery.

Serif
Line crossing the main strokes of a letter.
Typefaces that have serifs include Times, Courier, New Century Schoolbook, Bookman, and Palatino. See also Sans serif.

ABCDEFGHIJKLMN
OPQRSTUVWXYZ
abcdefghijklmnopqrst
uvwxyz
PALATINO

Size
To make a graphic image smaller or larger on a page.

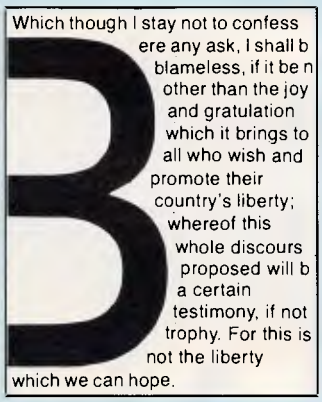


Style
One of the variations within one family of typeface, such as roman, bold, italic, outline, and shadow.

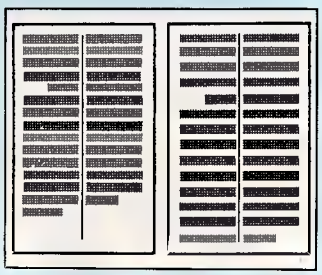
Style sheet
A collection of type specs and format definitions that can be saved and used in many different documents.

Text-only document
Text saved without any type specifications or other formatting.

Text wrap
The ability to wrap text around graphic images on a page layout. Some systems have an automatic text-wrap feature that will shorten lines of text when a graphic is encountered. In other systems, you need to change the length of lines by changing column margins or by inserting hard carriage returns to shorten lines.



Vertical justification
The ability to adjust the spacing between lines of text (leading) in fine increments so as to make columns end at the same point on a page and have pages end at the same point across a layout.



WYSIWYG
'What-You-See-Is-What-You-Get', or 'whizzywig', is a term used to describe systems that display full pages on the screen with text and graphics.

The term is also used to describe a word processing program whose screen display attempts to represent the appearance of the printed documents.

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Whether you're a novice or a seasoned pro TAS – Plus is the product that meets your needs no matter your experience or requirements.

Database

- Save up to 65,000 records in one file (limited by disk space and operating system).
- Find any record in a file in less than 3 seconds.
- Number of fields per record is limited only by operating system.
- Up to 254 characters per file.
- Up to 16 files open at same time.
- Up to 16 key fields per field.
- Up to 10,254 characters per record.
- Field type may be alpha, numeric, date or time.
- TAS – Plus Data Dictionary maintains all data file structures in one handy location.
- Dates use only 4 characters of storage.
- Numeric fields stored in BCD format (a 10 digit number uses only 5 characters of storage).
- Numbers can be up to 20 digits long and have up to 8 significant digits to right of decimal place.
- Print reports to screen, printer or disk.
- TAS – Plus program can exchange standard ASCII data with other programs. Convert Dbase III data files to TAS – Plus and vice versa.

Procedural Language

- Up to 4,500 command lines per program.
- Up to 255 named fields per program.
- Key files not counted as open file. All data file keys stored in one index file (opened automatically with data file).
- Powerful B-TREE file structure allows you to search on any one of 16 key fields per record without sorting.
- Up to 16 screen/report formats per program.
- Allows numeric and string arrays of up to 255 elements each.
- Gosubs may be nested 10 deep.
- Up to 10 nested parentheses per expression.
- Structures may be nested 10 deep.
- True recursion capabilities (subroutine can call itself).
- If command allows true if/then/else programming.
- If comparison types include less than, less than or equal to, equals, equal or greater than, greater than, and not equal to.
- Multiple company capabilities allow up to 1,369 different sets of data files to be accessed by the same programs.
- TAS – Plus has 86 commands (plus several options on many commands).
- Supports date and time arithmetic.
- Context sensitive help messages are easily added to applications.
- Find command can search for exact match, partial match, next record, previous record, beginning of file, end of file or related field between two files.

Compiler

- TAS – Plus compiler converts TAS applications into fast running pseudocode (executable by TAS – Plus run-time).
- Automatically checks program for syntax errors and command usage problems as it is compiled. Helps catch "bugs" before they become problems.
- Automatically checks to make sure files used exist in data dictionary or are defined in application.
- Compiled run-time programs are automatically compacted so they take up less disk space.
- TAS – Plus allows you to create run-time versions of your applications that are separate from the source code (perfect for program developers who intend on selling finished products).

Screen Painter

- Create screens that will look identical to your applications.
- Easily add color or graphic characters to your screen by making menu choices.
- Automatically create programs by "painting" the screen and allowing TAS – Plus to write the program.

Source Code Editor

- Displays all TAS – Plus commands in plain English.
- No need to memorize difficult syntax. The Editor displays all options and makes sure you make all required entries.

Report Writer

- Create and run reports quickly and easily.
- Columns can be totalled.
- Up to 10 different fields may be used as selection criteria in each report.
- Reports may be run over again and again.
- Report programs can be modified using the source code editor.

Other Utilities

- Browse utility lets you display 10 records at once, choosing which fields and in which order to display them.
- Maintain database lets you add change or delete records in a file.
- Create database adds a new database definition to the TAS – Plus dictionary and allows immediate entry of data.
- All utilities are menu driven and require no programming knowledge.

The Accounting Solution

Now solved is the problem of rigidly fixed off the shelf software. Source Code and the powerful TAS – Plus Developers Database are included – so programs can be easily modified as your needs change. Single and Multi User.

Modifiable Accounting

Includes General Ledger, Accounts Payable, Accounts Receivable and TAS – Plus Developers Version. Source code included.

Advanced Accounting

Includes all in Modifiable Accounting plus Sales Order, Purchase Order, Inventory, and Pay Roll. Source code included.

Developer's Version

For those who need even more power, there's the Developer's Version of TAS – Plus Relational Database. It offers everything that the standard package includes, plus a Programmer's Toolkit. It's the perfect addition for those persons developing sophisticated applications.

The Programmer's Toolbox allows the user to access features not normally available on a database/language. Primary among these are the ability to access additional blocks of program memory (up to 96K), to access files using variable file numbers (even if file names are unknown), and to directly control the memory stack (pop the stack). You can also have up to 17 million records per file and 32 Indexes per record.

Developer's Version also includes a Trace Utility that lets you place break points in your source code (for easier debugging). The Trace Utility includes: set break points, examine/change field value, and single step execution and Enter other character to continue normal operations.

For those who want to use a standard ASCII editor, the Developer's Version provides a complete cross listing of TAS – Plus commands plus a straight forward method of manually writing code. This includes a way of incorporating both screens and reports into the actual code.

Developer's Version includes these additional commands:

binary character
close variable file
display memory
file name search
fill memory
find rec var file
memory ptr update
memory space update
move string
open variable file
pop stack
print screen
ready find field
trace enable

TAS – Plus Commands

The TAS-Plus language commands are listed below in alphabetical order:

bell
clear array
clear buffer
clear line
clear screen
close non-tas file
close tas file
company code
compile program
cursor on/off
date
define field
delete record
delete file
display array
else
enter
equals
equals active
records
equals day
equals location
equals month
equals portion of
equals record num
equals size
equals total
records
fill field
find record
for/next
get character
get field from buffer
gosub
goto
if
if carriage return
if duplicate
if rec not found
initialize file
justify field
line label
menu
mount
on value
open non-tas file
open tas file
print chr$
print black lines
print box
print message
print on
print outside window
print report line
print set
print vertical tab
put field in buffer
put portion of
read non-tas rec
redisplay screen
reenter field
remark
rename file
return
reindex
file
run dos command
run non-tas program
run tas program
save record
save screen
screen lock/unlock
scroll
set color
set file active
set video highlight
set video normal
set video reverse
structure start
structure stop
time
top of form
trap
trim field
upcase field
while
window
wrap print
write non-tas rec

TAS – Plus	$199
Developer's Version	$569
(Multi user $869)	
Modifiable accounting	$999
(Multi user $1,299)	
Advanced accounting ...	$1,429
(Multi user $1,729)	

TAS – Plus comes with a 30 day money back guarantee (less $25 handling fee). TAS – Plus is available for the IBM PC/XT/AT and compatible computers.

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Signature

Name:

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THE FOLLOWING ARE REGISTERED TRADEMARKS OF THESE COMPANIES: TAS – PLUS, THE ACCOUNTING SOLUTION, BUSINESS TOOLS, INC.: IBM PC/XT/AT, INTERNATIONAL BUSINESS MACHINES CORP.

frame that contains a figure to the text that refers to it. When edits to the text force the figure reference to move from one page to another, the frame containing the figure will automatically move to the appropriate page.

Document management

A Ventura 'document' is composed of many different disk files. Text and graphics, page layout information, the style sheet and the font width tables, for instance, are all stored as separate files. One advantage to this approach is that you can edit the graphics using a graphics package or edit the text using a word processing program, and the changes that are made in the separate files will be reflected in the Ventura document. Conversely, any edits that are made to the text directly through Ventura are automatically reflected in the separate text file.

On the other hand, this approach makes managing files for a large document a formidable task. The task is complicated by the fact that you cannot simply copy all related files from one disk drive to another: if you assemble your document from files on drive C:, for example, then copy all of the files into drive A: or D: Ventura will still look to drive C: when you open the document in drive A: or D:. The solution is to use a 'save as' operation on each element from within the document, though this can be a time-consuming approach if your document is composed of many different files. Fortunately, Ventura allows you to create a single print file that you can copy to a floppy disk and transport from one machine to another easily, though you cannot edit this file directly.

Whether your text has been imported or typed into Ventura, it is automatically formatted in the typeface and paragraph format that you've defined in your style sheet for 'body text', although settings for bold, underscore, and italic text will be preserved from supported word processors.

One of Ventura's most powerful features is its ability to create style sheets, which allow you to define character and paragraph formatting that will apply throughout a document. Once a style sheet has been created and saved, you can use it in any number of documents. The package also gives you the option of marking text, which doesn't have to be contiguous, to change its type specifications or paragraph format.

You can format text in any size up to 254 points (for printers that support that range) and choose from a wide selection of typefaces that come with Ventura. You can also customise the list of typefaces, sizes, and styles available by loading a 'width table' which gives Ventura information about the width of each character in each font used in the document. This data determines how lines break throughout the text and is used for displaying the text on the screen.

Although the number of typefaces, styles, and sizes available at any one time will be determined by your printer, Ventura includes a number of downloadable fonts for the Hewlett-Packard Laserjet Plus. Version 1.1 eliminates 1.0's built-in limit of eight typefaces per document (or per width table). Ventura also lets you use Hewlett-Packard SoftFonts, Adobe PostScript fonts, and fonts from Bitstream. (Xerox has signed an agreement with Bitstream whereby owners of Ventura Publisher can buy Bitstream's Fontware library of typefaces at a discount. Details of Australian distribution will be available shortly.)

Typographic features

Ventura's typographic features are very flexible. You can adjust line spacing, or 'leading', in decimal increments of inches, points, or centimetres. Version 1.1 lets you adjust the position and thickness of underscores and strikethroughs. You can define the spacing between paragraphs and force headings to start at the top of the page or the column. An automatic widow and orphan control feature lets you define the minimum number of lines allowed when breaking a paragraph across a column or page.

Version 1.1 allows you to control the spacing in justified text by setting the size of the maximum, normal, and minimum space between words. You can adjust letter spacing on three different scales. Using the automatic kerning option, you can activate Ventura's built-in formulae for bringing certain pairs of letters closer together. A letterspacing option reduces the visual impact of loose lines (lines with too much space added between word as part of the justification process) by adding space between letters in increments of hundredths of an 'em' space (a horizontal measure that is equivalent to the vertical height or point size of the type). A tracking adjustments option lets you expand or contract selected text.

Ventura offers automatic page numbering. It will also automatically include a page number, the chapter number, and section name in a header or footer. Ventura Publisher's built-in hyphenation dictionary supports English, French, Spanish, and Italian, allowing you to hyphenate two languages in the same document. You can even limit the number of lines that are hyphenated in a row.

Ventura's built-in graphics are also very flexible. The graphics mode allows you to draw lines, boxes, and circles anywhere on the page using standard click-and-drag techniques.

You can assign ruled lines above, below, or around text by making the lines a part of the frame definition or a part of the paragraph tag. For example, you can draw a box around a frame that holds either text or graphics, or you can create a ruled line above every heading by that part of the style sheet's definition for that heading. This last feature is especially convenient for keeping ruled lines with the headings when the text moves as a result of edits or format changes in the document.

Frames, paragraphs, and drawn boxes can be given a fill pattern or background through a menu selection. You can set the line width and space above or below the ruled lines in decimal increments. The ruled lines that were set up as a frame or tag setting had to be either frame-wide or column-wide in Version 1.0, but in Version 1.1 you can set custom line lengths.

You can import both bit-mapped images and object-oriented line art into Ventura from a variety of outside sources. You can scale imported graphics to any size by dragging a corner of the frame that holds them. Version 1.0 lets

At a glance

Ventura Publisher, Version 1.1
Supplier: CO-CAM Computer Services
Tel: (02) 221 5755
Price: $1750
Requires: 512k RAM (640k RAM recommended), 10Mbyte hard disk, mouse, DOS 2.0 or later.
In short: Ventura offers a wealth of controls and options, including flexible and comprehensive style sheets and the ability to edit text throughout the production cycle. However, it is more difficult to learn than any of the other packages. Not copy protected.

Kaypro Computers Announces the KAYPRO 386.

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Thanks to its Intel's 80386 microprocessor, the KAYPRO 386 runs most popular software two to three times faster than the 8 MHz PC/AT.

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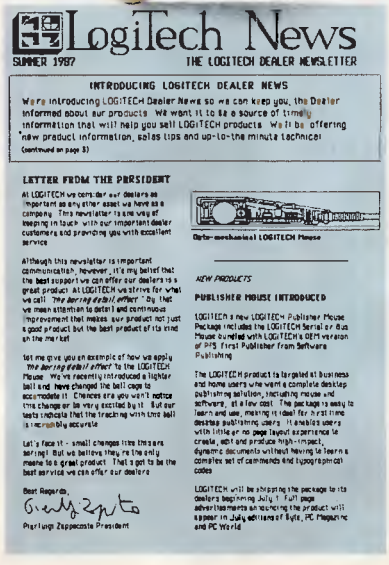
LogiTech News

SUMMER 1987 THE LOGITECH DEALER NEWSLETTER

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We're introducing LOGITECH Dealer News so we can keep you, the Dealer informed about our products. We want it to be a source of timely information that will help you sell LOGITECH products. We'll be offering new product information, sales tips and up-to-the minute technical

(continued on page 3)

LETTER FROM THE PRESIDENT

At LOGITECH we consider our dealers as important as any other asset we have as a company. This newsletter is one way of keeping in touch with our important dealer customers and providing you with excellent service.

Although this newsletter is important communication, however, it's my belief that the best support we can offer our dealers is a great product. At LOGITECH we strive for what we call "the darning drill effect". By that we mean attention to detail and continuous improvement that makes our product not just a good product but the best product of its kind on the market.

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SCREENTEST

Amiga WordPerfect

The lack of decent business software for the Commodore Amiga, coupled with the success of WordPerfect on the IBM PC, has prompted the WordPerfect Corporation to launch an Amiga version of this creditable word processor. Robert Schifreen indulges in some word play.

I should start this review by putting my cards on the table. I've been using the IBM PC version of WordPerfect for a couple of years now, and I wouldn't be without it. Not because it's faultless, but because I've used it for long enough to understand its idiosyncrasies; furthermore, it does almost everything I want it to.

The average Amiga owner won't have such a problem finding the ideal word processor as I did early in 1985. The majority of software houses saw Commodore's launch as the introduction of the world's best games machine, and hurriedly started to port their Commodore 64 software across. The WordPerfect Corporation, in the States, saw what was happening and decided that it would be worth rewriting its best-selling word processor for the new machine. The software is now available, and the company's thinking seems to have paid off — it now has the only decent Amiga word processor, and all those people who were taken in by Commodore's early advertising at last have a reason to put away Marble Madness and use the machine for something more productive.

The obvious sign that development of Amiga WordPerfect began some time ago is that the version of the software is 4.1. On the IBM PC, we're up to 4.2 and there are already rumours of a version 5. If everything were written in a high-level language like C, conversion would be easy; but the WordPerfect Corporation writes everything in machine code for speed, so it's forgivable that the company doesn't churn out new versions at the same rate that Rainbird brings copies of The Pawn into the world.

The main differences between version 4.1 and 4.2 on the IBM are a few corrections to the spelling checker, the rearrangement of some menus, and improved cursor movement routines. The only point you should bear in mind if you use 4.2 on a PC and 4.1 on an Amiga is that the rearranged menus may prevent you from using macros interchangeably.

Like the PC version, Amiga WordPerfect comes in an IBM-like box. This contains a glossy 600-page ring bound manual and four disks — none of which is copy-protected. The 'Learning' disk contains copies of all the example files that the tutorial chapters refer to, as well as a machine-readable version of the manual for a program (supplied) to define your own printer driver.

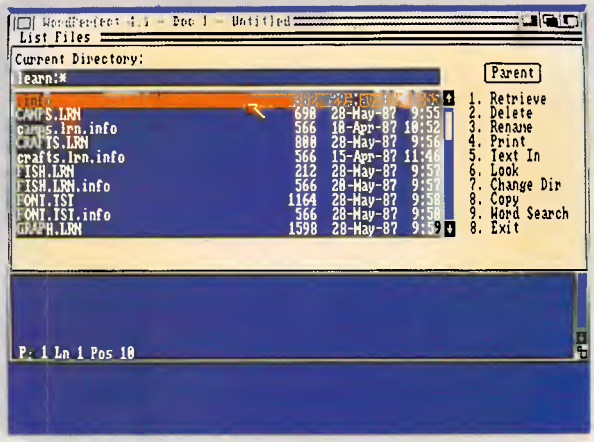
The 'Print' disk contains a couple of huge files which make up the system's entire library of printer drivers. The data for your particular printer is extracted from here and is copied to the working disk when you initially set up the system, so you won't need the Print disk unless you change printers or want to do fancy things with new fonts.

The third disk contains the spelling checker and thesaurus data — one file for each.

The remaining disk contains the WordPerfect program and enough of the Workbench system to create a bootable WP disk on an Amiga 500 that already has Kickstart in ROM. For those who don't know (or care) how the computer actually works (you 'eard about the bloke who thought a 4GL was a top-of-the-range Mazda?), this reduces to a minimum the time it takes to get the program working. Allowing software vendors to give away bits of Kickstart (the operating system) and Workbench (the desktop manager) was one of Commodore's better decisions.

SCREENTEST

WordPerfect has a dual-function 'Help' facility. If you need help on a particular subject, you type the initial letter. Alternatively, pressing a function key gives information on what that particular key does



The thesaurus is summoned by pressing Alt-F1 and will give you a list of synonyms and antonyms of the word currently under the cursor. Many of the words in the list can then be looked up again automatically

WordPerfect requires 512k of RAM and, officially, two floppy drives or one floppy and one hard disk. Although the program runs as a task and you can have multiple CLI (command line) windows, you can't have more than one copy of WordPerfect running at a time.

If you follow the manual's installation advice, you can then start WordPerfect by either clicking an icon from the Workbench or typing 'WP' from the CLI. To preserve precious disk space, I removed the Workbench (and the 'LOADWB' command from the start-up sequence file) and started everything

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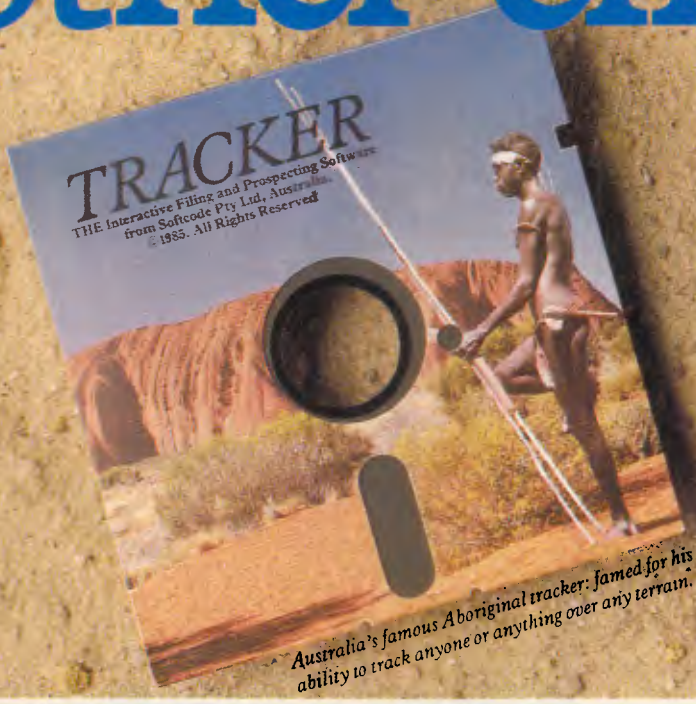

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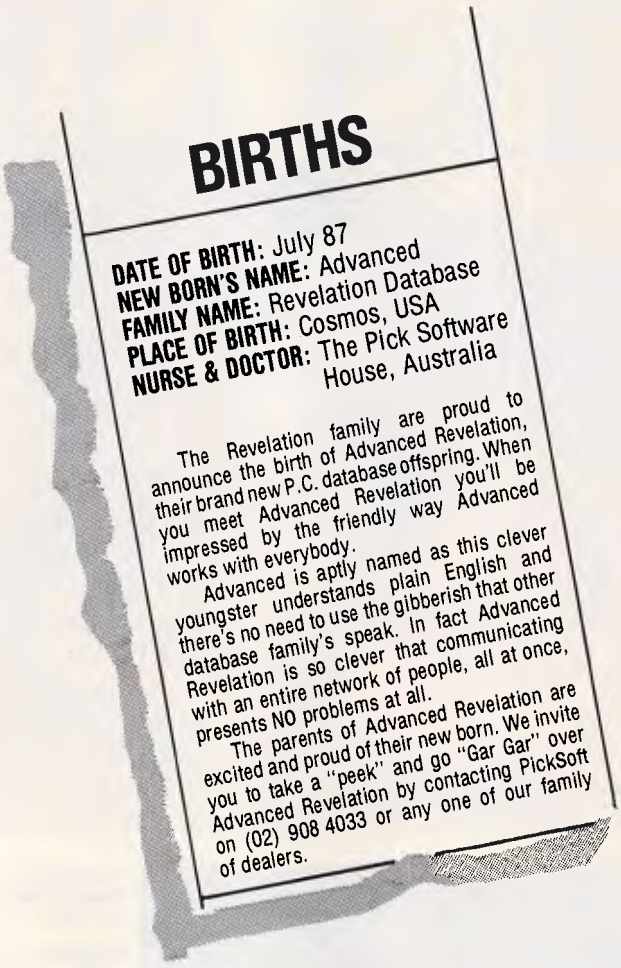

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from the CLI. This is a more flexible approach, since some options — such as initial configuration — have to be started from the CLI anyway, so you can type 'WP-S' (for set-up) rather than just 'WP'.

You will have to run the set-up program at least once, in order to adjust the default margins, line spacings, and so on, to your personal preferences. You can manually override them each time you create a document, but it's easier not to.

You will also have to select one of the dozens of printer drivers. Most of the popular printers are supported, including the Amiga printer, the Epson range, a number of laser printers, and a plain ASCII one that will ignore any fancy control codes.

In use

The WordPerfect Corporation has a much-publicised policy which applies to its entire PC software range: to keep the entire screen clear of unnecessary text and leave as much space as possible for the user. WordPerfect on the PC, for example, takes just half of the bottom line to show the current document, page, line and column positions, and the rest of the screen is clear. Unfortunately, the Amiga version has to take the top two lines of the screen to fit the window's title, and requires a scroll bar down the right-hand side. However, there is still room for 28 lines of text — four more than on a PC with a standard colour or mono monitor.

On the IBM PC, WordPerfect allows you to have two documents open at a time. The 'Switch' key (Shift-F3) opens the new window (actually a full screen) and the indicator at the bottom of the screen says 'Doc 2' and not 'Doc 1'. Where memory permits, the whole of a file (or two files, if you're using the double-document feature) is kept in RAM. As memory fills up, two temporary disk files are opened for each window — one to spool out everything above the cursor, and one for everything below. As you move the cursor up and down the document, so the necessary part of the RAM-based text is spooled out and any required text is spooled in from the other file.

On the Amiga version, you can have up to 32 documents open at a time. Quite why any sane person would want to perform this amazingly reckless feat escapes me, although I suppose it's nice to have the option if you want it. With 64 temporary disk files in operation, though, the Amiga's disk-handling system must get rather overworked, if not totally confused.

One point worth noting is that, in order to cope with 32 documents, the RAM buffer is set to 16k per document. This means that, even if you only have one document open, only 16k of it will be kept in RAM and disk spooling will take place if the file gets any bigger. You can change the figure of 16 through the set-up menu, and it's probably a good idea to do so if you plan to have only a couple of files open at a time.

Further examples of the way in which WordPerfect likes eating disk space when you're least expecting it is the 'Timed Backup' facility. If it weren't so amazingly useful (it's saved *my* life more than once) I wouldn't use it, but it is and I do. You give the system a number of minutes — say, 15 — and every 15 minutes your document is backed up to disk so that it can be recovered in the event of a power cut or system crash. The system also creates 'BAK' files (which it prefers to call 'BK' files) that contain a copy of the document as it stood immediately before you started to edit it.

Making choices

Across all the machines on which it runs, WordPerfect obtains commands from the user via the machine's function keys in combination with 'Ctrl', 'Alt' and 'Shift'. No-one denies that these commands are harder to learn initially, as 'Ctrl-S' is easier to remember than 'F7' as the command to save a document. For those used to a PC, all but one of the function key combinations still work, although most can now be achieved with the mouse if you prefer.

A pull-down menu bar at the top of the screen replaces the function keys, and blocks of text can be defined by holding down the left-hand mouse button while gliding the rodent over the block. It would be wonderful if you could then pick up a block of text and drag it to its new position. You can't.

If, like me, you prefer to keep your hands on the keyboard, pressing various combinations of 'Home', 'PgUp', 'PgDn' and the arrow keys will move the cursor to the top and bottom of a document, page or screen, or around in steps of a character or word.

Owners of the Amiga 1000, whose keyboards don't have such keys, are provided with small stickers to show the alternatives used.

WordPerfect for the Amiga has the best online 'Help' facility I've seen on any piece of software. If you press the

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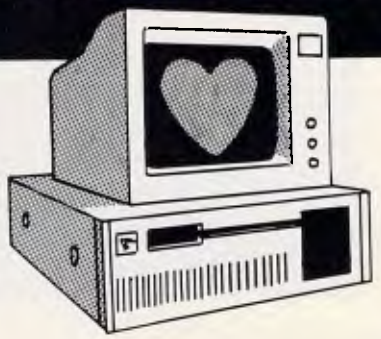

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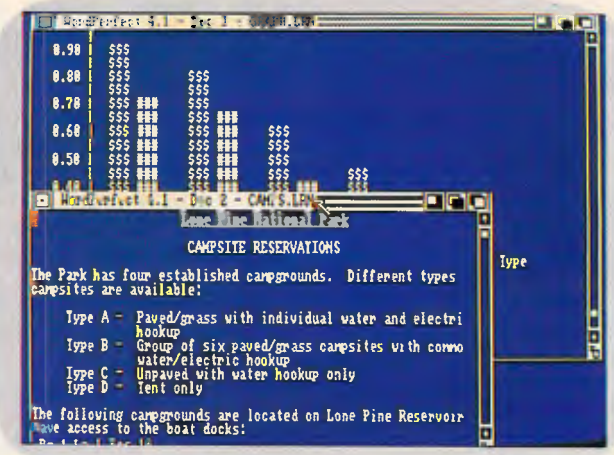
The function keys, in conjunction with Ctrl, Alt and Shift, are used in the same way as on the IBM PC version of WordPerfect. But if you'd rather make use of the mouse, a pulldown menu line at the top of the screen enables you to perform the same functions. You can also mark and move blocks of text with the mouse



On the IBM PC, WordPerfect allows you to have two documents open onscreen at a time. On the Amiga version, this figure is increased to 32. Consequently, the size of each document which can fit into the Amiga's RAM is reduced and disk-to-memory swapping becomes necessary for this to happen

'Help' key, followed by one of the function or cursor keys, a screen of information tells you everything you ever wanted to know about that particular key and how it is used in every part of WordPerfect. Alternatively, if you know what you want to do but don't know which key to use, press Help, followed by the first letter of your intended task, and the relevant part of a complete alphabetical help index is displayed.

Because the Amiga has a Help key, function key F3 (which produces the help information on a PC) is now free to provide italics. On the PC, italics can't be selected from the function keys (unlike bold and underlined, which can) but must be installed and summoned as an alternative printer font.

Despite the Amiga's lack of real-'text' mode, and the fact that everything has to be bit-mapped, I was impressed at the speed of the system. Typing at my fastest, and not checking too hard for mistakes, the screen kept up with me all the time. Scrolling was faster than on the PC I use at home, and almost as fast as my AT clone in the *APC* office.

Like most decent word processing systems, WordPerfect allows footnotes, page numbers, a table of contents and index generation. There's also a mail-merge facility and an outliner. I won't go into detail about any of these facilities, except to say that they exist. Some of the more unusual features include password protection and scrambling of files, as well as an excellent macro facility that can add your name, address and the current date to the top of a letter with a single keystroke.

Like the IBM version, there is a great degree of WYSIWYG (what you see is what you get) to the Amiga's WordPerfect. The only exception is that text on the screen is not right justified, although it will be so on the printer (unless you have switched off the justification facility). The WordPerfect Corporation says that screen updating would be too slow if the program had to rejustify the document each time a word was changed on the screen.

Not cluttering the screen with unwanted information and menus is one way that the software keeps the screen free for typing by the user; the other way is the lack of visible control codes onscreen. You can usually determine whether a control code is there because any text after it will be affected: for example, it will be bold, underlined, double-spaced, have a smaller margin setting, and so on. If you want to see the codes and their exact location, a special 'Reveal Codes' command splits the current screen horizontally, showing the normal text above and the same passage complete with interspersed commands below.

You can flick back and forth between the two windows, and any alteration made in one will apply to the other. You could, for example, remove the underlining from a passage of text by deleting the '[U]' command tha precedes it. The '[u]' *after* the text will automatically be removed by the system.

It's also possible to make control codes the object of 'Search' and 'Replace' commands.

WordPerfect includes a built-in file manager, which presents you with a list of the files on a disk. Having used the mouse or cursor keys to select one file, you can copy or delete it, print it, load it into WordPerfect, view it without loading it, and other things besides. Perhaps the most useful file manager facility is its ability to look through a group of selected files (or every file on a disk) and reduce the onscreen list to just those which contain a selected word or phase.

I like the way WordPerfect handles blocks of text. If you mark a block, either with a keyboard or the mouse, any function which normally applies to the whole document will operate only on the marked block. This includes the spelling checker and word counter, saving, printing, deleting, and so on, and means that you have only one set of commands to learn.

There is a maths facility but you have to explicitly switch on 'maths' mode when you want it, and arrange columns of figures neatly in such a way that you have to know in advance whether they are to be added up, subtracted, or whatever. You can't just highlight a block of numbers as you would a paragraph of text and say 'add these up'.

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Spelling checker & thesaurus

A spelling checker and a thesaurus are included as standard in the Amiga version of WordPerfect. Each has a separate data file, although both live on the same floppy disk or the hard disk if you have one. If you have two floppy drives and use one solely for data, you will have to swap disks before using the spelling checker or the thesaurus.

The spelling checker doesn't work as you type, but operates on a document (or part of one) that is already in RAM. It has a dictionary of over 100,000 words, and also detects double words. After the check, which can span a word, page, document or marked block, you are given a word count. Spelling is checked both by letter-matching and phonetically. This increases the program's chance of guessing a word but it does mean that some guesses appear twice in the list, as they are generated first by the letter-matching part of the program and then the phonetic routines. Removing duplicates has been judged too time-consuming by the WordPerfect programmers in the US.

For reasons best known to itself, the WordPerfect spelling checker regards a word with a number in it as being an error and gives you the option of correcting it, leaving it, or ignoring all words containing numbers for the remainder or the document. You can't add the word to the supplementary dictionary, which means that, taking this review as an example, the spelling

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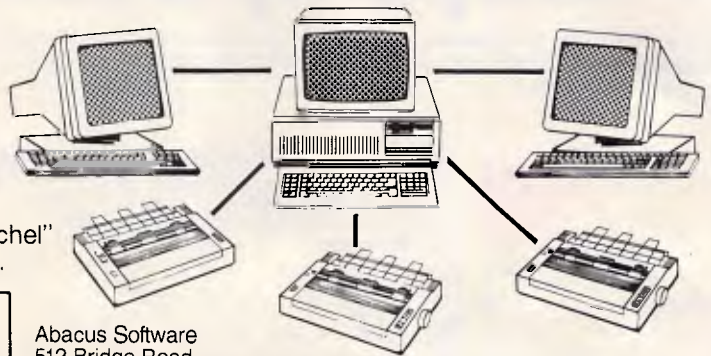

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The XT Compact handles a 1.2MB Floppy and is supported by a high speed 8088 16 bit micro-processor, which is 2.1 times faster than PCXT. With an optional NEC V20 processor, speed can be enhanced to 3.7 times faster than others.

A unique front panel switch facilitates selection of either turbo or standard speed at ease.

With our computers it is possible to mix and match with a variety of floppy drives. We even handle 3½" floppies.

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Datamini WINS!

Portable

This is truly an innovative portable PC with many outstanding features.

Like the Desktop range, the DATAMINI PORTABLE is available as the AT TURBO and XT TURBO.

The PORTABLE AT TURBO houses a 10MHz 80286 CPU with an optional 80287 co-processor.

Similarly, the PORTABLE XT TURBO runs at an incredible clock speed of 10MHz with an 8088-1 CPU. An optional 8087-2 co-processor enhances numeric computation. A NEC V20 IC further enhances processing speed.

The DATAMINI PORTABLE range comes with a built-in 9 inch Dual Frequency high resolution monitor and a 84 Key PC AT/XT compatible keyboard.

Secondary storage is virtually unlimited as it can support up to two Floppy Drives and one hard disk.

Port. XT	$1890
with 20 MEG HDD	$2580
Port. AT	$2990
with 20 MEG HDD	$3470

Parts are innovatively laid out with room for expansion

W 480 mm D 460 mm H 190 mm

DATAMINI DESKTOP AND PORTABLE COMPUTERS

SPECIFICATION	AT TURBO	XT TURBO
Main Board	16-24 Bit Microprocessor 80286 (10 MHz) CPU with Socket for optional, 80287 Co-Processor Expandable to 1MB Memory on board 8 Expansion I/O Slots (6AT & 2XT slots) 32K ROM BIOS, Expandable to 64K	**High speed 8088-1 16 Bit Micro-processor** **8087-2 co-processor (optional)** **10/4.77 MHz dual speed selectable** **640 byte RAM on board** **8K ROM BIOS, Expandable to 40K** **4 LAYER BOARD** **8 I/O PC Compatible Interface Slots.**
Colour Graphic Card	RGB Director and Composite Video 15.750 KHz Horizontal Scan rate Display 25 Rows by either 40 or 80 Characters with 5 x 7 Character Matrix Graphic Mode: 640 x 200 Addressable Dots	
Monochrome Graphic card (in place of colour graphic card)	TTL Positive Video Output Display 25 Ros by 80 Character Text with 9 x 14 Character Matrix 64 KB Screen Memory for Graphics and Text Graphic Model: 720 x 348 Addressable Dots Support Graphic Software eg: Lotus graph, Frame work graph, AutoCAD, Paint Brush Build in Parallel Port	
Serial Parallel Adaptor	RS232 Port (9 Pin OUTPUT) IBM PC Parallel Standard	On Multi I/O Card
FDD/HDD Adaptor	Supports 2 Floppy Drives (1.2MB & 360KB) and 2 Winchester Disks	
Floppy Disk Drive and Hard Disk	One 1.2MB 20 MB Hard Disk (Optional)	Two 360 Byte Teac Drives 20M Hard Disk (Optional)
Key Board	84 Keys PC XT/AT Compatible with "Click" Feel Enlarged RETURN and SHIFT Keys	
Multi-I/O Card		Real time clock/calendar Serial Ports which can be configured for COM1 & COM2 Centronics Parallel Printer Port operates as Lpt 1 & 2 Game Paddle Joystick Interface Utility diskette for real time clock setting and RAM DISK configuration
Power Supply	Input: Ac 90-130V/180-260V. 50 to 60Hz Power Output: 200W, Support 2 Floppy Drives and 2 Hard Disks	

Licensed **BIOS & MS-DOS, 12 months warranty.**

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V21AA 300 BPS FD Auto Ans.	$280
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1275 INT-Internal Modem V.21, V.23, Bell 103, Auto Dial 300 FD, 75/1200 (Viatel)	$460
321AD 75/1200 (Viatel), 300 BPS FD 1200 HD & FD, Auto Dial, Ans. Disc. V.21, V.22, V.23, Bell 103, 212A	$790
321Ad INT. Internal 321 AD Modem	$790
V22 1200 BPS FD, Auto Ans	$590

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DTX 14"n TTL	$240
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DMC MD3 Color	$620

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Star SD15 160 CPS	$750
Star NX-10 120 CPS	$490
Star NX-15	CALL
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Datamini Desktop XT	$1495
AT	$2470

CPC 10 - XT/Turbo 10 MHZ $1250
Same specification as Datamini XT
BUT: 150W P/supply, STD. 'AT' Type
Keyboard MS-DOS - Optional
Floppy drives-Mitsumi-Japan

CPC XT/TURBO 8 MHz $1090
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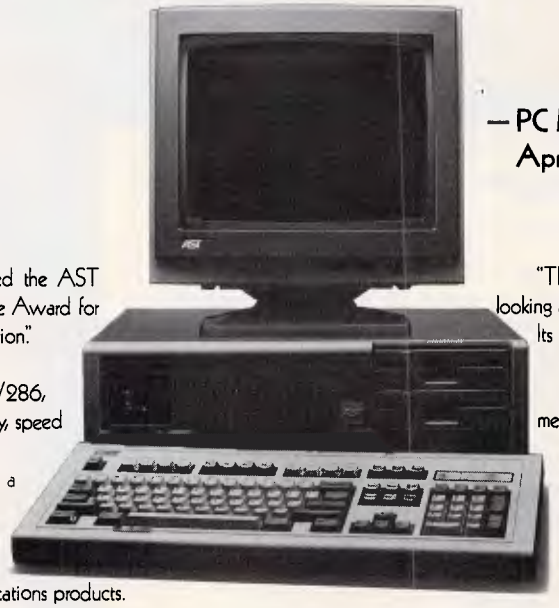
PC MAGAZINE EDITOR'S CHOICE

"The AST Premium/286 rates as what may be the best designed and built AT compatible on the market today."

— PC Magazine, April 28, 1987



Recently, PC Magazine awarded the AST Premium/286 with their Editor's Choice Award for its "winning price/performance combination."

We weren't surprised

When we designed the Premium/286, we built in uncompromising compatibility, speed and power.

But, that's not all. We also built in a commitment to quality.

The same quality that has been the trademark of our complete line of exceptional enhancement and communications products.

So, when it comes time for you to make a decision about buying a personal computer, you might want to remember what PC Magazine had to say about the Premium/286.

"The Premium/286 is without a doubt the best-looking and best-performing system with a 10MHz rating. Its quality makes its price a bargain."

"Workmanship is clearly top-notch."

"The AST Premium/286 uses a unique memory configuration to gain top honors in RAM access time."

"Overall, the AST Premium/286 rates as what may be the best-designed and built AT compatible on the market today."

AST's incorporation of "FAST slots" into the unique architecture of the Premium/286 gives true zero, wait state memory.

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CPU measures main processor performance relative to the 6MHz (Model 099) IBM PC AT. Hard disk performance is tested for sequential and random data access.

System (Clock speed in MHz/No. of wait states)	CPU	Hard Disk (sequential)	Hard Disk (random)
80286-Based PCs			
IBM PC AT (6/11)	1.00	1.00	1.00
Toshiba T3100 (6/1)	1.36	0.50	0.68
IBM PC AT (8/1)	1.37	1.17	1.40
Televideo Telecat 286 (8/1)	1.71	1.70	1.07
IBM PS/2 Model 60 (10/1)	1.72	2.02	1.67
Sperry Micro IT (8/0)	1.80	1.32	1.15
Compaq Portable III (12/1)	2.03	1.03	1.86
PC's Limited 12MHz (12/1)	2.08	1.08	1.68
AST Premium (10.0)	**2.25**	**1.41**	**2.12**

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checker would intervene each time I mentioned a function key (F1, F2, and so on) or a memory size (16k).

Words added to the supplementary dictionary are not included as guesses subsequently, and a separate program for dictionary maintenance is included in the program.

The thesaurus is summoned by pressing Alt-F1 and produces a list of synonyms (words with the same meaning) an antonyms (words with the opposite meaning of the word which the cursor is currently on. Each word in the list is labelled with a letter and, like the spelling checker's guesses, pressing the required letter substitutes the displayed word into the document. On average, the thesaurus will find at least half a dozen synonyms and as many antonyms of most words, including lots of computer jargon ones. A fair number of these words are marked with a black blob to show that they can be looked up in the thesaurus by means of another keystroke.

Printer control

When you start a print job, it is put into a queue, and you can carry on using WordPerfect while the print job is carried out in the background. The file that is being printed does not have to be kept loaded — it is copied to a temporary disk file and printed from there.

As each job is added to the print queue on the IBM version of WordPerfect, you have little control over it from that point on. Eventually, depending on the size of the queue, it will appear on the printer, or you can cancel the job if you decide you don't want it to be printed after all.

On the Amiga version, each job is assigned a default priority level of 128 when it is added to the queue, but you can change this to any value between 0 and 255. The higher a job's number, the faster it is printed, so you can bring forward jobs that are near the bottom of the queue if they are required in a hurry.

It is possible to embed printer commands in a document as hidden codes. So, if you didn't want to waste time setting up font definitions, you could have a macro that would embed the necessary ESCape code in a file to put the printer into NLQ mode when you wanted to switch to a better quality font. When I used to write manuals for a living, I set up a system of macros that would embed control codes for a typesetting machine, which allowed me to get a 60-page manual from disk to typeset proofs in about 90 minutes.

Any printer can be installed as a 'print to disk' printer, which means that the file will go to disk and not to the parallel port when printed, but the correct ESCape codes for the required printer will be included in the file for printing later or transferring via modem to a remote printer.

User image

Having highlighted some of the good points of WordPerfect, I should state here and now that this product does have its faults. Being told to 'please wait . . .' every ten minutes while the timed back-up is made is very offputting if you have the next four sentences in your head and want to commit them to phosphor as soon as possible.

The lack of a flexible column mode is disappointing, too. Although the system will cope with tabbed columns — and flowing newspaper ones, too —

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Hercules Runs Your Software

In Monochrome.....

Hercules offers two high resolution graphics cards for IBM PC/XT/AT's and compatibles – the Graphics Card Plus for monochrome monitors, and the new Hercules InColor Card for multisync and enhanced colour ("EGA type") monitors.

Both cards provide features not found on any other graphics card and both run more software at a higher resolution, with better text display capabilities than any other card – monochrome or colour!

The Highest Popularly Supported Resolution

Both cards feature the highest popularly supported resolution – "Hercules" 720x348. More software depends on this standard than any other, because of its crisp graphics display. It's available for the first time for monochrome monitors with the Graphics Card Plus and now in up to 16 colours with the Hercules InColor Card.

At last your favourite Hercules compatible programs like 1-2-3, AutoCad, Microsoft Windows and many more can run in full colour at this high resolution.

Good-bye Driver Worries

Both cards are completely compatible with each other. Any software you run on your Hercules monochrome graphics card will run in two (and sometimes more) colours on the InColor Card without changing the video driver. Most popular software packages like 1-2-3, Symphony, Framework, and AutoCad, which run in full colour on the InColor Card, also use a single unified driver to run on both cards.

So, you can use your entire monochrome software library on a multisync or enhanced colour monitor. Or easily move your software back and forth or network between mono and colour systems.

WYSIWYG... and More

And, of course, both the Graphics Card Plus and InColor Card feature RamFont...Hercules' powerful new mode that lets software display 3,072 software definable characters instead of the fixed 256 ASCII character set. Which means programs like Lotus 1-2-3 can display nearly twice as much data and even gain a pop-up window on the spreadsheet, without losing speed.

Microsoft Word runs up to four times faster. And word processors like Lotus Manuscript require RamFont to display subscripts, superscripts, italics and other attributes in the text processing mode.

But RamFont's power doesn't end there. Using third-party add-on software, most popular word processors can display and print foreign languages, scientific characters, or a wide variety of fonts. Not to mention the new breed of software that will let

Better
.....*In Enhanced Colour*

you combine large type with small type in a variety of fonts and symbol styles at lightning speed.

Two Kinds of Monitor One Brand of Card

So whether you work in colour or monochrome, choose Hercules. We run your software better.

A Few Examples...

Here are a few of the programs that benefit from Hercules 720x348 graphics and/or RamFont in monochrome on the Graphics Card Plus and full colour on the InColor Card. Not included in this list are the thousands of monochrome standard text Graphics programs which automatically run on both cards.

Aldus **Pagemaker.** *Desktop publishing. 8 colour or monochrome 720x348 graphics in Microsoft Windows environment.* Design Board **MegaCADD.** *a CAD program from 16 colours, or monochrome 720x348 graphics. Unified driver.* Ashton-Tate **Framework II.** *Expanded spreadsheet display, speeded up wordprocessor using RamFont. Unified driver.* AutoDesk **AutoCAD, Auto-Sketch.** *16 colour or monochrome 720x348 graphics. Unified driver.* Underware **Brief.** *Program editor uses RamFont for 43 line display.* BPS **35 M.M. Express.** *Slide production program. 16 colour or monochrome 720x348 graphics.* Broderbund **For Comment.** *Editing tool utilizes RamFont for 43 line display.* Computer Associates **SuperCalc 4.** *Spread-sheet. 16 colour or monochrome 720x348 graphics. Unified driver.* Computer Linguist **RussStar,** *etc. Add on programs use RamFont to convert* **WordStar** *to foreign language word processor with screen display and printer support.* Dragonfly Software **Nota Bene.** *Foreign language word processor uses RamFont to display Russian, Hebrew, Sanskrit, etc. with full printer support.* Evolution Software **FastCAD, EasyCAD.** *16 colour or monochrome 720x348 graphics.* Image Processing **TurboFonts.** *Uses RamFont to allow font substitution and printer support for most popular word processing programs such as WordPerfect, Multimate, WordStar, etc.* Generic Software **Generic CAD.** *16 colour or monochrome 720x348 graphics.* GSS **GSS Library.** *Driver library with support for Hercules mono and colour 720x348 graphics.* Javelin **Javelin.** *Integrated software. 8 colour or monochrome 720x348 graphics.* Lotus **1-2-3 Versions 2.0 and above.** *RamFont expands spreadsheet display from 80 columns by 25 to 90x38 (nearly twice data display), 6 colour or monochrome 720x348 graphics or graphic window on spreadsheet.* Lotus **Manuscript.** *Requires RamFont for display of italics, subscripts, etc. while text processing.* Lotus **Symphony.** *Uses RamFont to expand data display from 80 columns x 25 rows to 90x30 with faster scrolling.* Mace Utilities **GRASP.** *PC slide show system. 16 colour or monochrome 720x348 graphics.* Marc Publishing **WordMARC.** *Uses RamFont for display of italics, subscripts, symbols, etc* Metagraphics **Metawindow.** *Turbo-pascal & Turbo C graphics library, 16 colour or monochrome 720 x348 graphics.* Micrografx **In-a-vision.** *Computer aided drawing. 8 colour or monochrome 720x348 graphics in Windows enviroment.* Microsoft **Chart.** *16 colour or monochrome 720x348 graphics.* Microsoft **Multiplan.** *RamFont expands data display from 80 columns by 25 to 90x38 nearly twice data display), with toggle between the two. German and French versions only at this time.* Microsoft **Word (3.1 +).** *RamFont speeds up this program up to 4 times while retaining its impressive on-screen display of fonts and attributes.* Microsoft **Windows.** *8 colours or monochrome any application running under the Windows environment.* Paperback Software **VP Graphics.** *Graphics add-on. 8 colour 720x348 graphics.* Earth Imaging System **Panacea.** *Uses RamFont for geographic maps instead of graphics mode.* Patton & Patton **Flowcharting II.** *Uses RamFont to display flowcharting icons at text mode speed.* Perspective **3D Graphics.** *Add-on graphics package, 16 colour or monochrome 720x348 graphics.* PFS **Harvard Presentation Graphics.** *16 colour or monochrome 720x348 graphics.* San Francisco Design **Alexander.** *Word processor uses RamFont to display special fonts and symbols at text processing speed.* Scroll System **PS Technical Word Processor.** *Uses RamFont to display scientific and technical symbols at text processing speed.* Soft Evolution **SupraFont.** *RamFont font editor.* The Software Group **Enable.** *16 colour or monochrome 720x348 graphics. RamFont for italics and boldface in wordprocessor.* Software Products International **Open Access.** *16 colour or monochrome 720x348 graphics.* Solustan **Qalam.** *Indian language word processor, uses RamFont to display and print 14 dialects.* Stella Systems **Stella Business Graphics.** *16 colour or monochrome 720x348 graphics.* STSC **APL.** *Programming language using RamFont to display special characters required at text speeds.* T&W **Versa CAD.** *8 color or monochrome 720x348 graphics.* Woodsmith **Language Design Kit.** *Font editor and printing support add-on using RamFont for popular ASCII based programs.* ZSoft **PC Publisher's Paintbrush.** *16 colour or monochrome 720x348 graphics.*

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Hercules Graphics Card Plus.
For monochrome monitors.

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you can't define a block of text that starts at column 32, say, and finishes at column 70. If the spelling checker were to realise that some people actually do use numbers in their words, I'd be eternally grateful. Pressing the ESCape key followed by another key repeats the second key eight (or more) times if you've altered the default. This doesn't work with the 'Delete' key because if you press 'Escape' followed by 'Delete', WordPerfect assumes that you want to delete the Escape you've just pressed.

Documentation

The manual for Amiga WordPerfect has been totally rewritten from the IBM version. Although it's still biased towards the use of function keys for control, a column down the side of every page shows you how to achieve the same results with the mouse. Appropriate details have been updated to cope with the Amiga's operating system and 30-character filenames.

There is a 260-page tutorial which takes a couple of days to cover fully, but provides a thorough grounding in most of the package's features. I learned by diving straight into the software, using the online help if I got stuck and using the manual's alphabetical reference chapters when I was totally confused.

Price

WordPerfect for the Amiga costs $595. The IBM version retails for $870 officially, but it's available from many dealers for under $500 and I imagine that similar discounts will be available on the Amiga version if you shop around.

'There's no denying, though, that WordPerfect finally turns the Amiga into a credible business micro.'

Conclusion

The triviality of my personal gripes probably proves why WordPerfect is the best-selling word processor among the PC community. I'd like to think that it will go down as well with Amiga owners, and the almost total lack of real competitors in the market will certainly help it along that route.

However, I can't help wondering exactly who's going to buy this product. At $595 it isn't cheap, and I don't think it's aimed at someone who's just paid $995 for a single-drive A500. The ideal machine to run it on would be an A2000 with a hard disk, although if I had such a machine and had also purchased the IBM-compatibility bridge card, I might well shell out a bit more for the IBM version of the software in order to remain within the standard that governs the entire computer-using business public at the moment. There's no denying, though, that WordPerfect finally turns the Amiga into a credible business micro.

END

WordPerfect is distributed by Sourceware. Tel: (02) 411 5711.

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Q&A Write is Q&A's lightning fast wordprocessor. It zips through writing projects and automates personalised mailings. Q&A Write makes it quick and easy to create, edit, print and check the spelling of your documents. A powerful "wordfinder" thesaurus is also available, providing 220,000 alternatives at a keystroke.

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Note: Q&A Write is now available separately

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Symphony, Lotus 1-2-3, .pfs: File/Write, dBase II and III, IBM Filing Assistant, WordStar, Multimate

Requirements
IBM PC/XT/AT or compatible. 512K RAM, two floppy drives or hard disk. **Note:** 80386 version also available.

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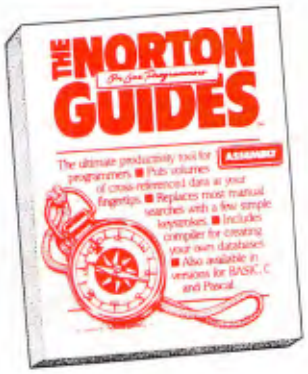

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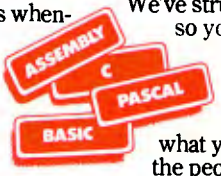

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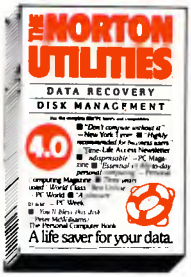

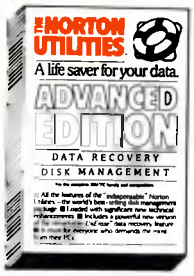

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HyperCard

Marvin Bryan presents a first-look at Apple Computer's latest innovation and gives it the thumbs-up.

(This article is not a Benchtest, but a preview. A full test will be presented in a forthcoming issue of *APC — Ed.)*

The concept of file cards has spawned database software from many developers that does little more than maintain an electronic Rolodex file of names and addresses. Apple Computer's HyperCard does much more: it provides both relational-database capabilities and a novel working environment for the bargain-basement price of $99.

It's so hot that Owl International, a US firm, is already hard at work on a clone to run on IBM PCs; the Owl version will be based on Guide, the firm's hypertext text-retrieval program that runs under the Window's 2.0 graphics environment.

From October, Apple will provide HyperCard at no extra cost to all purchasers of new Macintoshes and, reportedly, plans to incorporate it into the system ROM.

Developed primarily by Apple scientist, Bill Atkinson, HyperCard will store and retrieve text, graphs, illustrations, digitised photos and even sounds, animation and video input. Plus, the cards can be nested many levels deep.

In other words, selecting an option by clicking a button on one of these cards (displayed on a Mac screen) can lead to a subsidiary card with detailed information about the subject chosen; this second card might also contain a new set of options accessed through buttons, icons or scroll bars. The user can individually program all these menu features.

The cards are stored in stacks, giving rise to a new term — 'stackware'. Third-party developers are already offering stackware sets, which offer information retrieval from major newspapers and access to statistical sources under the name Information Access. Other suppliers have announced stackware dealing with business-travel data and educational/trainingsubjects.

Stack sizes

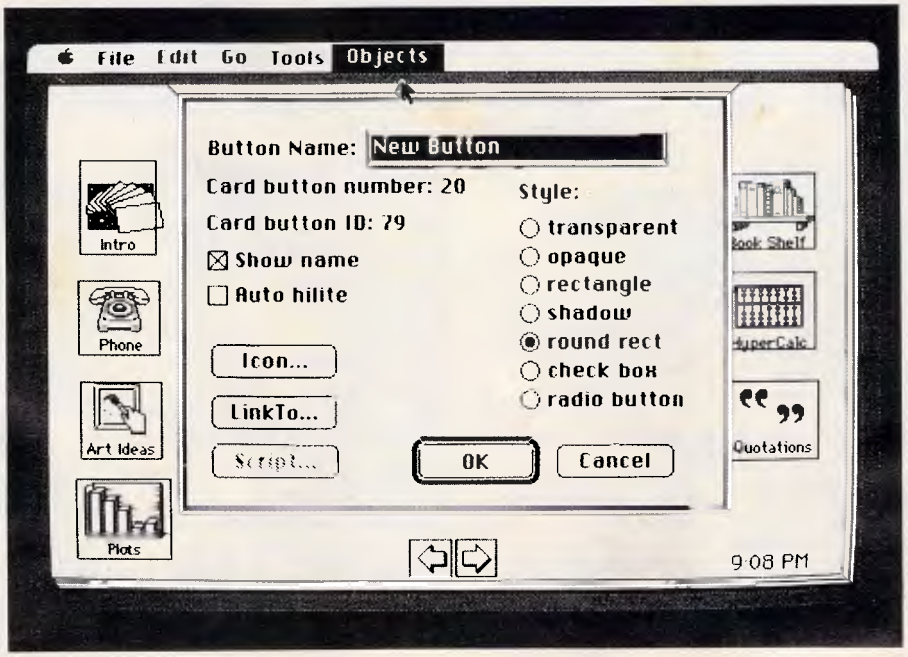
HyperCard requires a Macintosh with at least 1Mbyte of memory and two 800k disk drives or a hard disk. The number of stacks that can be used is limited only by the disk storage available. The maximum size for a stack is an astounding 4096Mbytes.

The program operates in any of five user-preference levels. Each successive level incorporates all the features of the previous levels. The lowest level is Browsing; here the user can look up information and cut-and-paste data of interest.

The default mode, Typing, is the second level; this allows the entry and editing of data in existing fields. Next is Painting, where the user can perform considerable customisation. The fourth level is Authoring, which adds button and field tools to the capabilities available. The highest level is Scripting, which provides full programming powers.

Users can change the preference level by selecting the User Preferences card and clicking on the level desired. User Preferences is always the last card in the current stack and is reached by picking Last from the pull-down Go menu, the principal means of navigating within stacks.

The Home card is the HyperCard equivalent of a main menu. It displays icons for the stacks available and is the starting point for all operations. The 'starter set' of stacks is intended both



With Apple's HyperCard, users can perform many programming functions through menus

as a series of modules that can be changed and personalised for actual use by the purchaser, as well as a library of examples.

Within the library are excellent graphics that illustrate some of the many possible uses of the program. It includes an address stack that serves as the model for a database of frequently contacted personal or business acquaintances, and a dialler for calling them. Another database contains all of the area codes in the United States and Canada. Users can search this database either to find the area code for a particular city or to determine which cities are included within an area code. Unfortunately, there are no plans at this stage to 'Australianise' it.

A monthly calendar stack is tied into the computer's clock, accompanied by a weekly memo book and a things-to-do list. An expense record and a parts catalogue are available for modification. A collection of drawings for inclusion in menus or documents has everything from a sketch of two executives conferring, to geographical maps.

If the prefab drawings won't fill the bill, the user can call on HyperCard's paint tools to draw new images and size, shade, rotate, move or combine them. Graphics can also be imported, including MacPaint files and digitised images.

Called HyperTalk, the programming language included with HyperCard allows users to write scripts that place complicated macro sequences behind buttons or create entire new dialogue boxes and menus. Visual effects such as fades and wipes can be used, and numeric calculations are easily specified. HyperTalk will even control external devices, such as compact disk, read-only memory (CD-ROM) drives, online information services and videodisk players.

An individual script measures up to 30,000 characters in length. There is no limit to the number of buttons allowed or to the number of links between cards.

Strings can be any length, and the contents of any field can be a variable. HyperTalk supports both global variables and dynamically created local variables. Control structures include repeat until condition, repeat with loop counter, if/then/else conditionals, exit loop or procedure and pass message/send message.

Organised in the usual handy Apple format, the spiral-bound HyperCard manual includes an excellent basic tutorial. However, HyperTalk is explained only in an appendix that deals with a small subset of the language. For those wishing more complete information, the HyperCard Script Language Guide is available from the Australasian Apple Programmer's and Developer's Association at the Illawarra Technology Centre. It comes as part of the HyperCard Development Package along with the HyperCard Stack Design Guide for $36; call Tracey Burt on (042) 26 8880 to order a copy.

Using HyperCard is a pleasure. Users can perform many programming functions through selections from menus without knowledge of the HyperTalk language. The Button Info dialogue box is one of the key elements in this process; through it a user can name a new button, given a choice of different styles and shapes, and it's linked to another card to which the user will be taken if the button is picked.

Alternatively, the button can appear as an icon to be clicked on.

A different property

Users can set separate text properties for each field on a card by selecting Text Style from the Edit menu. These properties include the font to be used and its size, style, alignment and line spacing.

A user can create card layouts in a background mode; in this case, the design will serve as a template for a group of cards, rather than applying only to the individual card on the screen.

The Go pull-down menu makes looking for specific information very simple. A Find option will institute a search throughout the current stack for specific letter combinations, words or phrases. Another option — Recent — displays miniatures on the screen of the last 42 cards viewed. Clicking on the image of any card will take the user to it.

The experienced user can press the Command key in combination with a number or letter of the alphabet to provide shortcuts around many menu options.

HyperCard supports both the ImageWriter and LaserWriter printer families and compatibles. Information can be printed with data from the stacks in three formats: columns, rows or labels. The labels choice prints the data in a format suitable for mailing labels.

For reports, users can specify the page-layout form, and can set up a header through a menu option to print page numbers, the date, the current time and/or the stack name at the top of each page.

HyperCard will be a platform for many useful databases from third-party developers, and it can serve businesses in hundreds of ways as they generate their own databases for purposes ranging from inventory management to connecting to their mainframes.

Every Macintosh owner should have this program. Thanks to Apple's current policy, all new Mac purchasers will indeed find HyperCard bundled with their computers.

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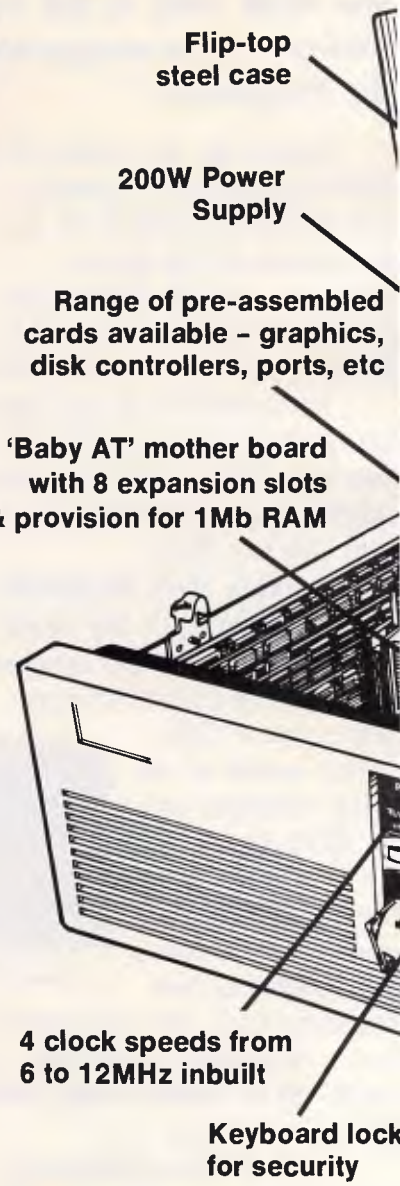

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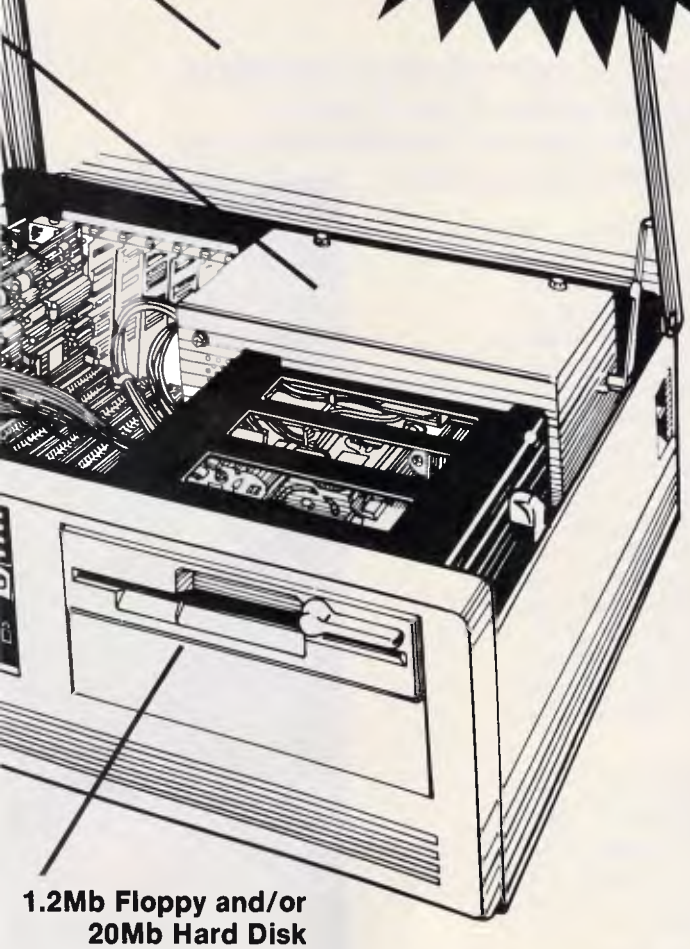

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Power to the Transputer

Although Inmos' Transputer was designed to support parallel processing using communicating chips and, so, will primarily be of use to supercomputer users, Dick Pountain suggests that its ultimate future may lie in enhancing conventional desktop systems.

With the first shipments in April this year of the new IMS T800 Transputer, the saga of Inmos' revolutionary new processor has arrived at the end of Chaper One on a pleasingly upbeat note. The T800 incorporates the chip architecture which Inmos first planned to make several years ago but had to scale down in its early versions. Inmos is back in profit, and has a substantial world lead in the technology of parallel processing.

What exactly *is* the T800 and what makes it so important? At a superficial glance the T800 is a fast 32-bit microprocessor, competing with a number of other fast 32-bit microprocessors such as the Intel 80386, the Motorola 68020, the NatSemi 32032, the Fairchild Clipper, and more. What's more, some will say that the Transputer suffers the disadvantage of not being made by Intel, whose writ rules in the world of personal computing thanks to a little deal it made with IBM some years ago.

This, however, is to miss the point. The T800 is certainly a very capable microprocessor. In fact it is currently the fastest single-chip processor in the world, capable, thanks to its on-chip floating point unit, of performance equivalent to a VAX 8600 supermini. All its competitors require the assistance of external floating point co-processor chips to even approach this performance.

However, the point of the T800 (and indeed of all the Transputer family) is that it was designed from the start to support parallel processing using a large number of communicating chips, and its performance can be extended by stringing more chips together as more power is required. Parallel processing means executing a program on more than one processor, with different parts of the program being executed at the same time, or concurrently. Multi-tasking on a single processor (as happens under Unix or Concurrent DOS) is a different matter entirely: programs only *appear* to run at the same time, as the processor gives a small slice of its time to each one in turn, but the total processing time available for each program is reduced in proportion. On a true parallel computer, adding more processors will increase the execution speed of the program; limited only by our ability to split the algorithm into a sufficient number of concurrent parts, and the cost of communication between the processors.

The rival 32-bit micros are all descended from earlier 16-bit designs (for example, the Intel 8086) which were designed to work in the classic Von Neumann environment — namely, one CPU talking to a lot of external memory, or in other words The Computer as we have known it so far. It would not be true to say that the Intel 80386 and the Motorola 68020 *cannot* be used in parallel computers, for some such machines have already been designed around them (for example, the Intel HyperCube). But it is very much more difficult to design parallel systems around these chips. For one thing they communicate with the external world via conventional buses (and huge 32-bit wide buses at that). With a hundred such chips in a box, merely designing a PCB layout to interface all these buses becomes a horrific task. Then there is the problem of programming them, since these CPUs were designed to be the sole

master of a system, rather than to cooperate with equal brethren.

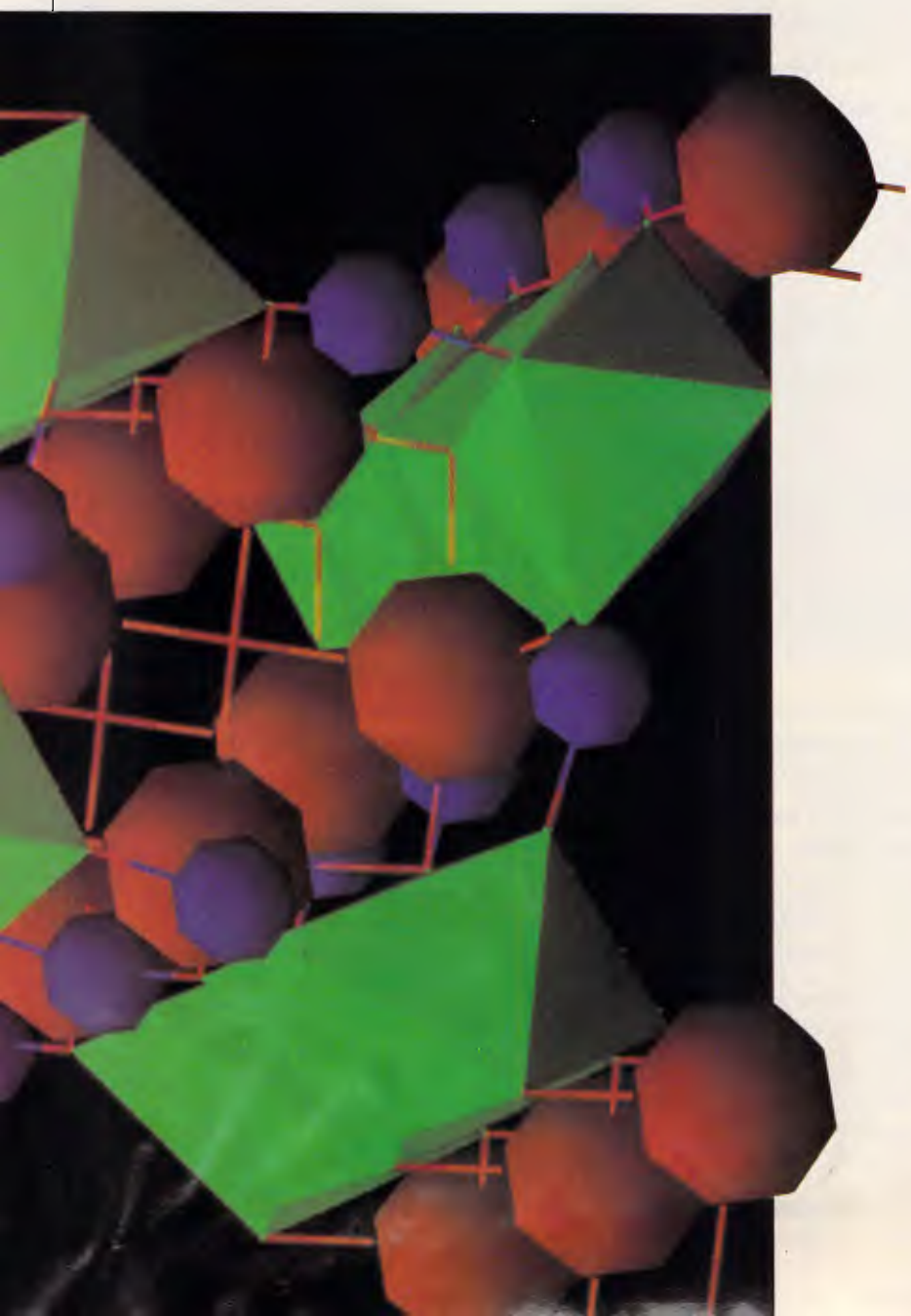
The ideal candidate

What is unique about the T800 that makes it so suitable for parallel processing? A Transputer is a whole computer on a chip; that is, it contains all the elements of a computer system, and can in theory execute a program without any external support apart from a clock signal. In addition to a conventional CPU unit, capable of arithmetic, logic and memory operations, a Transputer contains its own RAM (4k in the case of the T800) and four high-speed, asynchronous, serial communications links. It is therefore possible to download a program to the chip through one of the links and have it executed without providing any external memory at all. Obviously the size of such a program is limited to 4k, but a parallel application will typically be broken down into such small individual processes. Transputer code is very dense (the most common instructions only occupying one byte), and so a lot can be done in a 4k process.

The T800, in common with its predecessors the T414 and the 16-bit T212, also has a conventional memory bus, so that up to four gigabytes of external memory can be addressed. Some future members of the family will have this removed to reduce the package pin-count, and will only execute parallel programs from on-chip memory.

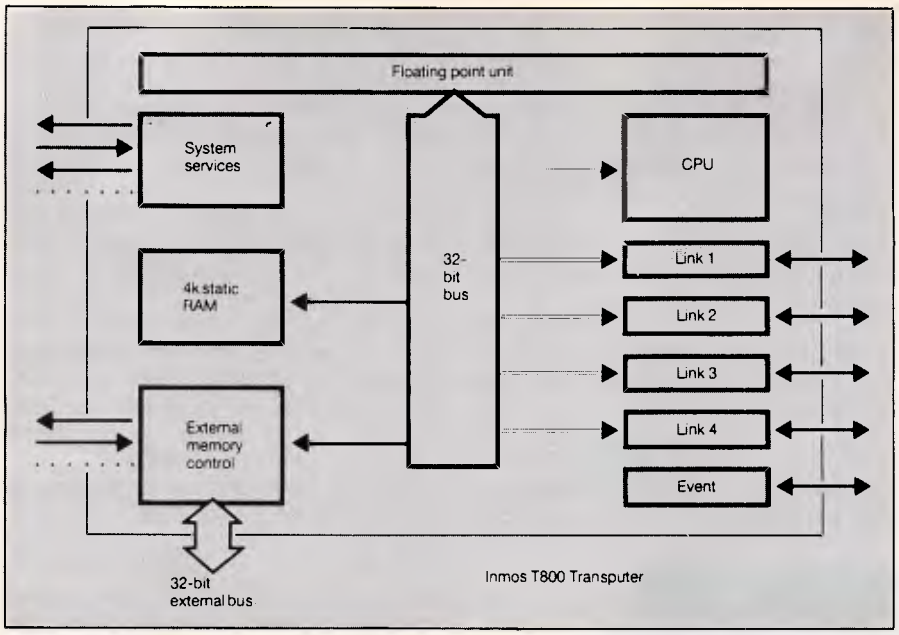
You might like to think of the communications links as the equivalent of RS232 ports, though they are of much higher performance. At 20Mbits/sec it would be better to think of them as comparable to a Local Area Network like Ethernet. If you think of them this way then the T800 looks like a complete PC on a chip, capable of being connected to other PCs in a network. One consequence of this design is that two Transputers can be connected together by a single twisted-pair wire, so connecting a hundred of them together is no longer a topological nightmare for the PCB engineer.

But the most important feature of the architecture is that the communications links run concurrently with the processor unit, and this is the key to building and programming parallel processor networks. It is possible for a Transputer to perform calculations while *at the same time* communicating (in both directions) with up to four other Transputers; moreover, this causes only a minimal degradation of processing speed. If the CPU had to devote all its attention to communication then there would be little benefit from running many chips in parallel, as each one would have to stop calculating while it passed intermediate results to a neighbour. A T800, however, can perform a calculation, store the results in its internal RAM, tell one of the communications links where the results are stored, and then immediately go on to the next calculation. Meanwhile, the link independently transfers the results to another Transputer (or to a screen or other external device). From this point of view, the links can be thought of as DMA controllers, capable of transferring data from the RAM of one Transputer to another without CPU intervention.



T800 hardware

The first published specification for the Transputer announced that it would have 4k of on-chip RAM. However, the first released chip, the T414 launched in October 1985, had only 2k. The reasons for this scaling down were only in part technical. Due to an internal reorganisation, Inmos had to rather hastily transfer fabrication of Transputers from its US facility in Colarado to its UK facility in Wales. The UK plant was not at that time set up for the advanced fabrication process required to cram 4k RAM onto such a complex chip (the process uses a



A simplified block diagram of the IMS T800 Transputer

```
PROTOCOL String IS BYTE::[]BYTE  -- defines objects channel can carry
PROC chop.after(BYTE char, []BYTE in.string, CHAN OF String output)
 INT index, limit :
 SEQ
  index := 0
   limit := SIZE in.string          -- SIZE is a built-in function
   WHILE index < limit
    nextchar IS in.string[index] :   -- an abbreviation
    IF
      nextchar = char
        SEQ
          output ! BYTE(index + 1)::[in.string FROM 0 FOR (index + 1)]
          index := limit
       nextchar <> char
         index := index + 1
   output ! ' '                      -- send a space character
```

Listing in Occam 2

tungsten silicide interconnect layer, for the solid-state physicists among you).

A redesign for an older fabrication process was accomplished in only three months and the T414 was born. As if to prove the truth of 'It's an ill wind that blows no-one any good', during the redesign the Inmos team cleaned up some of the structures, thus saving some silicon space in the planned tungsten silicide version. The space saved turned out to be big enough to put in the circuitry for a floating point processor, which was not part of the original specification. And so the T800 arrived.

The advantage of having a floating point unit on the CPU chip cannot be overestimated. Processors which employ an external floating point co-processor, such as the Intel 8087 or the Motorola 68881, pay a performance price because the time taken to send floating point numbers off the CPU chip, via a bus, to the FP chip and back again is a considerable fraction of the time taken to do an arithmetic operation. An experiment published in the US magazine *Byte* has demonstrated, for example, that an Intel 80286/80287 used in an IBM PC/AT is seriously I/O bound to the point where certain floating point operations are actually performed faster by the 80286 alone.

The T800 Floating Point Unit performs 64-bit floating point arithmetic using the ANSI-IEEE 754-1985 Standard format for numbers, and can sustain a rate of 1.5 MFLOPS. A 20MHz T800 performs about ten times faster than an 80286/80287 combination, and five times faster than a 68020/68881 on the Whetstone Benchmark.

The CPU of the T800 is mostly similar to that of the T414, though the instruction set has been enhanced in a few respects. The Transputer CPU employs many of the features of a RISC (Reduced Instruction Set) computer, in that it uses relatively few instructions and no fancy addressing modes. Unlike other RISCs such as the Acorn ARM, though, it is microcoded. This means that many of the instructions are quite high-level (that is, they perform a lot of work), rather than being simple and 'atomic'; these instructions are designed to support features of the Occam language. It also differs from a 'classic' RISC design by not employing a large number of programmable registers. 'Workspaces' in the on-chip RAM are used instead, the workspace of the current process being pointed to by a special register which is not normally accessible to the programmer. The on-chip RAM is so fast (80Mbytes/second) that it functions like the registers of a conventional processor.

The T800 has added three new instructions to aid high-speed graphics application. These perform block moves on two-dimensional byte arrays with a single fast instruction, and so enable the T800 to act like a 'blitter' for windowing applications and character generation. Transparent and inverted options are offered, which move only zero or non-zero bytes. Strictly speaking these operations are not BitBlts because they only work on byte boundaries; in other words they are optimum for colour graphics systems which employ eight bits per pixel, rather than for black and white bit-mapped graphics.

Inmos also manufactures a Colour Lookup Table chip with eight bits per pixel which is incorporated in the new IBM PS/2 machines (it has been wrongly described as a Transputer by some magazines), which suggests that the company regards this as the minimum display standard for future applications. I wholeheartedly agree as working to byte rather than bit boundaries simplifies graphics software enormously, and 256 colours begins to approach photographic levels of realism.

One more new instruction on the T800 counts the number of set bits in a memory word, which is useful in image processing and similar applica-

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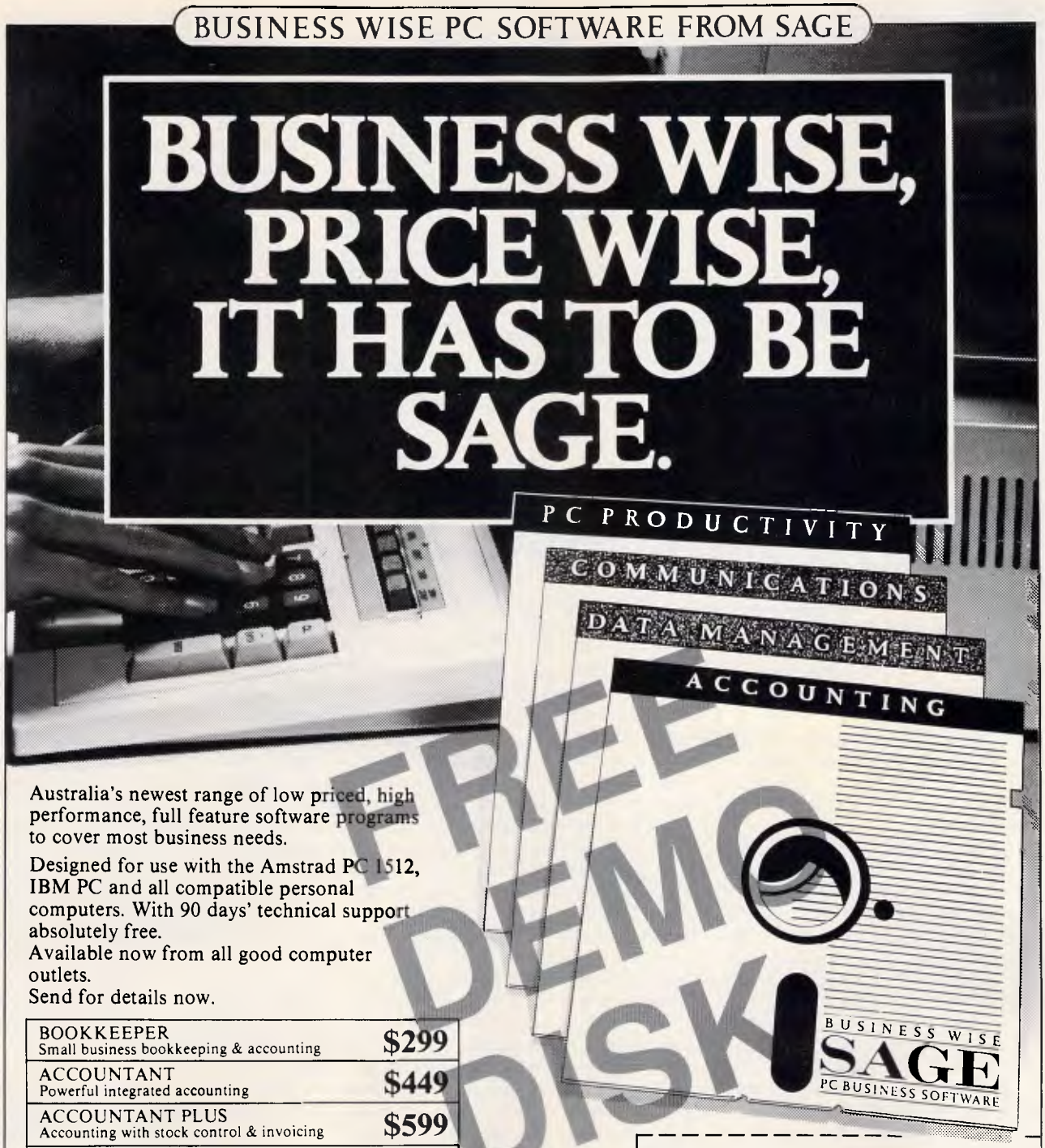

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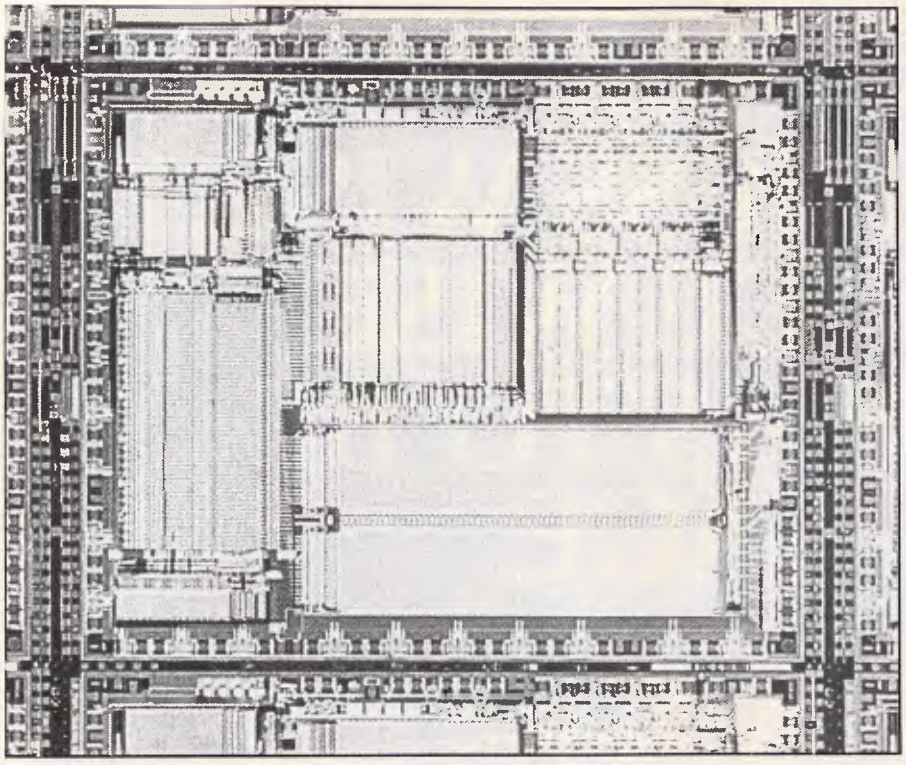

The T800 Transputer is the fastest single-chip processor in the world

tions, and is time-consuming if programmed using simple logic operations.

A simplified block diagram of the T800 is shown on the previous page.

Occam 2

The Transputer family was designed to be programmed in a new language called Occam; in fact, Occam and the chip were designed together so that the Transputer instruction set is optimised for executing Occam programs. Occam differs from conventional languages like C and Pascal in that it was designed from the start around a model of many concurrent processes communicating with each other over links (or 'channels', as the software equivalents are called). In other words, I/O is incorporated into the very heart of the language. In conventional languages I/O must always be an afterthought, because they are based on a model of computation in which a single CPU process is really concerned only with what occurs in its own memory space.

Occam does not mind whether several concurrent processes making up a program are executed on the same chip or on different chips of a network; a channel joining two processes may be physically represented either by a memory location on one Transputer, rather like a variable, or a hardware link between two different Transputers, and the programmer need not know which when the program is being written.

Since I first became aware of Occam, over three years ago, it has gone through some changes and the new version, called Occam 2, incorporates many improvements and additions. It is now a strongly typed language like Pascal, which supports a number of data types including 16, 32 and 64-bit integers and real (that is, floating point) numbers, which on the T800 are processed by the hardware as fast as integers. The other major improvement is that channels can now carry structured data objects rather than merely 16-bit values as in the original Occam. This means that strings, arrays and more complex objects similar to Pascal's records or C's 'structures' can be output in a single operation; this greatly simplifies the writing of concurrent message-passing software systems.

In response to demand from programmers Inmos has also produced a C compiler for the Transputer, to be followed shortly by Pascal and Fortran compilers (there are Fortran compilers already available from other sources). Since these languages do not fully support the notion of concurrency, the method for porting old software systems to the Transputer is to recompile all the relevant modules as conventional sequential programs and then bind them together with a small, concurrent 'harness' program written in Occam 2, which has the ability to call such modules as processes. The UK firm Meiko (more later) has used this method to recompile some large Fortran simulation programs used in nuclear physics.

The listing shows a simple process written in Occam 2; it searches an input string for a given character and outputs the string chopped off after that character through a channel. The output channel leads to another process, possibly running on a different processor.

Applying Transputers

It would be quite possible to make a personal computer based on just a single T800 Transputer. By also incorporating Inmos's new Disk Controller Transputer (the IMS M212) and the Colour Lookup Table chip, such a PC would greatly outperform anything that is currently on the market, including the Macintosh II. This may happen some day, but at the moment it is not the way that people are using Transputers. The reason for this is that the Transputer doesn't yet support any industry standard operating system, and so the vendor of such a machine would have to start from scratch with the software; in fact from the kind of position that the 68000 occupied five years ago. In addition, the primary advantage of the Transputer lies in its parallel processing capabilities, and it wouldn't make much commercial sense to port an operating system that didn't make use of this capability. Most other vendors of parallel computers are supplying them with Unix, which is by no means the best solution for Transputer-style parallelism. The field of truly parallel operating systems is a new and experimental area.

Instead, most third-party manufacturers are choosing to put Transputers into high performance sub-systems which can be hung on the back of a conventional computer, such as an IBM PC/AT, a DEC MicroVax or a Sun Workstation, which supplies the operating system, mass storage and programmer's interface. The target market for these creations is the community of supercomputer users; scientists and engineers who need vast amounts of number-crunching power.

Computer graphics and animation is another area with a limitless appetite for computing power. The Transputer can be used to make such power available for a lot less than the price of a

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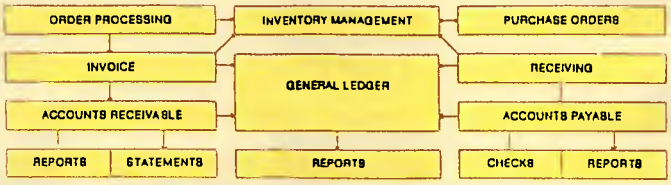

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Cray XMP. A new category of Transputer-based 'Personal Supercomputers' has appeared; single-user machines which either fit on a desktop (or at least slide under the desk), don't require three-phase industrial power supplies and Freon cooling, and cost tens of thousands rather than millions of dollars. At the other end of the scale, a US supercomputer manufacturer, Floating Point Systems, has adopted the Transputer as a node controller for its new series of parallel mainframes.

A good example of the new breed is the Meiko Computing Surface, made by a firm started by several ex-Inmos designers. This is a modular system, built from four different kinds of board. A Master board contains all the usual motherboard housekeeping functions and one master Transputer; a Compute Element board has four Transputers and 1Mbyte of RAM; a Storage Element board has one Transputer and 8Mbytes of RAM; and a Display Element board contains one Transputer 1.5Mbytes of dual-port video RAM and three Colour Lookup Tables (one each for red, blue and green).

By combining one Master with a mixture of the other three boards, various systems of mind-boggling speed can be constructed in a single box, containing up to 150 Transputers. The configuration of the network can be altered under software control using a custom switching chip that Meiko has designed in-house. If you like playing with Mandelbrot sets, the Computing Surface can plot them in 256 colours in less than a second. Typical customers are more interested in animated ray-tracing graphics, which draws life-like solid objects, complete with correctly moving shadows and reflections.

Meiko is also experimenting with an operating system which distributes work to the individual processors dynamically. Each Transputer runs a small Occam process which either accepts data coming in over the network for processing, or passes it on to the next processor if it is too busy at the time. This is a truly distributed operating system, in which the actual kernal is spread among the various processors.

Another application where Transputer power may prove crucial is in raster processing for sophisticated laser printers. To approach professional typeset quality these will need enormous processing ability to plot high-resolution fonts in different sizes from a master description. Multiple Transputers can offer an attractive alternative to custom hardware.

Conclusion

The T800 and other members of its family offer the promise of extraordinary computing power in desktop-sized packages. However, it is unlikely that we will see a low cost PC based on the Transputer very soon. Such enormous power represents total overkill for the average user who just wants to run a word processor (a Z80 can handle this quite adequately, as Amstrad has shown with the PCW8256).

For some time the only people who will be prepared to tackle the task of creating software for Transputer systems will be those who really need this level of power. In the farther future, though, I can see an entirely new generation of PCs emerging which will have animated graphics capabilities superior to the Quantel Paintbox, and to which you will add more oomph as required by merely adding another processor card.

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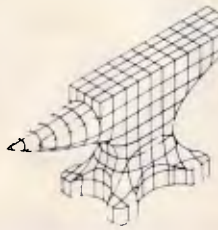

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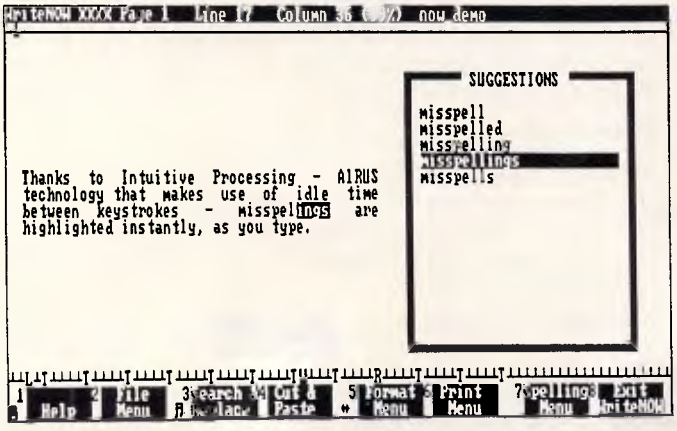

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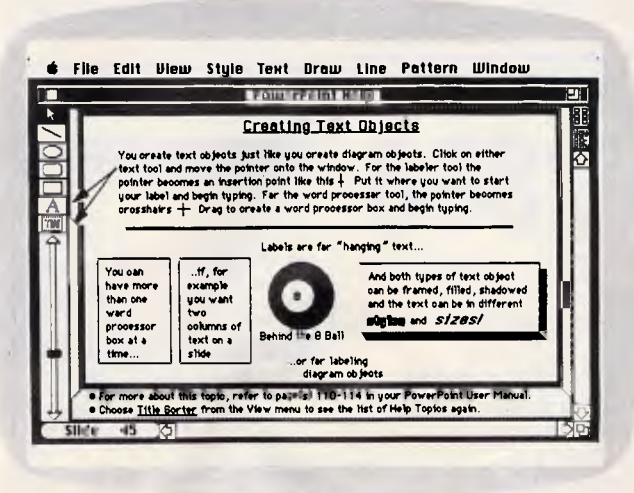

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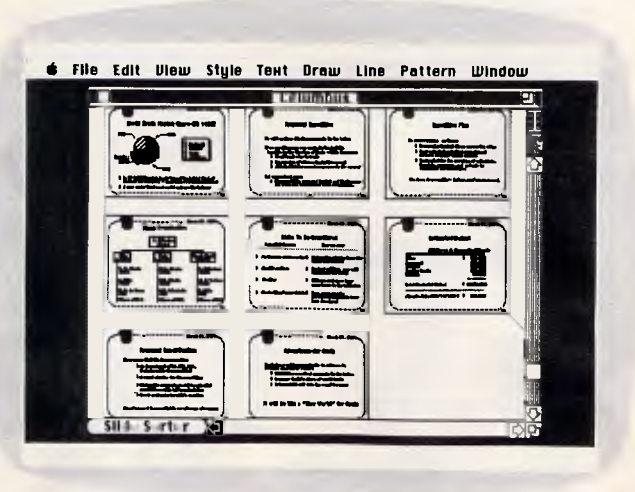

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M1044: MARTIAL ARTS. Match your skills against all sorts of vilains and dangers.

M1045: EGA GAMES. World Domination for those with Enhanced Graphics Board.

M1046: SUPER COMPILED GAMES (5). With World Domination (Risk), Beast, Locust, Rockets, Subchase, etc. Needs CGA.

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M1048: GOLDEN WOMBAT. Fine British taxt adventure searching for Lost Empire. Needs CGA.

M1049: MURDER MYSTERY. Puzzle your way through suspects and clues.

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M2012: DISK DOCTOR COLLECTION. Excellent debugging and file repair programs.

M2016: MENU SYSTEMS. Create your own menus. Contains Sysmenu, Automenu, EZMenu.

M2021: UNIX COMMAND SHELL. Control your programs with commands like those in Unix.

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M2023: BATCH LANGUAGE ENHANCEMENT. More features and control in creating .bat files.

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M6002: WINDOWS FOR BASIC & C. Gives windowing capability to your programs.

M5025: TURBO PASCAL DEBUGGER. Interactive, with pop-up help, formatters, etc.

M5026: MACRO ASSEMBLER. If you didn't get one, this is an excellent choice.

M5030+: TURBO PASCAL SELECTION. 3 disks with source code for windows, pass 64k limit, time/date, copy, format, interrupts, spell check, editor, random nos, etc. $30.

M5031: CROSS ASSEMBLER FOR APPLE. Creates code for 6502 processor.

M5032: SCREEN GENERATOR FOR TURBO PASCAL. Produces code for entry and help screens.

M5033: TURBD PASCAL RDUTINES FOR HERCULES GRAPHICS.

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Some excellent programs for contacting bulletin boards. Many features. Recent releases for:
M6008:QMODEM **M6009:KERMIT**
M6010:PROCOMM

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M7004: STOCK MARKET ANALYSIS. Special aids to help you "think and grow rich". For managing and evaluating portfolios and prospects. Needs Basic.

M7006: STATISTICAL ANALYSIS. Many programs in Basic for analysis – Chi, regression, Fisher, Binomial, Variance, Histogram, Poisson, Correlation, etc.

M7016: PROJECT MANAGEMENT. Handles 1000 tasks; does critical path analysis, cash flow, bar charts, stock reports. Needs Basic.

M7029: INTEGRATED ACCOUNTING. General ledger, Cash Book, Debtors, Payroll, etc. – all on one disk.

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M7032: SMALL BUSINESS SELECTION. includes small spreadsheet, mail list manager, printer controller, typewriter emulator, text reader, word processor, & UK accounting system for income/expenditure/reports – all on one disk!

M7033+: SALES MANAGEMENT. Controls prospecting, sales managing, order processing, job costing, profit analysis, labels, letters. Needs hard disk. 3 disks. $30.

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M7040: 123 COMPATIBLE SPREADSHEET. Also does graphs and pie charts. 52x200 cells. Many good features.

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M8003+: FAMILY TREE/GENEALOGY. Recording, tracing, grouping, printing family tree. In Basic. 2 disks. $30.

M8010: FILE MANAGER. 2 disks on 1. Does mailing lists, calculations, inventories.

M8012: LABEL PRINTING. Collection that allows you to print labels for all sorts of uses, as well as control mailing lists.

M8013: RELATIONAL DATA BASE MANAGER. Menu driven, easy to use. Allows 100 fields and up to 2 billion records.

M8018+: DBASEIII COMPATIBLE DATA BASE MANAGER. Bargain with similar features to DBaseIII and is compatible with files generated by it. 2 disks $30.

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Programmes are intended for IBM-PC or close compatibles. If Basic is specified then Basica or GWBasic is required. Most programmes are compiled.

EFFICIENCY WITH FILES AND COMMANDS

U14. FAKE A KEY to provide the input expected when batch processing.

U15. MULTI-CHOICE MANAGER. Very cleverly apportions memory so that you can switch between three files.

U16. SOUND A TUNE that lets you know a stage has been completed in batch processing.

U17. REQUESTS INFORMATION in batch file processing. A timed ask utility.

U18. MULTIPLE FORMATTING of disks. Lets you format a lot at same time.

U19. SMALL, FAST SUPER DIRECTORY. Lists directory in 2,4, 6 columns, sorts, etc.

U20. SORTED DIRECTORY. Screen listing that automatically shows hidden files and offers 2 or 4 columns. Various sorts.

U21. PERMANENT DIRECTORY SORT. Resorts your directory and saves it to file. Will work on subdirectories and hard disks, as well as floppies.

U22. SUBDIRECTORY LIST. Shows subdirectories in a given directory.

U23. SPACE ALLOCATION. Combines Dos Tree and Dir commands to show amount of space to be allocated when files transferred to hard disk.

U24. FILE MANAGER with execution facility for running programmes. Will also copy, view, delete, etc.

U25. MEMORY-RESIDENT FILE MANAGER with multiple windows, variable size..Needs CGA card.

U26. BATMAKER. Creates bat files containing all matching files. This is great when using Find in a text search.

U27. **MENU PROGRAM.** Allows for tailor made menus. Good screen appearance.

U28. GO TO DIRECTORY directly on a hard disk. Reduces amount of keyboard work.

U29. SECONDARY DOS. Lets you suspend currently executing application and invokes a secondary Dos command processor so new commands can be executed.

U30. ALL8UT the programmes you specify can be acted on. Eg, delete, copy, etc.

U31. MEASURE the time your computer takes to execute commands.

U32. DISK ERROR MONITOR. A resident programme that monitors disk errors and gives more information than the abort/retry/ignore message.

U33. REMEMBER COMMANDS. Remembers last 50 commands which may be edited or executed.

U34. RENAME A DIRECTORY.

U35. DISPLAY COMMENTS FROM CONFIG.SYS file when booting up.

U36. BUILD DIRECTORY FILE WITH COMMENTS. Has asm source code so that you can tailor to own needs. Produces list of files with size, crc, file no. and space for comments.

FILE PRINTING/EDITING

U130. PRINT ITALICS. Set printer for output in italics. Epson compatible.

U131. PRINTER RESET. Resets printer to power-up mode.

U132. GRAPHIC SCREEN DUMP for Epson compatibles.

U133. SET 51 LINES PER PAGE on Epson compatible computer.

U134. SET 132 COLUMNS PER PAGE on Epson compatible computer.

U135. SET UNDERLINE MODE on Epson compatible printer.

U136. SET COMPRESSED PRINT on Epson compatible printer.

U137. SET ENLARGED PRINT on Epson compatible printer.

U138. SET WIDE PRINT on Epson compatible printer.

U139. SET EMPHASISED PRINT on Epson compatible printer.

U140. SET EXTENDED CHARACTERS on Epson compatible printer.

U141. PRINT SPOOLER. Creates a 16k buffer in memory, which allows you to do other work whilst printing.

U142. DISK-BASED PRINT SPOOLER. Uses capacity of disk as buffer for printing, allowing you to continue with other work.

U143. SEND ESCAPE (ESC) SEQUENCES as part of command, such as for printing.

U144. WORD FREQUENCY. Counts number of times each word is used in a text file.

U145. FAST WORD COUNT. Provides count of words, characters, lines, plus a mathematical check sum, which allows you to compare text files for changes.

U146. APPOINTMENT REMINDER. Stores data on disk like a daily appointments diary. Prints details of next 7 days.

U147. PRINT WITH NUMBERED LINES. Great for listing source coding.

U148. SIMULTANEOUS EDIT of multiple text files. Lets you make the same text changes to several files at once.

U149. WORD LENGTH ANALYSER. Checks the length of words in text and compares with readers' level of schooling.

U150. TEXT CHECKER. Examines Wordstar files for typing errors such as missing brackets and quotes.

U151. TEXT FILE SORT. Fast and works with very large files.

U152. LIST NON-ASCII BASIC FILE without loading Basic. Also helpful for listing if you don't have Basica/GWBasic.

U153. PAUSE LISTING so that printer will produce 55 lines on a page.

EQUIPMENT HANDLING

U406. CONTROL BACKGROUND/FOREGROUND COLOURS as displayed on your monitor.

U407. HARD DISK PERFORMANCE TEST. Checks the running of hard disks.

U408. COMPUTER LOG to keep track of amount of time of computer usage, how time spent.

U409. ELECTRIC TYPEWRITER. Converts computer into electric typewriter (for notes, envelopes, etc.).

U410. KEYBOARD OPTIMISER that will set cursor size, give type ahead buffer, more. Easy to use command line editing.

U411. MAP RESIDENT PROGRAMS. Shows program addresses, possible conflict.

U412. TRACK MEMORY as programs are running. Has windows and more.

U413. MEMORY ORGANISER. Determine, mark, release, allocate, display memory. Shows how files are loaded in memory.

U414. MULTI-SCREEN. Allows output to be directed to more than one screen. Needs CGA. Multitasking features.

U415. NEW ANSI.SYS that may aid screen presentation and allow faster execution of many functions.

U416. BLACK & WHITE MODE can be switched on colour graphics card.

U417. TIMEPARK HEAD of hard disk after a specified time has elapsed.

U418. SET 40 or 80 screen columns BW mode on colour systems.

U419. STATUS REPORT on system, including information about drives, memory available.

U420. SPEED TEST (1) checks processor speed and compares with IBM-PC. Similar to Norton test.

U421. SPEED TEST (2) checks computer speed in two areas, including Sieve calculation and track to track access time, and compares with IBM-PC.

U422. SPEED TEST (3) comprehensive checks on processing, including block write, register/memory, multiply, divide, stack operations, far jumps, etc, and compares with IBM-PC.

U423. RAM TEST. Tests and tests and tests ram. Identifies faulty memory.

U424. DOS ENVIRONMENT VARIABLE EDITOR. Make changes to edit path, prompt, etc.

U425. EXPAND DOS ENVIRONMENT SPACE TO 1K.

U426. FLIP ON/OFF (TOGGLE) DOS PARAMETERS: Works on several standard Dos parameters.

U427. WHAT PROCESSOR? Examines and identifies the processor/s being used, such as 8088, 8086, etc.

U428. WHAT DEVICE DRIVERS? Examines and reports on devices (eg ports) installed in your computer.

U429. WHAT DOS CONFIGURATION? Examines and reports on memory, vector addresses, and statistical information about version of Dos you are using.

U430. WHAT EQUIPMENT? Examines your equipment and reports on the installed drives, type of cards (eg, printer, colour, mono, RS232) etc.

U431. EDIT RAM STORAGE in your computer.

U432. DRIVE STATUS. Reports on no. of bytes, sectors, clusters-what capacity is and how much is free.

U433. DIAGNOSTICS. Performs large number of computer diagnostics and reports on serial, parallel ports, video, etc.

U434. DRIVE TEST. Floppy disk test drive utility.

U435. SLOW AMSTRAD 1512 Programs e.g. games that run too fast.

FILE MOVING

U511. HARD DISK UNERASE. Exceptional features. Most unerase utilities don't work on hard disk – this one does!

U512. DELETE ALL BUT those programs you identify.

U513. INTELLIGENT COPY PROGRAM that creates sub-directories as part of the transfer. Also renames rather than over writes.

U514. SUPERIOR COPY PROGRAM that checks and evaluates target before copying. Eg, copies last dated version.

U515. UNIQUE COPY PROGRAM with same function as £.£ but does not copy those already on target disk.

U516. TREE SURGERY. Prune files unwanted/ duplicated on hard disk. Has source code and compares files with the same name.

U517. KILLDIR. Delete a branch of a directory. Reduces steps and saves time.

U518. MOVE DIRECTORY around if you prefer it stored in different location.

FILE ORGANISATION & CHECKING

U611. BOMB ALERT. Examines new files for malicious intent and reports on possible danger to other files.

U612. BASIC MENU GENERATOR. Better access to your Basic files through a menu. For Basica/GWBasic.

U613. UNSQUEEZE ARC FILES. Small, efficient utility that occupies less space and is simpler to use than Arc.Exe.

U614. HARD DISK OPTIMISER. Related group of files that optimise hard disk usage and eliminate file fragmentation. Helps pack the disk.

U615. FILE RE-ORGANISER. Regroups a fragmented file into contiguous sectors on a disk for more efficient disk access.

U616. RECOVER BAD SECTORS. Re-records data on disk. Does 12 retries and thus may recover bad sectors.

U617. COLLECT BAD SECTORS. Marks bad sectors for collection into a separate file that will not be used. Works with floppies and hard disk.

U618. ADVANCED COMPARE facility that can save as edlin script, generate and update deck.

SPECIAL FEATURES

U805. PREPROCESSOR FOR "C" COMPILERS. Has "C" source and helps organise coding into efficient form for compiling.

U806. VOICE EMULATION. Compiled with Basica source module which allows extensions, revision or use as tutorial.

U807. DEMONSTRATION OF COMPUTER GRAPHICS for those who have CGA.

U808. DAYS SINCE JAN 1ST. Calculate no. of days elapsed since beginning of year. Needs Basica/GWBasic.

U809. BINARY FILE CONVERTER. Converts files from machine language to hex equivalent for examination and modification.

U810. CAPTURE BIOS contents and store in a separate file.

U811. EXPLORE FAT (FILE ALLOCATION TABLE). Shows the table entries, starting clusters of files, etc.

U812. MINICALC. A small, easy to use spread sheet with 11 x 22 cells for quick every day use.

U813. PROGRAMMER'S CALCULATOR which does special hex and other calculations for those writing programs.

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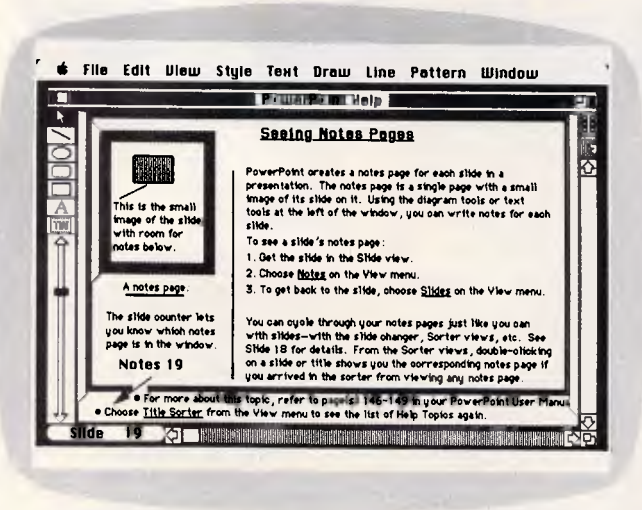
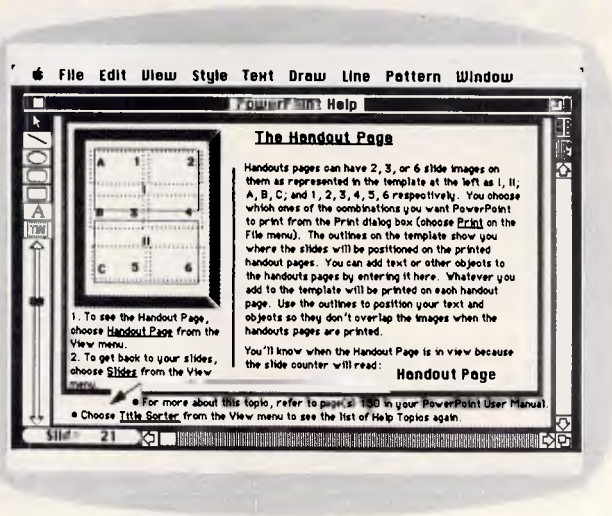
23	24	25	26	27	28	29	30	31
32	33	34	35	36	130	131	132	133
134	135	136	137	138	139	140	141	142
143	144	145	146	147	148	149	150	151
152	153	406	407	408	409	410	411	412
413	414	415	416	417	418	419	420	421
422	423	424	425	426	427	428	429	430
431	432	433	434	511	512	513	514	515
516	517	518	611	612	613	614	615	616
617	618	805	806	807	808	809	810	811
812	813			435				



A 'notes' page can be designed and associated with each slide as a presentation aid. A miniature view of the corresponding slide is included as an extra



PowerPoint automatically generates audience handout pages with up to six slides per page. Any details which are added to the template will be printed on each page

processor as well as all the slide-creation drawing tools. Therefore, it's a simple matter either to produce a comprehensive set of notes that could be used to prompt the user through a full-scale presentation, or to conduct a satisfactory briefing in those situations where the room or the equipment is inadequate for a screen presentation.

PowerPoint also allows you to print audience 'handouts' of up to six slides per page, to accompany a briefing.

Preparation

An important decision in preparing a presentation is determining the medium that will be used to show the slides. Overhead transparencies or flip charts might be used in those cases where there is a lot of audience/presenter interaction, and information in the presentation is altered or updated; while 35mm slides are better for large-group, information-dispensing lectures.

The latest trend in computer-generated presentations involves real-time projected displays, which offers the presenter considerable flexibility. PowerPoint is capable of automatically formatting slides for overhead transparencies, 35mm photographic slides, flip charts, and onscreen presentations. In addition, the user can select an option that will allow virtually any customised screen layout.

Note that although the program will generate slides appropriately sized for transparency or 35mm slide production, additional hardware is required to make the transfer to these mediums.

Creating a professional presentation involves collecting pieces of disparate information, formatting attractive and interesting slides, and maintaining continuity from slide to slide. The latter concerns choice and the order of subject matter, but also involves style and formatting.

To help maintain a constant 'feel' or format, PowerPoint includes the option to create a 'Slide Master' which serves as a model upon which all subsequent slides are based. The master can be altered at any time, and all changes are immediately reflected throughout the whole presentation.

Similar to the Slide Master is the 'Notes Master' which allows text or graphics to be inserted universally.

PowerPoint also features a 'Slide Show' option that can be used to preview a presentation, or with a projector or large screen for showing to a small audience. In order to minimise possible audience distraction, PowerPoint removes the menus and any other window items during the slide show. It's also possible to automate the show and have it continuously cycle through the slides for display purposes.

Tools

Word processor

PowerPoint includes a versatile word processor which simplifies the creation of bullet charts and tables. This tool is available in both 'Slide' and 'Notes' modes (master or individual) and can be accessed regardless of slide size.

Conveniently, word processing text is treated as an object and can be repositioned or resized to fit a slide after the text has been entered. Fonts and styles can be changed at will and text can be selected to add emphasis. A text ruler with five indents allows you control over leading lines and body text by employing a clever system of draggable indent icons. In addition, standards tabs and decimal tabs can be set, and the ruler represents true inches independent of view or window size.

Slide counter

A slide-counter box is always visible in the bottom left of the screen to indicate the specific slide or notes which are currently in the active window.

Sorters

Clicking the 'Slide Sorter' icon presents miniatures of the slides arranged in order, while choosing the 'Title Sorter' view shows the titles of your slides, again listed in order. Both of these tools can also be selected from the 'View' menu.

Drawing tools

PowerPoint's drawing tools include line, oval, rounded rectangle and rectangle icons which can be used in either Slide view or Notes view. Delimiter key combinations can be used with these tools to generate vertical, horizontal and 45-degree lines, perfect circles or squares, or to draw from the centre. Note that all figures generated by this process are objects and can be resized or repositioned, filled with pattern, and the border thickness or style adjusted. Permanently attached labels can also be entered, frames attached and drop-shadow applied. A variety of line thicknesses and styles is available, including the ability to generate arrows for emphasis.

Digiview 2.0

THE Amiga video digitiser. Produce high quality images in colour or black & white in low, high or medium resolution. Uses all of Amiga's 4096 colours with the HAM option. Save images for use in other programs and more

Digipaint

The advanced drawing program utilising Amiga's HAM mode to the full. Uses Amiga's 4096 colours. Combine images with different palettes on the one screen, or work on Digiview images.

ProVideo

The character generator that is the ideal partner to Genlock. Up to 100 screens of animated text in different fonts, colours, sizes and shading can be queued for automatic display. Excellent promotional tool. (PAL version requires extra drive and 1Mb RAM.)

Hard Drives

ACME distribute the entire range of C-Ltd. Hard Drives. Capacities range from 20Mb for under $1900.00. Turns your Amiga into Super Amiga. Very fast drives that connect directly to the Amiga bus. A real winner in a recent price/performance comparison.

Futuresound

The ultimate sound digitiser for the Amiga. Digitises with NO background noise. Collect samples from your video, stereo, CD or your own voice (microphone included). It's t-t-t-t-errific!

Genlock

Turns your Amiga into a video production studio. Overlay Amiga graphics/text over a video signal. Chroma-key and fade as well. Very versatile, lots of professional and educational uses. Australian PAL system.

Memory Expanders

Expand your Amiga's memory without expanding your budget. Half, one and two megabytes of 'fast' RAM available with Auto-Config circuitry and pass through bus. An extra slot is provided so an additional 2Mb card can be added, or even a hard-drive controller. Great value and tops in quality.

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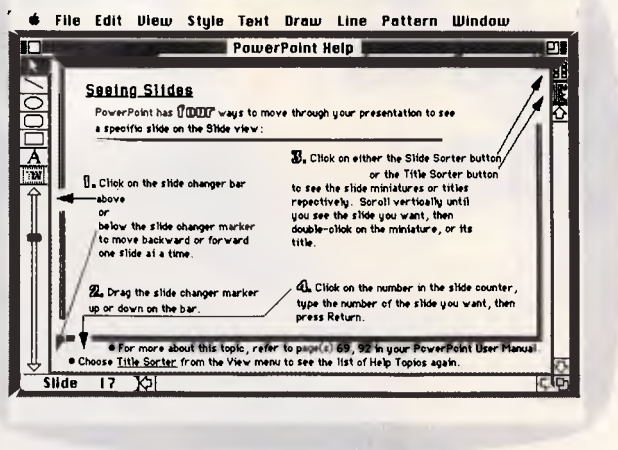
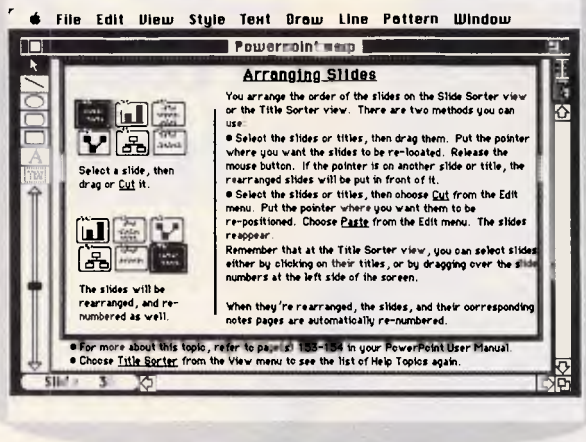


PowerPoint includes icon-based tools for viewing slides from four different perspectives on the 'Slide' view. A slide counter is visible to the bottom left of the screen



Slides can be reordered and renumbered at will on the 'Slide Sorter' or 'Title Sorter' views with corresponding notes pages automatically renumbered

PowerPoint includes a built-in reference system for aligning objects on slides. An invisible grid system similar to that found in MacPaint can be used to automatically align objects.

The program also includes an innovative system of horizontal and vertical 'magnetic' guides which attract the slides or the centres of various objects: that is, when an object comes close to a guide, it automatically jumps to it. This feature is particularly useful for aligning objects, such as boxes in an organisational chart or columns of text, and makes it easy for the user to place objects in the middle of a slide accurately.

Slide changer

A 'Slide Changer' icon allows the user

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to page through slides or notes one at a time, or to move to a specific location quickly.

Importing graphics

Although the tools mentioned above are capable of generating some rudimentary slides by themselves, the real *power* of PowerPoint is accessed by importing graphics from other Macintosh software and enhancing them to create slides; while the real *point* of PowerPoint is to provide the means to do this from a full presentation perspective rather than from an individual slide viewpoint.

In the process of creating slides, the user can incorporate graphics from the scrapbook or clipboard, or can paste them in directly from any MacPaint or MacDraw formatted data file. All graphics imported to PowerPoint become, and are manipulated as, objects.

All slides can be viewed in 'full size', '66 per cent', '50 per cent' or '33 per cent' mode, and clicking the resize box automatically sizes the window appropriately.

PowerPoint's drawing tools and word processor operate regardless of window size, although selecting the appropriate font size can be confusing while working in reduced screens.

Printing

PowerPoint supports printing on Apple's ImageWriter and LaserWriter, and includes the following options: 'Print Slides', 'Notes Pages', and 'Handouts' (two slides per page, three slides per page, and six slides per page). The user can print collated sets of presentations or, to save time, may choose to print copies sorted by page.

Help

An online 'Help' file takes the form of a 67-frame slide show.

Although the help slides are well formatted, concise and pertinent, I had some problems with memory capacity while operating PowerPoint under Switcher 5.1 and when attempting to use the Help file. The program attempts to load the whole file into RAM, and so conflicts with files loaded under Switcher.

Documentation

PowerPoint's documentation includes an extensive 'Quick Tour' which takes the user step by step through the design and creation of a slide show presentation, and which references a presentation file included on the library disk. More detailed advice and suggestions are provided in a 'Using PowerPoint' section, and experienced users can obtain information quickly from the 'PowerPoint Reference' pages. For those needing advice on the preparation of effective presentations, a separate 45-page guide is provided.

Overall, the documentation is well written, concise, and aptly illustrated.

The package also includes a second disk with clip art, sample presentation templates, slide layouts, sample presentations, and storyboard forms which serve as an invaluable aid in learning the program and in using it effectively.

Customer support

Forethought guarantees its product to work in the way the company says it will. That is, Forethought provides the traditional warranty concerning defective disks and manuals but also *'warrants that the program operates substantially as described in the user's manual, and that the user's manual contains all information which Forethought and its software suppliers deem necessary for use of the software'.* Registered users can take advantage of a Customer Support Line, an upgrade program, and a product replacement program, and the company offers site licences for volume users and has a volume purchase program.

The extensive support provided by Forethought should minimise any attempt to obtain or distribute illegal copies of the unprotected software.

Conclusion

PowerPoint provides the presentation power which frees the Macintosh user from the limitations of screen size, and maximises the impact of the sophisticated output from programs such as Excel, MORE, SuperPaint, and FileMaker Plus. Graphics presentations in business are about to become clearer, more informative, and much more palatable as a result.

END

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At the time of going to press, news broke regarding Microsoft in the US buying the company, Forethought Inc. Microsoft Australia were unable to comment, however, it can be assumed that PowerPoint will be available through Microsoft in Australia soon.

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Back-propagation

William Jones and Josiah Hoskins describe a generalised delta learning rule.

A cherished dream of the computer age is to build machines that can think as we do. How closely must the computer's internal representations and processes resemble those of a person for this to occur? The wisdom of the artificial intelligence community has long been that a close resemblance is neither necessary nor, given the architecture of a conventional computer, feasible. However, some recent impressive successes of the neural-network approach to the production of intelligent behaviour have forced a reconsideration of this position. Computer-based neural networks, for example, have learned to speak (see reference 1), to induce kinship patterns (see references 2 and 3), to recognise handwritten characters (see reference 4), and even to play games (see reference 5). Do these proof-of-concept demonstrations presage a breakthrough in efforts to build intelligent machines?

Implementations of neural networks, it turns out, date back to the beginnings of the computer age (see reference 6), and it has long been known that some of the earlier, more basic networks are severely limited in the kinds of computations they can perform (see reference 7). What, then, is new in neural-network research that might justify the current wave of excitement? Some of the resurgence of interest is a consequence of recent hardware advances in the construction of massively parallel machines that may enable much faster simulations of a biological neural network. Other theoretical developments may dramatically increase the computational power of neural networks — even when these are realised in a conventional Von Neumann machine.

This article focuses on one such development by Rumelhart and colleagues (see reference 8) (with similar developments by Parker [see reference 9] and Le Cun [see reference 10]) known as the back-propagation rule. This is a powerful, general learning algorithm employing a gradient or 'steepest'-descent heuristic that enables a network to self-organise in ways that improve its performance over time. We will examine the back-propagation rule and demonstrate its learning capability with a simple neural-network simulation implemented in C. But first, we set the stage by discussing the neural-network approach and some of the events leading up to the development of the back-propagation rule.

The neural-network approach

The neural-network approach, also referred to as connectionism or parallel distributed processing, adopts a 'brain metaphor' of information processing. Intelligent behaviour in a person seems to emerge from interactions involving huge numbers of neurons — each of which, compared to a computer, is quite limited in its processing capabilities (ie, with regard to its speed, the information it acts upon, and the information it produces). Similarly, under a neural-network approach, information processing occurs through interactions involving large numbers of simulated neurons, such as the one depicted in Fig 1. This simulated neuron, or unit, has four important components:

- input connections (synapses), through which the unit receives activation from other units.
- a summation function that combines the various input activations into a single activation.

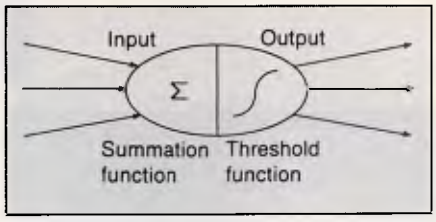

Fig 1 A simulated neuron

- a threshold function that converts this summation of input activation into output activation (eg, perhaps 0 output activation if the input activation falls below some threshold).
- output connections (axonal paths) by which a unit's output activation arrives as input activation at other units in the system.

An inter-unit connection in a computer-based neural network is typically assigned a numeric weight that modulates the activation passing through the connection. If the connection from unit A to unit B has a weight of w_{BA} for example, then the activation output of unit A might be multiplied by this value to determine the activation actually

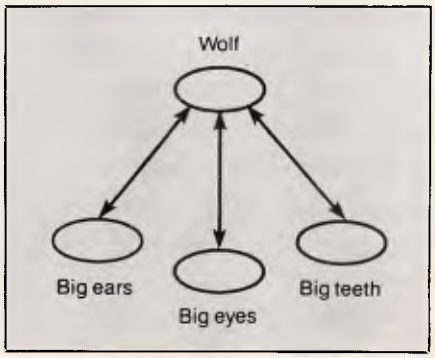

Fig 2 A simple 'wolf-detector' assemblage

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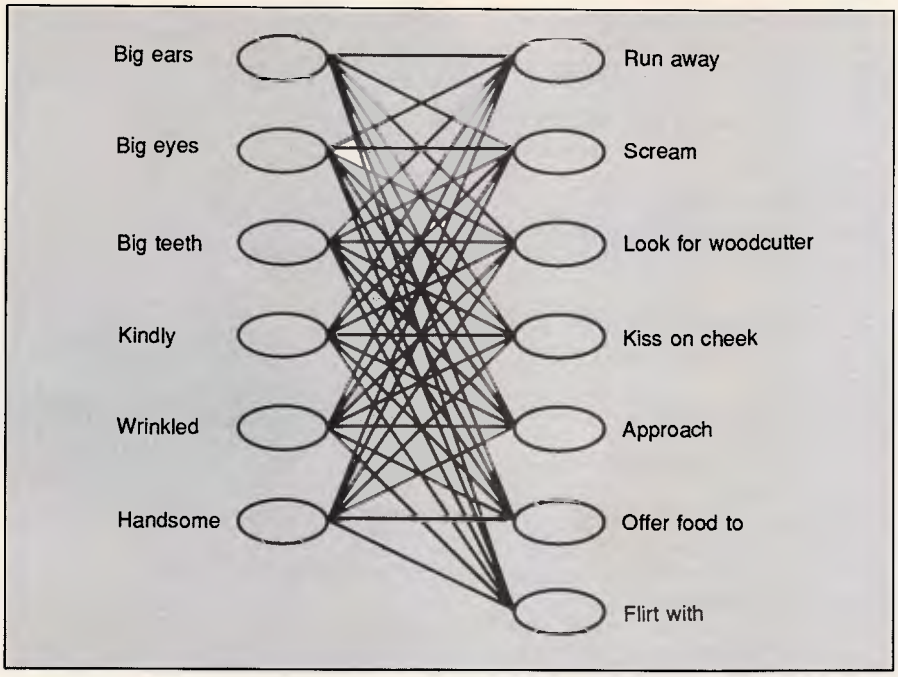

Fig 3 A network produced by the basic delta learning rule

received by B. We can then represent the absence of a connection between A and B by simply assigning w_{BA} a value of 0. An inhibitory relation between A and B can be represented by giving w_{BA} a negative value.

It is instructive to draw two important contrasts between the neural-network approach and a more conventional rule-based approach found in AI expert-system work:

- the knowledge of a neural network lies in its inter-unit connections and their weights. In contrast, much of the knowledge of an expert system lies in its rules (ie, its condition/action or if/then pairs).
- a neural network is driven by the activation that passes from units to other units. In contrast, an expert system is driven by symbols generated as a consequence of rule-firing.

Because only numerically valued activation passes from unit to unit in a neural network, neural networks are often said to involve a subsymbolic level of computation. A network's input,

Monday	Wednesday	XOR (M,W)
0	0	0
1	0	1
0	1	1
1	1	0

Table 1 The exclusive-OR problem

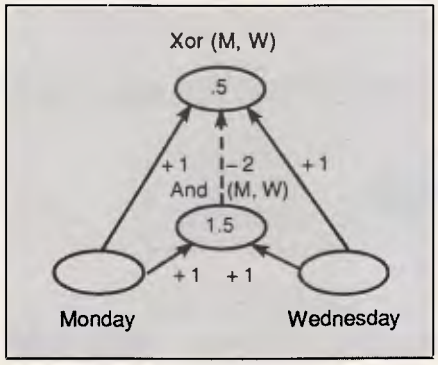

Fig 4 A network solution to the exclusive-OR problem

output, and internal state can all be characterised by patterns of activation across its nodes.

How can intelligent behaviour emerge from such very low level subsymbolic interactions among a network's units? It is sometimes helpful to view each unit as a classifier or a feature detector. Consider a simple example involving a tabula rasa Little Red Riding Hood who is sent to school to learn how to detect wolves in the forest. (Hopefully the school is not on the other side of the forest!) Little Red Riding Hood is shown a series of wolf pictures until she has internally formed the network depicted in Fig 2. Input primitives in this example are the features of 'big ears', 'big eyes', and 'big teeth'. For each feature, there is a corresponding input unit with a rate of firing (ie, an amount of output activation) that depends upon the extent to which this feature is detected in the outside world.

These input units, in turn, are connected to a unit corresponding to the 'wolf' classifier unit. The actions of this unit's threshold function may cause it to behave like a Boolean AND so that it fires only when all three wolf features are observed. As the unit's threshold is lowered, its functions increasingly like a Boolean inclusive-OR, such that any combination of wolf-features is sufficient to trigger the wolf classification. It is through the combined effects of large numbers of such classifiers and input-unit feature detectors that intelligent behaviour can emerge from a neural network.

The numerical base of the neural-network approach provides a ready means by which to represent continuous gradations in such things as the intensity of an input feature, the certainty of a classification, or the importance of a connection between two units. By contrast, such gradations are represented with great difficulty or not at all in most rule-based expert systems. Additional advantages of the neural-network approach may stem

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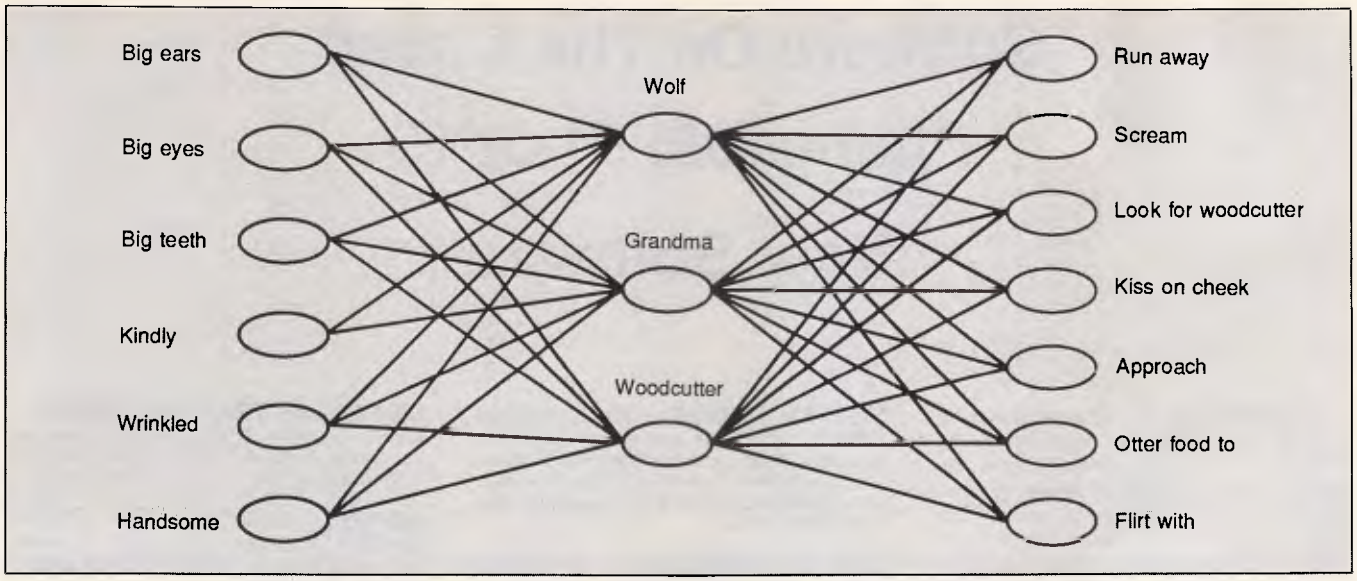

Fig 5 A network produced by the back-propagation learning rule

from properties of default assignment, content addressability, graceful degradation, and spontaneous generalisation (see reference 11).

But how are the connections and connection weights of a network determined? As the size of a network increases, it is no longer feasible for the human designer to determine network connections by hand, nor is it feasible to engage the computer in a brute-force iterative search for the right connections. In a network with only a single layer of connections — those connecting input units to output units — there is a simple and elegant learning heuristic, the delta rule, that gives a network an ability to form and modify its own connections in ways that often rapidly approach a performance optimum. A brief discussion of the delta rule (sometimes called the Widrow/Hoff rule [see reference 12]) serves as an introduction to its recent successor, the more general and more powerful back-propagation rule.

The basic delta rule

We describe the delta rule through the continuing education of our tabula rasa Little Red Riding Hood (LRRH). She will encounter three distinct beings in her world that we know as the wolf, the grandma, and the woodcutter. We limit LRRH to a single layer of connections between input nodes representing observable features and output nodes representing actions that LRRH can take. LRRH must learn to run away, scream, and look for the woodcutter when she detects a being with big ears, big eyes, and big teeth (the wolf). She must learn to approach, kiss on the cheek, and offer food to beings that are kindly, wrinkled, and that have big eyes (grandma). And she must learn to approach, offer food to, and flirt with beings that are handsome, kindly, and have big ears (the woodcutter).

Under these circumstances, the delta rule produced the network depicted in Fig 3, with red lines corresponding to negatively weighted connections, and blue lines corresponding to positively weighted connections. Some features in the network have more diagnostic value than others (eg, 'big teeth' versus 'big eyes'). However, LRRH need only correctly identify two features of a being in order to produce an appropriate set of actions using the network in Fig 3.

The training procedure used in conjunction with the delta rule to produce the network in Fig 3 is straightforward. There are three I/O training pairs, one each for the wolf, grandma, and the woodcutter. An input pattern I is represented by a vector of 0s and 1s that follow the ordering of input nodes in Fig 3. Thus, the input pattern for the wolf is {1 1 1 0 0 0}. The target output pattern T that we want LRRH to produce in response to an input pattern can be similarly represented. Thus, the target output pattern for the wolf is {1 1 1 0 0 0}. Before training begins, connections between all input nodes and all output nodes are formed, and each connection is randomly given a small, initialising weight.

Training using the delta rule then proceeds by cycling through the training pairs until a satisfactory level of performance is reached. On a given trail, the network first generates an output pattern O_p in response to the input pattern I_p of a training pair. This discrepancy, or delta, between the actual and the desired behaviour of the network is

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then determined by subtracting vector O_p from the target output pattern T_p of the training pattern. Under the delta rule, the post-trial change in the weight w_{ji} of a connection between input unit U_i and output unit O_j is a function of the activation I_{pi} of the input unit and the delta $(T_{pj} - O_{pj})$ associated with the output unit. Specifically,

$$\Delta w_{ji} = n(T_{pj} - O_{pj})I_{pi} \qquad (1)$$

where n represents a trail-independent learning rate. (As the learning rate increases, so too does the risk of oscillatory behaviour.)

The delta rule essentially assigns credit (or blame) to the input units according to their activation levels; the more active an input unit, the more responsible it is (or should be) for the current distribution of activation among output units. The effect, then, is that connections pointing from the more active input units of a trial will undergo the largest modification in their weights. At the same time, among connections pointing from a given input unit, the larger modifications will involve those connections that point to output units with larger associated deltas (ie, discrepancies between actual and target activation levels).

It can be shown that the delta rule belongs to a class of gradient or steepest-descent heuristics. This means that the delta rule will cause a network of connections to change in directions that maximise the change in an error term that sums the squares of output deltas. One way to view this feature is to see the delta rule as a skier who always moves with the fall-line in a breakneck journey back to the clubhouse.

Limitations of the basic delta rule

The basic delta rule works quite well at assigning connections and connection weights in single-layered systems (involving only input units and output units), but it is unable to determine connection weights in a multi-layered system involving hidden units (units that have no direct contacts with the outside world). In a careful analysis done nearly 20 years ago, Minsky and Papert (see reference 7) delineated a number of interesting computations that single-layered systems cannot perform. For example, they cannot compute the exclusive-OR. To take a concrete situation, a single-layer system cannot learn a preference for classes meeting on Monday or Wednesday evenings but not (eg, because of time constraints) meeting both evenings. Table 1 illustrates the problem. There is simply no linear combination of variables M or W (for Monday and Wednesday classes, respectively) that will generate the desired values of the exclusive-OR.

In a sense, single-layered networks are limited to computations that map similar-looking input patterns into similar-looking output patterns. In many computations such as the exclusive-OR relation or the more general parity computation, a small change in the input pattern may necessitate a drastic change in the desired output pattern. In these instances, we need multiple-layered networks with hidden units.

'A neural network's input, output and internal state can all be characterised by the patterns of node activation.'

Through hidden units, the system can represent abstractions that it cannot directly encode from the environment via input nodes.

Fig 4 illustrates that a simple two-level network with only one hidden unit can compute the exclusive-OR. In this case, the hidden unit represents the abstraction 'Monday and Wednesday'. With the right set of connections to and from a large enough set of hidden units, a network can perform any desired mapping between input and output. (It is often the case that hidden units will also reduce the number of connections needed to perform a particular computation — a point we return to in the example of the next section.) Much of the current resurgence of interest in neural networks can be traced to the development of a powerful generalisation of the delta rule that can arrive at such a set of connections in a multi-layered system. This back-propagation rule (see reference 8) is described in the next section.

Back-propagation

The equation that determines weight changes under the back-propagation rule is similar in form to that of equation 1. However, the back-propagation rule provides a more general means of computing the delta of a unit. On a given trial, the delta of an output unit is computed in much the same way as it is computed in the basic delta rule. Specifically,

$$\sigma_{pj} = (T_{pj} - O_{pj})f'_j(net_{pj}) \qquad (2)$$

where $f'_j(net_{pj})$ is the derivative of a 'squashing' function that operates on the sum of the inputs to a unit in order to determine the unit's output. A squashing function is a special kind of threshold function that is differentiable and nondecreasing. Such a function can be found in the listing of our C language implementation of the back-propagation rule. (*The source code for bpsim.c is available on Microtex, page *6663#. bpsim.c, which must be compiled and run on Unix systems, illustrates the Little Red Riding Hood example in this article.)* In a linear system with no squashing function, the output of a unit equals its input. In this special circumstance, the delta produced by the back-propagation rule is identical to that produced by the basic delta rule.

The real power of the back-propagation rule comes from its assignment of deltas to hidden units that receive no

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direct feedback from training patterns in the outside world. These deltas, in turn, influence the modifications of weights to connections leading into the hidden units. The delta for a hidden unit is computed as follows:

$$\sigma_{pj} = f'_j(net_{pj})\sum_k \sigma_{pk} w_{kj} \qquad (3)$$

This is a recursive definition in which the unit's delta is determined by the derivative of its squashing function multiplied by the weighted sum of the deltas to which the unit sends activation via outgoing connections. A given delta term σ_{pk} in the summation is, in fact, weighted by the strength of the connection pointing from the hidden unit U_j to the unit U_k that is the source of the delta.

As the back-propagation rule's name suggests, the basic idea behind this computation of deltas for internal units is to propagate back through the system errors that are based on observed discrepancies between the values of output units and a training pattern. The deltas are first computed for the output units, and these are then propagated backward to all units pointing to the output units in the layer below. These units, in turn, propagate their received deltas backward to units that point to them, and so on, until the input level is reached. These deltas then drive the network's weight changes in much the same way as with the basic delta rule; the back-propagation rule, like its basic delta rule predecessor, is a gradient-descent heuristic.

We return to the tutoring of Little Red Riding Hood to illustrate the effects of the back-propagation rule with a more concrete example. Suppose we were to follow the same training procedure used to generate the network in Fig 3, but now we introduce three hidden units. Initially, each input unit is connected (with some low, randomly determined weight) to all three hidden units; similarly, each hidden unit is connected to all output units. No connections are permitted that directly connect input to output units. We now have two layers of connections, necessitating the use of the back-propagation learning rule.

Fig 5 shows the results of this experiment. Interestingly, the hidden units have come to represent internally the concepts for wolves, grandmas, and woodcutters. It is often the case that hidden units, through the actions of back-propagation, will come to represent useful abstractions of the outside world. Note that the I/O mapping in this example does not require the use of hidden units. As Fig 3 indicates, this mapping can be accomplished without hidden units using the basic delta rule. It is, nevertheless, interesting to note that the introduction of hidden units in Fig 5 reduces the number of connections needed to represent the mapping.

Applications and future directions

In principle, the use of the back-propagation algorithm would seem to give a system the ability to induce an I/O mapping of arbitrary complexity — providing that the system has enough units and connections at its disposal. As such, the back-propagation algorithm and related work may profoundly alter our use of computers. Much of the current applied work on neural networks is focused on the construction of pattern-recognition systems (ie, systems that can recognise handwriting,

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gestures, images, and so on). But the range of potential applications is clearly much broader.

Consider the economic value of a system that observes and eventually mimics the behaviour of a domain expert. Currently, the construction of expert systems often requires an enormous amount of effort. Rules must be laboriously abstracted, entered, and checked for potential incompatibilities with the existing rule base. Moreover, as the saying goes, 'rules are made to be broken'. All too often, expert systems are brittle, so that their performance precipitously degrades in situations not anticipated by their human designers. As an alternative, a neural-network approach using back-propagation may give us a system that essentially builds its own rule base with a minimum of outside intervention, so that over time it gradually takes over the tasks of the human expert. In this direction, work is currently under way to build an adaptive neural-network system to aid in fault detection and diagnosis in a chemical-engineering plant (see reference 13).

On the downside, neural-network implementations involving the back-propagation rule can be demanding of computational resources (see reference 14). As we noted, one general approach to this problem is to completely redo machine architecture in ways that support massively parallel computation. It may also turn out that many important applications permit limited implementations of the back-propagation rule that are extremely fast even on today's smaller computers.

Will the neural-network approach, in conjunction with techniques such as the back-propagation rule, usher in a new age of computing? Or will it, like so many developments in the AI field, prove to have a grasp that falls far short of its reach? Only time will tell.

END

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LETTERS

This is your chance to air your views — send your letters or contact us via Microtex on Telecom's Viatel, page 666. The address to write to us is Australian Personal Computer, 124 Castlereagh Street, Sydney 2000.

Compression queries

I was excited to read of the Data Compression Programming Competition being run by *APC* in conjunction with Microsoft, and immediately started to prepare an entry.

However, a closer examination of the rules revealed a number of ambiguities that make it difficult for me to continue. Here they are, listed in order of difficulty:

1. Is it permissible for a single person to enter more than one program into the competition (assuming of course that each program is entered separately)?

2. Rule 5 states that 'only Microsoft languages may be utilised'. Does this restriction mean that the program must be written in a programming language for which Microsoft provides a language system or does it mean that the program must be implemented using a Microsoft language system? Does it make sense, for example, to ask whether Pascal is a Microsoft language?

3. Does 'the time taken to compress a file' mean the time taken to compress the file only, or the sum of the compression and decompression times? Some algorithms take a long time to compress and a short time to decompress and vice versa.

4. What exactly is meant by the statement 'All programs must be able to run in one of the following environments: . . . on either a Macintosh Plus or Macintosh SE'? Does this mean that a Macintosh entry should be able to run on both machines or on just one of them as designated by the competitor?

5. What can be assumed about the amount of memory and disk space available to the executing program? If a RAM disk is to be used during the judging, will each entry have to run with less than the usual 1Mbyte of RAM found in an SE? How much spare disk space can programs assume that they have available to work with?

6. On the top left corner of page 40 of September 1987 *APC*, it is stated that 'all programs received will be evaluated on the same machine, utilising a freshly formatted RAM disk to eliminate any discrimination due to disk fragmentation between runs'. How can all the programs be run on the same machine when the competition is open to programs for both the IBM PC and the Macintosh? Will the different clock speeds and the different powers of the instruction sets be taken into account when measuring speed?

7. What exactly is the optimal speed/compression trade off? As the article describing the competition does not rule speed out of the judging equation, it is necessary for contestants to have an idea of how important speed really is. The only clues are on page 39 ('remember, the time taken to compress files is of little significance, and if program A provides twice the compression of program B but takes twice as long to run, then program A will win') and on page 40 ('remember that speed is not of primary importance, but if two programs achieve very similar compression ratios, then the faster program will win'), and these do not really provide much assistance to an entrant trying to evaluate many compression programs whose compression/speed tradeoffs are different.

What if one program takes ten times as long but gives two per cent better compression? What about twenty times and one per cent. I believe that contestants should be given a more accurate idea of where the line is to be drawn. Ideally, this should be supplied in the form of an evaluation function $e(c, t)$ where c is the final file size divided by the initial file size and t is the time taken to perform the compression (in seconds).

8. Overwhelmingly, the governing factor in the design of a data compression algorithm is the nature of the data. While it is, of course, necessary for the judging panel to keep secret the actual files that will be used to test the entries, I feel that contestants should be given a better idea of the mix of files that are to be used in the judging and the rough weightings associated with each. Do bigger files get bigger weightings for example? If this were so, then a compressor that is good at compressing databases would have an advantage. Will most of the files be English text? If they are, then a compressor that knows all about English texts will have an advantage. The point is that if a very good but absolutely 'general' compressor were entered into this competition, it would most likely lose. Because of the likely ferocity of competition, the winning entry will be not the best compressor in general, but rather the one that happens to be specifically tailored for the selection of files chosen by the judges. This selection is presumably meant to represent the selection of files found on a 'typical' installation, but what is typical?

Without this information, contestants can only lay their bets and wait. There is no such thing as a 'best' data compression technique. The 'best' can only be defined over a probability distribution of possible files.

I realise that the last few questions may be difficult or messy to answer but some sort of indication would be appreciated.

Finally, I must thank *APC* and Microsoft for running this competition which has provided me with an interesting opportunity to test my data compression algorithms.

R Williams

It's good to see that interest in our little extravaganza has been sparked so quickly. Looks pretty serious, too.

In terms of the number of entries, we did not place any restrictions as we really didn't expect the question to arise. You'll know which of your algorithms works best before you send it in, and it will be measured against all sets of data. Just send in your best shot, and if that happens to transparently en-

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compass three different techniques, then that's fine. Just so long as it looks like one program to us.

In terms of Microsoft languages, this means what it says — the program must run under a Microsoft implementation of a language. In other words, Turbo Pascal is not acceptable but Microsoft Pascal is. This should not prove to be a problem, though, as Microsoft has good implementations of most major languages.

The programs may run on either a Macintosh SE or Macintosh Plus, or an IBM PC. In other words, one of the Macintoshes, or the IBM PC, at your discretion. When we said that all entries will be run on the same machine, we really didn't mean that the Macintosh entries would be run on a PC or vice versa. All we meant was that the environment will be controlled and nobody will be disadvantaged by the environment.

While we didn't want to get into too much detail early in the piece, next month we will publish full details of the scoring method which takes into account compression and decompression speeds which compensate for the relative speeds of the machines and also the degree of compression. Speed will be of a very minor importance, so long as the system executes in a reasonable amount of time. This will all be quantified next month.

Finally, Mr Williams raises a valid point concerning the type and size of the data streams. Surely you don't expect $30,000 for a push over! The details of the data files used for evaluation will remain undisclosed, but it is a fair assumption that we will provide a wide variety of text data, including binary data, text, database files and executable programs, and different sizes of each.

The challenge is to create a system which performs well over the entire range of files.

It's certainly a bit tricky, but we reckon it's worth a shot and still stands to be the quickest $30k one APC *reader will make.*

I Davies

Money changes everything

I have just finished reading the review of IBM's new series of computers, the System 2 (*APC*, May), and can't help wondering if IBM isn't assuming too much.

I do not have the necessary statistics, but I believe there must be millions of the old IBM PC and compatibles that use 5¼in in use today. Does IBM expect that we would just throw our (now archaic) 5¼in-based machines out of the window and buy its new machines?

Technically the new machines are superior, but I wonder how quickly they will replace the old machines? And if, as the review implies, the new IBM machines are difficult to clone, wouldn't the likes of me stick to our old machines? And if everyone (humour me) refuses to budge, how can IBM make the machines as acceptable as it did with its PC? Or will corporate users (whom I suspect mostly use minis and mainframes anyway) be the first to try out the System 2 on a large scale?

My intention is to wait and see before I trade in my 'old faithful'.

A Sambo

I suspect you underestimate the power of IBM in the computer market. As I write, the company is having to disprove rumours that its PS/2 machines are not selling. No-one wants to believe that they won't succeed. IBM's charisma and marketing ability is still strong.

Think for yourself. If someone offered you unlimited funds, wouldn't you think seriously about buying an IBM PS/2 rather than a clone?

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LETTERS

Windows catch

I read with great interest the article 'All Systems Go' by Robert Schifreen in your September issue.

As a small business user I run a word processor, spreadsheet, database and communication link (for telex). Customer calls often mean that I have to go from the application I am using into one of the others. It is a pain having to exit from one program and enter another, and then reverse the process to get back to what you were doing.

As far as I am aware, there are no decent application programs available under Windows. Are the big software houses going to release versions for Windows 2 and/or Windows 386, or are they going straight for OS/2 and Presentation Manager?

R Smith

I'm duty bound not to reveal what I know about multi-tasking environments but you can be sure of getting the most up-to-date reviews on APC *pages.*

Breaking the code

Are any of your readers aware of the solution to the so-called 'travelling salesman' problem? This was supposed to have no easy solution until a few years ago, when there were reports that a Soviet mathematician had cracked it.

The problem is that a salesman must visit all the towns in a given network, with minimum mileage, the distances between towns being given.

It would undoubtedly be of great interest to many readers if you were to publish the Soviet algorithm.

G Sassoon

Anyone know the solution?

A change of style

The recent article by Mark Burgess on programming style was, I assume, intended to stimulate a response. I would like to offer my input.

I agree entirely with the idea of presenting programs in a format which offers some clues as to their structure. Burgess' methods serve well for programs contained within a single file: larger applications require yet more clarification.

In an effort to achieve this, I adopted a similar approach some years ago for ('C') source but with some differences.

The simple use of 'level 1' as a description gives no real information as to a function's location in the hierarchy. Further, it seemed to me that very few programs require a hierarchy which was more than five or six levels deep. I therefore defined the levels as follows:

Control level

Highest level function, either Main() itself or the functions called by main(). Unlikely to be carrying out any direct I/O or data handling but, if so, then this would be command choices or types at the highest level.

Control level functions will call functions at the preparation or handler level.

Preparation level

Called by control level functions, this level may be considered as a sidestep in the hierarchy. Typically used for initialisation functions. It need not be present in all cases.

Handler level

The logical level below the control level. This level handles the fundamental activities of the program. Data types at this level may be complex. It may be considered analogous to an executive in a multi-tasking system. The handler level despatches commands or calls to the select level.

For example, in a windowing environment, this level would be responsible for selecting and passing control to the appropriate window. (Not all applications may require this level.)

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the appropriate action to be taken. This may require user input to select a choice or it may allow field-to-field movement on a screen. I/O at this level would determine *which* task is to be carried out.

Data types at this level may be complex, but not more complex than at the handler level.

Data level

Data I/O functions, user and other input routines, screen control functions and device drivers. This level provides and responds to the actual data required by the select level.

Service level

This level contains all the 'dumb' functions (or toolkits as Burgess calls them). Although they may be called from any level, they would most typically be called by the data and select levels. At this level functions should be standalone and operate on simple data types. They would usually be held in a library, grouped according to their function — screen control, string handling, for example.

The above definitions are used with the following further conditions:

- Functions of different type are rarely held in the same file (module).
- Each function (or at a minimum each file) has a heading of the form shown.
- A separate border style is chosen to delineate each level type.

I hope these comments will be of some interest and look forward to seeing more discussion on this subject.

C Masterson

END

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Graphic algorithms

When you have mastered the basic mathematical principles, creating simple algorithms for computer graphics should result in some sophisticated drawing programs. Mark Parlour guides you step by step through the routines involved.

This article outlines simple algorithms for plotting lines and circles and for filling areas of the screen. The algorithms can be used in high or low-level languages, and rely on some knowledge of mathematics to explain how the techniques are derived from the equations of lines and circles.

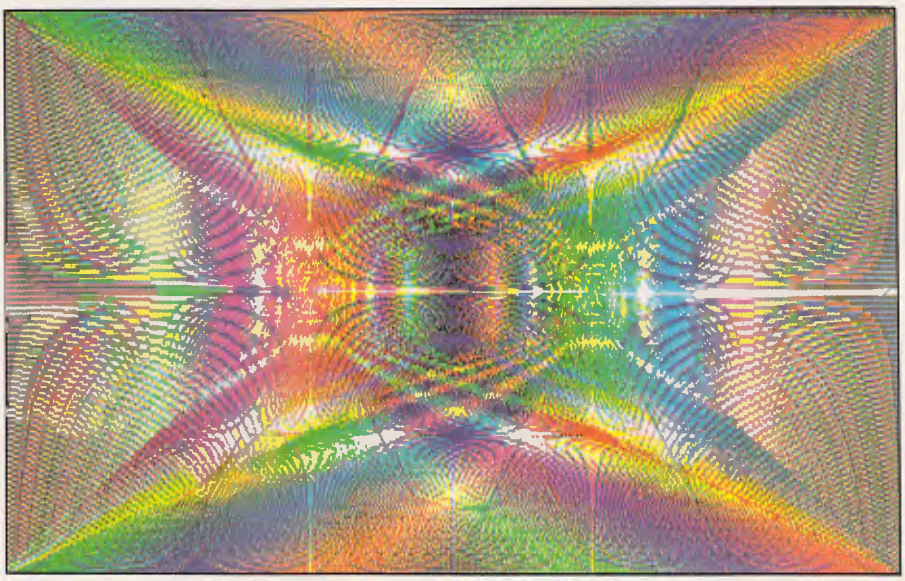
Before considering line plotting, it is necessary to investigate the problem at a lower level: that of plotting individual points (pixels) on the screen.

Plotting points onscreen

Consider a high-resolution screen of 640x200 plottable points: that is, X coordinates of 0-639 and Y coordinates of 0-199. It is essential that we are able to set or test the colour of any pixel of our choice on this screen.

Ideally, we should be able to directly access any point by reference to its coordinates, but there are three principle reasons why this is usually impossible. Firstly, the pixels are not stored in a simple sequence reflecting their position on the screen. Secondly, although each pixel needs only one bit to represent on or off, encoding colour may involve a sequence of bits or multiple images of the same screen encoding different primary colours. Thirdly, we may want to access a single bit but the smallest data item we can read or write directly is a byte, so some extra manipulations (shifts and logical operations) will have to be performed to access individual bits.

Fig 1 shows a fairly typical screen layout for a monochrome display in which we want to access pixel (13,5). The screen is composed of 80 columns by 50 lines of blocks, where each block comprises four bars of eight pixels. To access the pixel we must first access the byte (bar) in which it resides.



Patience and perseverance with basic mathematics could lead to programming skills which enable you to create elaborate graphical displays

Given an X coordinate, we know that if we divided this by eight we would get a result of the block position with a remainder which indicated the bit position within that byte. More specifically:

```
block = X div 8
pixel = X mod 8 (equivalent to
  X AND 7)
```

which for X=13 gives block 1, pixel 5. Likewise, dividing the Y coordinate by four gives us the line number with a remainder which denotes the bar position on that line. Hence:

```
line = Y div 4
bar = Y mod 4 (equivalent to Y
  AND 3)
```

which for Y=5 gives line 1, bar 1. Thus the address of any byte (its offset from the start of the screen) can be calculated as:

```
total bars = (line *80 *4) + (block
  *4) + (bar)
total bars = ( (line *80 + block) *4)
  + bar
```

Thus for pixel (13,5), the address = (1 *80 + 1) *4 + 1 which is byte 326 of the screen.

In Pascal we may access the byte simply as:

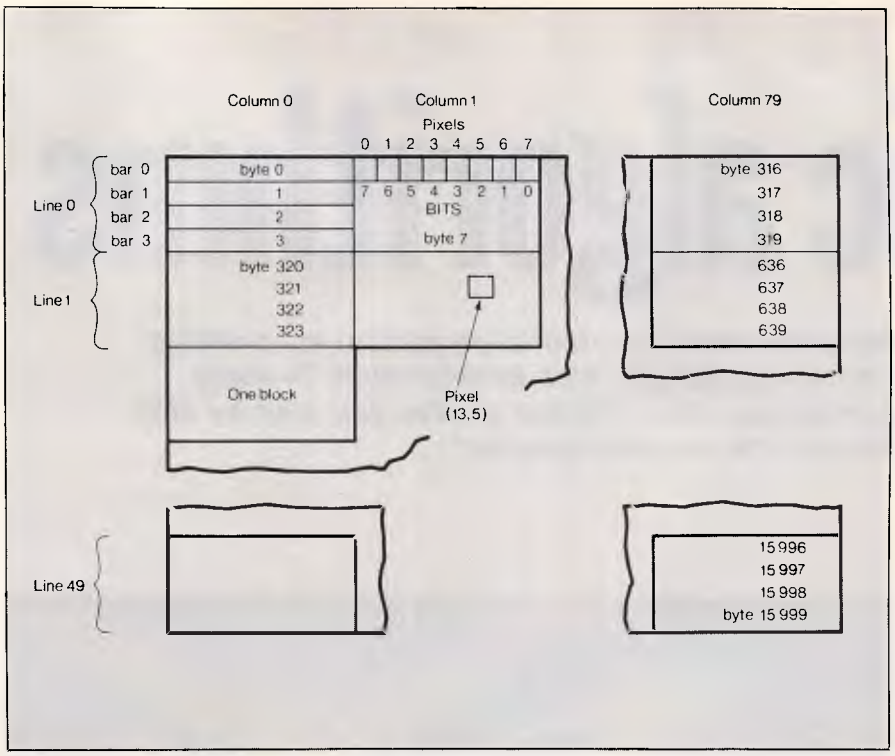


Fig 1 This diagram represents a screen which is 80x50 lines and 640x200 pixels. Most screens are organised similarly but with differing sizes

address = (X div 8) *4 + Y div 4 *320 + Y AND 3

In the calculation, AND is used rather than MOD because it is quicker.

In a low-level language the coordinates have to be split first (as shown in Fig 2 for the Intel 8086/8) by using shift operations on the register specified. The offset can then be calculated by a series of multiplications and additions.

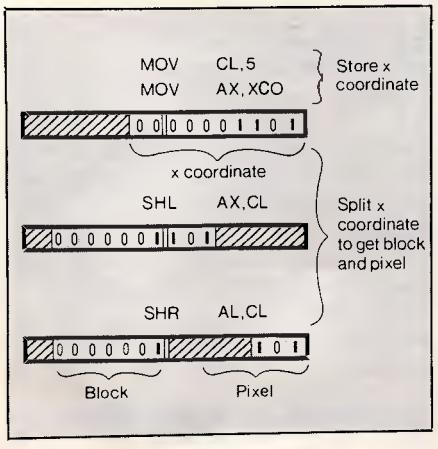


Fig 2 Splitting coordinates in a low–level language (the Intel 8086/8)

To set any pixel we need some knowledge of the logical operators NOT, AND, OR and XOR shown in the logical truth tables (Fig 3).

Fig 4 shows the situation of a screen bar containing the pattern 10100001 in which we want to set pixel 5 (or bit 2).

A	NOT A
0	1
1	0

A	B	A AND B
0	0	0
0	1	0
1	0	0
1	1	1

A	B	A OR B
0	0	0
0	1	1
1	0	1
1	1	1

A	B	A XOR B
0	0	0
0	1	1
1	0	1
1	1	0

Fig 3 Truth tables

Fig 3 Truth tables

We must first create an 'OR mask' by loading a bit into an empty byte (a) and shifting it into place (b). If we perform logical OR with this mask on the screen byte (c), you will see that this sets only bit 2 and leaves the others unchanged (d). The mask acts as a stencil: you create the mask to 'expose' the byte to be affected and then 'spray' the operation through it onto the byte. Likewise, to clear that same bit at a later time we must prepare an 'AND mask' (e) by inverting the OR mask using the NOT operator.

In fact, XOR operations are frequently used employing the OR mask because the required bit is set on the first call and cleared when called again using the same mask. Note, however, that if the bit is already set it will be cleared on the first call using this technique. The main use of this technique is in overlaying a simple moving image (for example, a cursor or a sprite) over a complex background image without corrupting it.

In Pascal, the OR mask is constructed by mask := 128 SHR(X AND 7) and the relevant bit is set by ORing or read by ANDing it with the current byte at the calculated address, as shown in Fig 5.

Drawing a line

Shown below is a representation of a line from position (0,0) to position (9,5). Because the difference in the X axis (dX) is greater than the difference in the Y axis (dY) there is only one point plotted for every X value within the range, whereas there are always one or more points plotted for every position of the Y axis. The axis which only has one point plotted is called the major axis and the one which has one or more points plotted is called the minor axis.

```
          5 . . . . . . . . . *
          4 . . . . . . . * * .
Y         3 . . . . . * * . . .
(minor)   2 . . . * * . . . . .
axis      1 . * * . . . . . . .
          0 * . . . . . . . . .
            0 1 2 3 4 5 6 7 8 9
                X (major) axis
```

I'll now consider three methods of drawing the line, each relying on looping through every value on the major axis and plotting the point using the corresponding minor axis coordinate. Because of this, there exist four types of line depending on which is the major axis and whether the gradient is posi-

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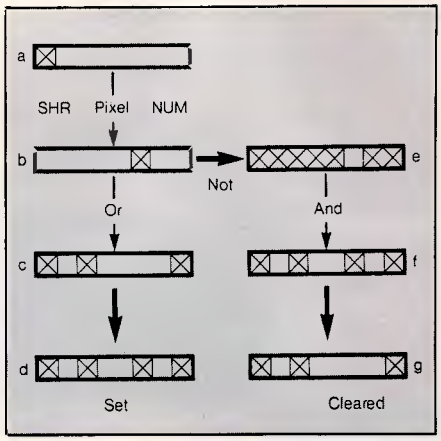

Fig 4 The situation of a screen bar containing the pattern 10100001

tive or negative. The decision algorithm is shown in Fig 6. Given coordinates are X1, Y1, X2, Y2 for the points (X1,Y1), (X2,Y2) at the ends of a line.

For each of the three methods of drawing the line I'll now consider the case of X major positive as above.

Direct method

We know that a line through the origin (0,0) is described by the equation y = mx (where m is the gradient dY/dX). So, by adding 1 to the major axis displacement and adding the gradient to the minor axis displacement (rounded down, we may calculate the new coordinates each time: because we are using the minor axis, the gradient will always be less than one, ensuring that no points are omitted during plotting.

```
let Y = Y1
for X = X1 to X2
  pset(X, round(Y) )
  let Y = Y + gradient
```

There are problems with precision if we try to store these values accurately (while at the same time making the routine as fast as possible) and there are many elaborate ways of solving this problem — for example, using fixed point arithmetic (see 'Simple arithmetic', *APC*, September 1986).

The integer digital differential analyser method

Rather than calculate the gradient directly, it is possible to set up a guide value or 'dump'. This dump is a constant value and its use simplifies the calculations which the computer has to perform. This in turn means that the calculations will proceed more quickly, so the line will be drawn more quickly. In this case, dX is 9 and dY is 5, so the gradient is 5/9. This is not an integer and its addition to Y followed by rounding Y down takes longer than if only integer operations were used. The best way to understand the use of a dump is to try out these values in the algorithm below. We subtract dY from the dump each time we increment X, and only increment Y when the dump drops below zero (at which time dX is added to it). At the end of the process we will have added 5 steps of 9 and subtracted 9 sets of 5, so the gradient will be preserved. The dump is initialised to half dX to ensure that the line appears balanced around a central axis.

```
let dump = dX div 2
for loop = X1 to X2
  pset (x,y)
  let x = x + 1
  let dump = dump - dY
  if dump < 0
    then
      let y = y + 1
      let dump = dump + dX
```

Through using integer arithmetic, this is a very simple and fast routine.

```
VAR
  address : integer ; mask : BYTE;
  screen : array [0..8000] of byte absolute $3C00:$0000;
procedure PSET (X : integer; Y, C : byte);
  begin
    address := (X DIV 8) *4 + Y DIV 4 * 320 + Y AND 3;
    mask := 128 SHR (x AND 7);
    screen[address] := screen[address] OR mask
  end;
function pget (X : integer; Y : byte):boolean;
  begin
    address := (X DIV 8) * 4 + Y DIV 4 * 320 + Y AND 3;
    mask := 128 SHR (x AND 7) ;
    if (screen[address] AND mask)>0 then pget:=1 else pget:=0
  end;
```

Fig 5 Constructing the OR mask with mask:=128 SHR (X and 7)

```
let dx = X2-X1
let dy = Y2-Y1
if abs(dx) > abs(dy)
  then (X_MAJOR)
    if X1>X2 then swap
       (X1,Y1) with (X2,Y2)
    let gradient = dy/dx
    if gradient < 0
      then call X_MAJOR
        POSITIVE routine
      else call X_MAJOR
        NEGATIVE routine
  else (Y_MAJOR)
    if Y1>Y2 then swap (X1,Y1)
with (X2,yY)
    let gradient = dx/dy
    if gradient < 0
      then call Y_MAJOR
        POSITIVE routine
      else call Y_MAJOR
        NEGATIVE routine
```

Fig 6 Decision algorithm

However, the problem with it is that a number of calculations are performed each time to find whether the minor axis shift (y = y + 1) should occur. Also, in this version, the plotting position is calculated afresh each time whereas only the relative change from the last position need be known.

Residual gradient dump using relative shift plotting

We know that the gradient is never greater than 1 because of the way we define the major and minor axes. It is possible to use an extension of the first algorithm a 'residual fractional dump' (from 0 to 0.999.) to which the gradient is added each time and a minor axis shift is only performed when the dump becomes greater than one. Only now is the fact that there is a surplus *significant*. All points are now plotted by shifts relative to the last point without reference to its absolute position. Therefore, the necessary accuracy is

```
let loop counter = dX + 1
set pixel (X1,Y1)
repeat
  dump = dump + fractional
    gradient
  shift pixel right (increment X)
  if carry signalled then shift
    pixel up (increment Y)
  decrement loop counter
until loop counter = 0
```

Fig 7 Residual gradient dump using relative shift plotting

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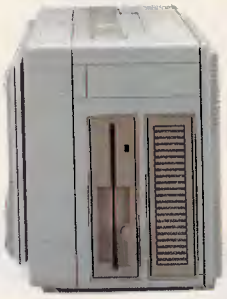

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Video bandwidth: 16MHz (−3dB)
Scanning frequency:
Horizontal: 18·432 +−0·1KHz
Vertical: 50HZ +−0·5%
Active display area:
216(H) x 160(V)mm
Display charactars:
80 characters x 25 lines
Input connector: 9 pin connector
Controls:
Front; Power ON/OFF, Contrast.
Rear; V-Hold, V·Size, Brightness
Internal; Vertical Linearity, Horizontal Linearity, Horizontal Width, Focus.
Power supply: 110/120V 60Hz, 220/240V 50 Hz
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Shipping weight: 8·3Kg

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Vertical: 60Hz
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Rasolution:
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Vertical: 200 lines
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Phosphor: Green (P42)
Video input signal: Composite/TTL Switchable
Poiarity: Negative/Positive
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Impedance: 75ohm, more than 6·8K ohm
Scanning frequency:
Horizontal: 15.75 KHz +−0·1%/18·432KHz+−0·1%
Vertical: 47-63Hz
Video bandwidth: 20MHz
Active display araa:
Composite: 206(H) x 160(V)mm.
TTL: 216(H) x 160(V)mm
Display character:
80 characters x 25 rows.
Input terminal: Phono Pin Jack, 9 pin D-Sub Connactor.
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Inside: H-Width, H/V linearity, Focus, H/V-Shift.
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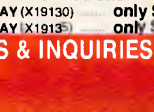

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Phosphor: Available in Green or Amber
Video input signal: Composite Signal
Poiarity: Negative Sync
Level: 0·5-2·0Vp-p
Impedance: 75ohm
Scanning frequency:
Horizontal: 15.734 KHz +−0·1%
Vertical: 50-60Hz
Video bandwidth: 20MHz
Active display area:
216(H) x 160(V)mm.
Display character:
80 character x 24 rows.
Input terminal: RCA Phono Jack.
Controls:
Outside: Power Switch, Contrast, Brightness, H-Shift, V-Size.
Inside: H-Width, H/V hold, H/V linearity, Focus.
Power supply: 110/120V 60Hz, 220/240V 50Hz
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- High resolution, 80 or 40 character display

SPECIFICATIONS....
Picture tube: 12" diagonal and 90° deflection
Phosphor: Available in Green (P39) or Amber
Video input signal: Composite Signal
Polarity: Negative Sync.
Level: 0·5V-2·0Vp-p
Scanning frequency:
Horizontal: 15.734 KHz + – 0·1%
Vertical: 60Hz
Video bandwidth: 20MHz
Active display area: 216(H) x 160(V)mm
Display character: 80 characters x 25 rows.
input terminal: RCA Phono Jack
Controls:
Outside: Power Switch, Contrast, Brightness, H-Shift, V-Size.
inside: H-Width, H/V hold, H/V linearity, Focus.
Power supply: 110/120V 60Hz, 220/240V 50Hz
Dimensions: 308(W) x 307(H) x 297(L)mm
Weight: 7·3 Kg
Shipping weight: 8·3 Kg

Cat.No.	Description	Price
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- Bell 103 300 Full duplex
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MasterCard VISA

Listing 1: 8088 machine code for setting individual pixels on a Sanyo MBC555

```
;PIXEL SETTING ROUTINE FOR SANYO MBC INTEL 8088
;R.M.PARLOUR. FOR TURBO PASCAL   defined by
;PROCEDURE PSET(X,Y:integer;C:byte);external 'pset';


CSEG SEGMENT 'CODE'
assume cs:cseg
pset PROC near
;
   X      EQU [BP+08]
   Y      EQU [BP+06]
COLOUR    EQU [BP+04]
RED       EQU 0F000H
GREEN     EQU 03C00H
BLUE      EQU 0F400H
;
PUSH    bp    ; save the base pointer
MOV BP,SP     ;save  SP to access parameters
PUSH DS       ;DS must not be corrupted
;
;split the x coordinate into columns + pixels
;============================================
;
MOV       AX,X              ;load the x coordinate
MOV       CL,05             ;prepare 5 bit shift
MOV       DX,AX             ;copy x coord into DX
AND       DL,00000111B      ;DL = 3 bit pixel position
SHL       AX,CL             ;AH = 7 bit column position
MOV       DH,AH             ;DH = column position
;
;split the y coordinate into lines + bars
;========================================
;
MOV       AX,Y              ;load the y coordinate
INC       CL                ;prepare 6 bit shift
MOV       BX,AX             ;copy y coord into BX
AND       BL,00000011B      ;BL = 2 bit bar position
SHL       AX,CL             ;AH = 5 bit line position
MOV       BH,AH             ;BH = line position
;
;calculate the pixel's byte offset from screen start
;===================================================
XOR       AH,AH    ;clear AH
MOV       AL,BH    ;AL = lines
MOV       BH,50h   ;BH = 80 (columns per line)
MUL       BH;AX     AX = lines*80 = blocks
XOR       CH,CH    ;clear CH
MOV       CL,DH    ;CL = columns within line
ADD       AX,CX    ;AX = total columns offset
SHL       AX,1     ;AX = AX*2
SHL       AX,1     ;AX = AX*2 = offset in bars to block
MOV       CL,BL    ;CL = bars within block
ADD       AX,CX    ;AX = total offset in bytes
MOV       SI,AX    ;load memory pointer with offset
;
;prepare byte and masks for plotting
;===================================
MOV       CL,DL          ;load pixel position for shift
MOV       AL,10000000B ;set leftmost bit
SHR       AL,CL          ;and shift into positon
MOV       AH,AL          ;copy OR MASK into AH
NOT       AH             ;convert to AND MASK
;
;test and plot pixel on each screen in turn
;==========================================
MOV       CH,colour      ;load CH with pixel colour
MOV       DH,00000100B ;initialise test bit (red)
MOV       BX,red         ;operate on red screen
CALL      DISPLAY        ;display pixel
MOV       BX,green       ;operate on green screen
CALL      DISPLAY        ;display pixel
MOV       BX,blue        ;operate on blue screen
CALL      DISPLAY        ;display pixel
;
POP DS
MOV SP,BP
POP BP
RET 6      ;return from pset and discard parameters
;
;display procedure
DISPLAY PROC NEAR
MOV       DS,BX          ;load screen offset into DS reg
MOV       CL,CH          ;copy colour test bit into CL
TEST      DH,CL          ;test whether to set or clear pixel
JZ        CLEARPIX       ;if no match clear the pixel
OR        [SI],AL        ;else set pixel using the OR mask
JMP       NEXTCOL        ;and jump over to the colour rotate
CLEARPIX:
AND       [SI],AH        ;clear the pixel using the AND mask
NEXTCOL:
SHR       DH,1           ;shift next colour test into position
RET                      ;return from display procedure
DISPLAY ENDP
PSET ENDP
CSEG ENDS
END
```

achieved using a dump of two bytes on which addition alone is performed, and then the decisions are reduced to a simple test of carry so the speed of the routine is maximised (Fig 7).

Shift logic

The shifting procedure warrants some description as it can be used in a wide variety of graphics algorithms and has the benefit of being very fast (for example, to recalculate the screen address and offset each time on the 8088 takes around 221 clock cycles, whereas to shift takes between 32 and 40).

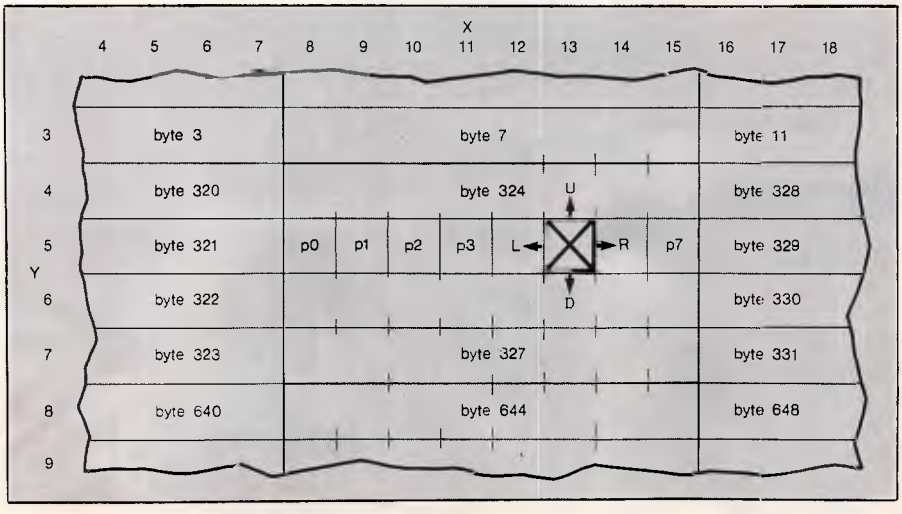

Fig 8 Travelling up, down, left or right from the central pixel can be done by adding/subtracting 1 from the byte address or by shifting the bits in the byte left or right

Fig 8 shows pixel 13,5 marked X. To move up we simply subtract 1 from the address pointer; likewise, to move down we add 1. Similarly, to move right we shift the mask right (or divide it by two) and to move left we shift the mask left (or multiply it by two).

Needless to say, it isn't always this simple, and peculiar conditions exist at the block boundaries as shown in Fig 9. When pixel A moves up we expect to subtract 1 from the address, but, in fact, in crossing the boundary we have to subtract an extra 316. That's simple, but how do we know when it's at the boundary? By simple inspection you will see that the addresses of the top bars within each block are 0,4,8, and so on, which means that the last two bits of the address are clear when in this bar. Therefore, the complete 'shift up' (or decrement Y) routine is as follows:

if (address AND 3) = 0

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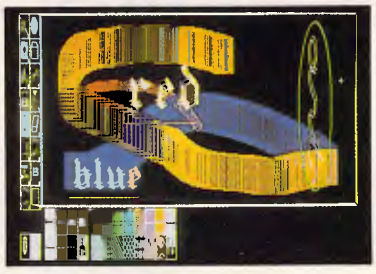

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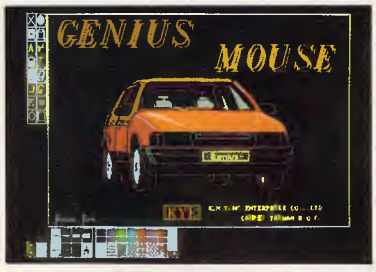

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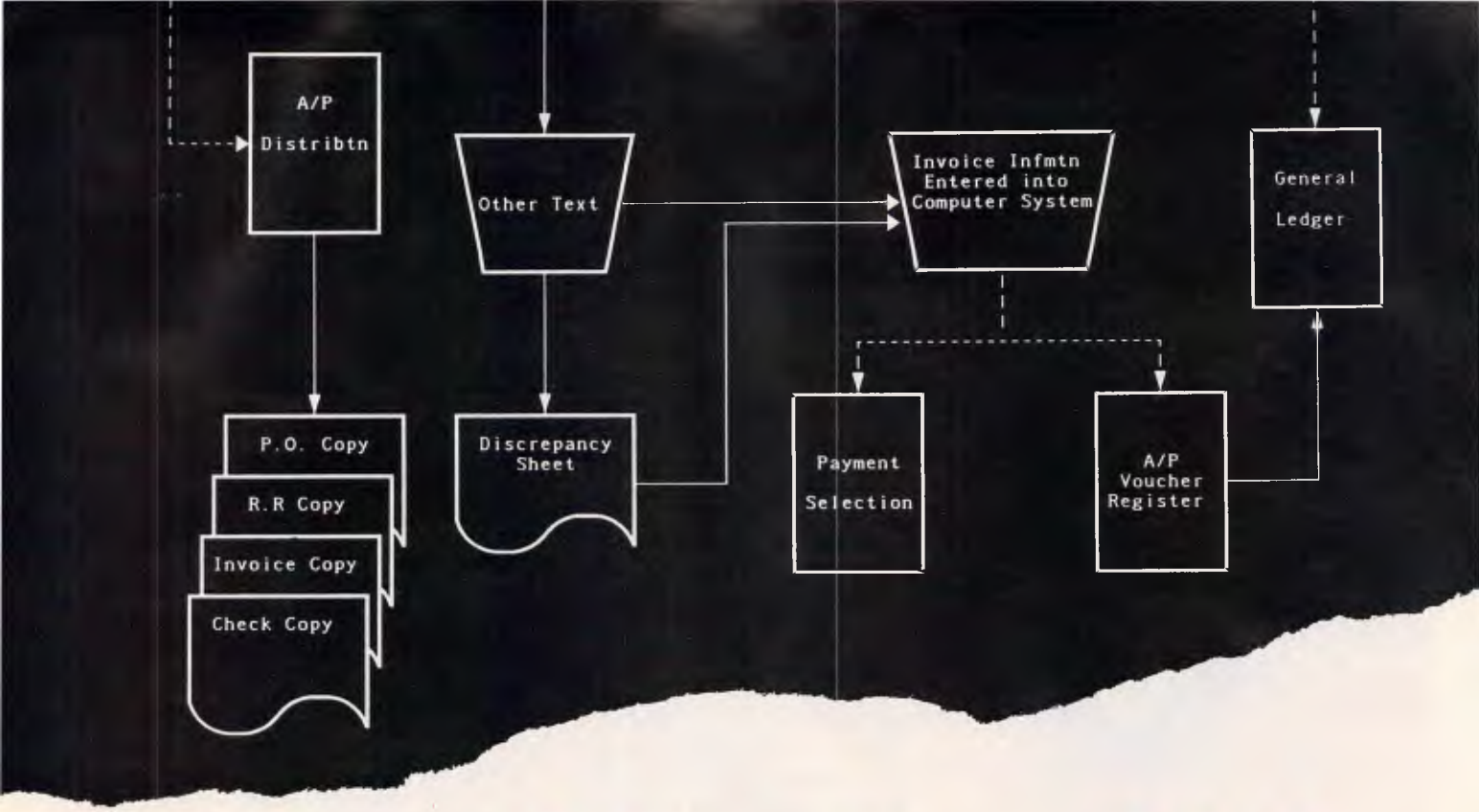

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Listing 2: Turbo Pascal procedure to draw a line on a Sanyo MBC555

```
procedure FGDLINE(x1,y1,x2,y2:integer;c:byte);

(* uses 14 bit fractional gradient placed in a dump *)
(* with a carry to signal the minor axis update *)
(* written in Turbo Pascal for the SANYO MBC 555 *)
(* by R.M.PARLOUR . DECEMBER 1986 *)

VAR
    address : integer                                    ;
    mask    : BYTE                                       ;
    gs      : array[0..8000] of byte absolute $3C00:$0000;
    rs      : array[0..8000] of byte absolute $F000:$0000;
    bs      : array[0..8000] of byte absolute $F400:$0000;
    x,y     :integer;
    gradient, dx,dy,absdx,absdy,dump,pointer,loop:integer;
    carry_set:boolean;

 procedure plotpoint;
    begin
    if C>3 then  RS[address]:= mask OR RS[address];
    if (C AND 2>0) then  GS[address]:= mask OR GS[address];
    if (C AND 1>0) then  BS[address]:= mask OR BS[address];
    end;
 function grad(dy,dx:integer):integer;
    begin grad := trunc(32767.0*dy/dx) end;
 procedure update_dump;
    begin dump:= dump+gradient;carry_set:=false;
    if dump<0 then begin dump:=dump+maxint;carry_set:=true end;end;
 procedure calc_offset(x,y:integer);
    begin
    address:=x div 8 * 4 + y div 4 * 320 + y and 3;
    mask:=128 shr(x and 7);
    end;
 procedure increment_x;
    begin
    mask:=mask div 2;
    if mask = 0
    then begin mask:= $80 ;address := address + 4 end;
    end;
 procedure decrement_x;
    begin
    if mask < 128
    then mask:=mask * 2
    else begin mask:= 1 ; address := address - 4 end;
    end;
 procedure decrement_y;(* update the y coordinate *)
    begin;
    if ((address and 3)=0 ) then address := address - 316;
    address := address -1;
    end;
 procedure increment_y;(* update the y coordinate *)
    begin
    if ((address and 3)=3 ) then address := address + 316;
    address := address +1;
    end;

 begin dx:=x2-x1; dy:=y2-y1;
 absdx:=abs(dx); absdy:=abs(dy);
 if absdx > absdy

 THEN (* X MAJOR *) begin
    dump:=absdx div 2; gradient:=grad(dy,dx);loop:=absdx+1;
    if x1>x2 then calc_offset(x2,y2) else calc_offset(x1,y1);

    if gradient < 0
    then  begin gradient :=-gradient;
       repeat plotpoint;increment_x;update_dump;loop:=loop-1;
          if carry_set then decrement_Y;
        UNTIL loop = 0; end
    else begin
       repeat plotpoint;increment_X;update_dump;loop:=loop-1;
          if carry_set then increment_Y;
       UNTIL loop = 0;  end
    end

 ELSE  (* Y MAJOR *) begin
    dump:=-absdy div 2;gradient := grad(dx,dy);loop:=absdY+1;
    if Y1>Y2 then calc_offset(x2,y2) else calc_offset(x1,y1);
    if gradient < 0
    then begin gradient:=-gradient;
       repeat plotpoint; increment_y;update_dump;loop:=loop-1;
          if carry_set then decrement_X;
       UNTIL loop = 0 ; end
    else begin
       repeat plotpoint; increment_y;update_dump;loop:=loop-1;
          if carry_set then increment_x;
       UNTIL loop = 0; end
    END;
 END;
```

then let address = address - 316
let address = address - 1

Likewise to shift down (increment Y):

if (address AND 3) = 3
then let address = address + 316
let address = address + 1

When considering horizontal moves we must test the mask to see if we are at the boundary. For pixel B moving left this is:

if mask = 128
then let mask = 1
let address = address - 4
else let mask = mask SHL 2

and for pixel C moving right (increment X):
if mask = 1

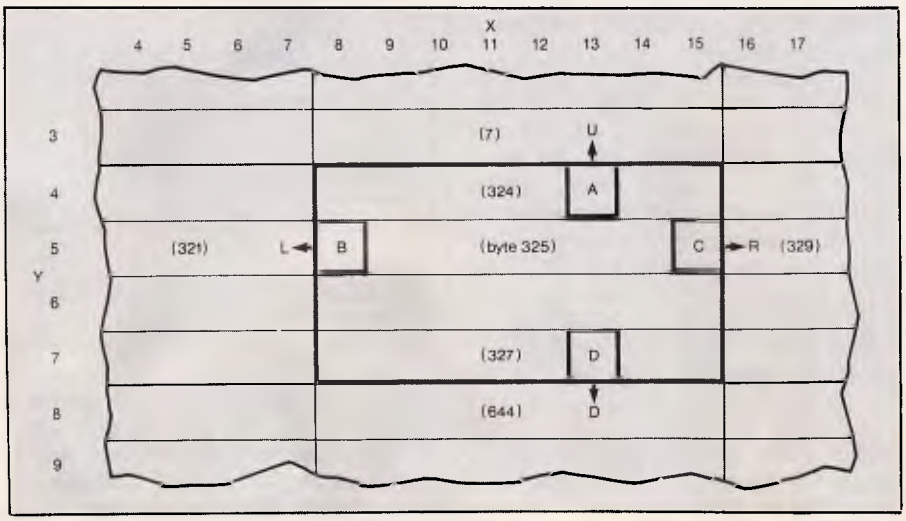

Fig 9 Problems arise in the shift method when a block boundry is reached (indicated by the darker line)

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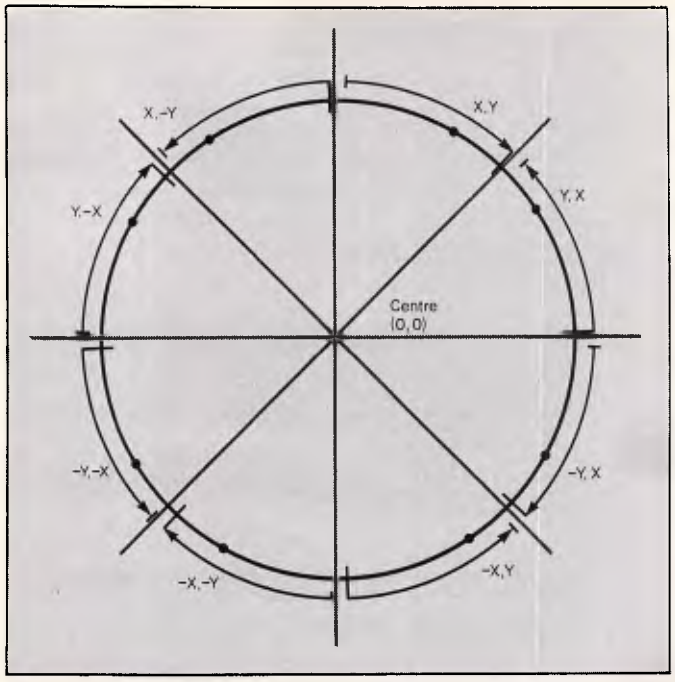

Fig 10 Eight-fold symmetry from algebraic calculations

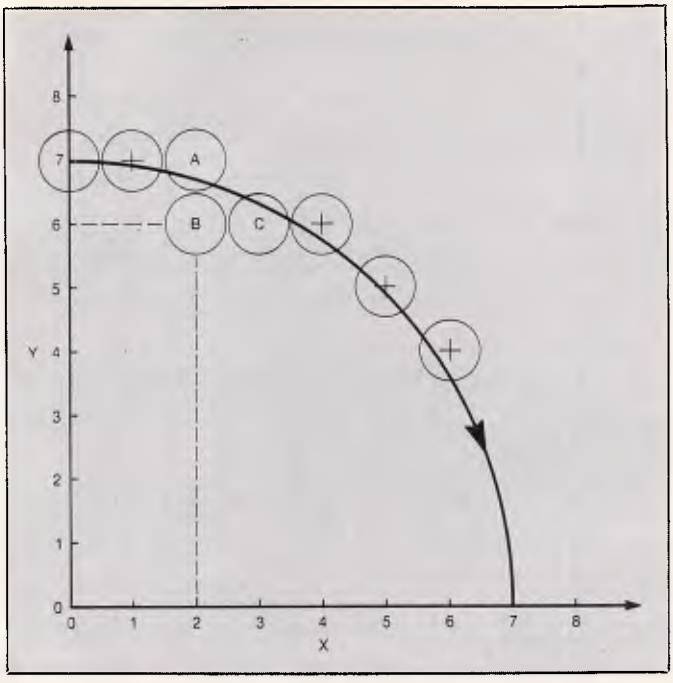

Fig 11 Plotting pixels as near as possible truly on the circle

```
X          =   0  1  2  3  4  5  6
X²         =   0  1  4  9  16  25  36
diff       =      1  3  5  7  9  11
diff       =         2  2  2  2  2  2

Y          =   R     R−1       R−2         R−3
Y²         =   R²    R²−2R+1   R²−4R+4     R²−6R+6
Y²−R²      =   0     −2R+1     −4R+4       −6R+9
diff       =     2R+1      2R+3      2R+5
diff       =          2         2
```

Fig 12 Differential analyses

```
then let mask = 128
  let address = address + 4
else let mask = mask SHR 2
```

Drawing circles

It is possible to calculate all the points of a circle by rotating through 360 degrees and calculating the X and Y coordinates using trig functions. However, this is inefficient for three reasons. Firstly, the circle has an 8-point symmetry (Fig 10) which we may utilise by calculating points only in the first 45 degrees and calculating the seven corresponding points by simple algebra. Secondly, plotting by radius may give us more than one point plotted per pixel on a small circle (wasteful in time and some unexpected results using XOR plotting) and gaps in large circles (unsightly and difficult to fill). Thirdly, the processing time is prohibitively long for the functions and various multiplications involved. However, simple integer difference methods using addition and subtraction alone may be used.

The equation for a circle of centre 0,0 is $X^2 + Y^2 = R^2$. Thus if we start at X = 0 we know Y = R. We can rearrange the equation to get $X^2 + (Y^2 - R^2) = 0$ which simply means that this equation holds true when on the line describing the circle. Consider now the point in Fig 11. If we were at point A(2,7) then the equation would yield 4 + (49-49) = +4 which means we are off the line. It is clear by inspection that the Y coordinate needs to be decremented, and when this is done the new point B(2,6) yields a value of (4+36-49=) -5 which, being negative, indicates that it is time to increment the X axis. In practice, we can use a dump (as above) as our guideline to the true value.

```
let X=0
let y=R
let x_update = 1
let y_update = −2 * R + 1

let dump = x_update + y_update
repeat
  set_pixel(xc+y, yc+x)
  set_pixel(xc+x, yc−y)
  set_pixel(xc−y, yc−x)
  set_pixel(xc−x, yc+y)

  if dump <0 then
    let x = x + 1
    let x_update = x_update + 2
    let dump = dump + x_update
  if dump >= 0 then

    let y = y − 1
    let y_update = y_update + 2
    let dump = dump + y_update
  set_pixel(xc+x, yc+y)
  set_pixel(xc+y, yc−x)
  set_pixel(xc−x, yc−y)
  set_pixel(xc−y, yc+x)
until x = y
```

Fig 13 Completed algorithm for a circle of radius R and centre (xc,yc)

When the dump is positive we must decrement Y such that the term $(Y^2 - R^2)$ becomes more negative and the updated dump is moved towards or through zero. Similarly, when the dump is negative we must increment X and update the dump's X^2 term, and only then plot the point. (Note that this is

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Listing 3: IBM program to draw circles

```
program gtest;
var
xc1,yc1,r,i:integer;

procedure pset(x:integer; y:byte);
var
address:integer;
pix:byte;
sc: array[0..16192] of byte
                absolute $b800:$0000;
begin
address:=(x div 8)+(y div 2)*80
                + (y AND 1)*8192;
pix:=128 SHR (x AND 7);
sc[address]:= pix OR sc[address];
end;

procedure circle(xc,yc,r:integer);
var
   x,y,ydump,xdump,res:integer;

begin
      x:=0;
      y:=r;
      ydump:=-2*r+1;
      xdump:=1;
      res:=ydump+xdump;
      repeat
            pset(xc+y*2,yc+x);
            pset(xc+y*2-1,yc+x);
            pset(xc+x*2,yc-y);
            pset(xc+x*2-1,yc-y);
            pset(xc-y*2,yc-x);
            pset(xc-y*2-1,yc-x);
            pset(xc-x*2,yc+y);
            pset(xc-x*2-1,yc+y);
            if res<0 then begin
               x:=x+1;
               xdump:=xdump+2;
               res:=res+xdump;
            end;
            if res>=0 then begin
               y:=y-1;
               ydump:=ydump+2;
               res:=res+ydump;
            end;
            pset(xc+x*2,yc+y);
            pset(xc+x*2-1,yc+y);
            pset(xc+y*2,yc-x);
            pset(xc+y*2-1,yc-x);
            pset(xc-y*2,yc+x);
            pset(xc-y*2-1,yc+x);
            pset(xc-x*2,yc-y);
            pset(xc-x*2-1,yc-y);
      until x>=y;
end;
begin
      hires;
      hirescolor(15);
      for i:=1 to 40 do begin
          xc1:=random(440)+100;
          yc1:=random(120)+40;
          r:=random(40);
          circle(xc1,yc1,r);
          fill(xc1,yc1);
      end;
end.
```

not an 'either/or' situation and that both updates must be considered before the next point is plotted.)

At the moment we still need to calculate the terms (X^2) and ($Y^2 - R^2$), but a simple method of solution comes to light when we consider the differential analyses in Fig 12 for the two terms.

These results show that we can generate the main dump's X and Y update terms simply by adding a calculated amount which itself is changed by two each time it is used.

The completed algorithm for a circle of radius R and centre (xc,yc) is shown in Fig 13.

In practice, this method sometimes leaves the edges of the circle too widely spaced. This problem is easily solved by plotting an extra pixel each time with an x coordinate one lower than the points listed above. An example of this is given in Listing 2.

So far I have used techniques involving iterations — that is, performing a simple function a number of times within a loop such that fairly complex solutions may be effected within minimal code. A second technique is that of recursion where a procedure is able to call itself (or disappear up its own stack!) and this is shown in the case of an algorithm for filling a space bounded by an unbroken line of pixels. By now you should be able to see how it works for yourself.

```
procedure fill(x,y)

 if not pixel_set_at(x,y) then
   set_pixel(x,y)
   fill(x+1,y)
   fill(x-1,y)
   fill(x,y+1)
   fill(x,y-1)
 (end if)
```

Conclusion

This has been a fairly sketchy introduction to drawing lines and circles on a graphics screen, and the techniques used are complicated but very fast. Some of them, such as shifting, are applicable to a wide range of graphics techniques and can be used as a basis for techniques like scrolling areas.

END

Converting the graphics routines to other computers

The problem with using these routines on other computers stems from different screen sizes and the different ways in which screens are mapped out in memory. The article assumes that a 640x200 pixel screen is used. It also assumes a monochrome screen and that the organisation in memory is as given in Fig 1 (that is, that blocks of four types represent 8x4 blocks of pixels).

To access individual pixels, you need to be able to convert an (x,y) coordinate into an address consisting of a byte and a pixel number. For the screen described in the article (a Sanyo MBC555), the conversion is as follows:

address (byte value) = x div 8 * 4 + y div 4 * 320 + y and 3

mask (bit value) = 128 shr (x and 7)

The mask is simply a single bit positioned at the correct place in a byte, and the above formula holds true for any screen with pixels stored as single bits within bytes. If your machine uses several bits per pixel, with the bit pattern representing a colour, then you will need to put the bit pattern in the top part of the byte and shift all the bits to the correct place. For example, if you use a four–colour screen with groups of two bits representing pixels, then you would use colour patterns. The formula would be: mask = colourpattern shr ((x and 3) * 2) where colourpattern is a preset value for whatever colour you want to set the pixel to.

The address can be much more complicated. In the above example, the (y and 3) represents the groups of four bytes, the y div 4 * 320 represents the lines of blocks and the x div 8 * 4 represents the columns. To convert to your screen's organisation, you will have to draw a diagram such as that shown in Fig 1 and work out the conversion. Here is an example for the high-resolution screen on an IBM-compatible CGA:

The IBM CGA monochrome screen is 640x200 pixels. These are organised in memory as a sequence of bytes, with each row across the screen as a block of 80 bytes. This should mean that the screen is represented as 200 rows of 80 bytes in strict sequence. The problem is that the IBM display is interlaced, which means that the even-numbered rows are kept in one place and the odd-numbered rows in another. So, converting an x coordinate is simply a matter of dividing the value by 8 to obtain the byte address. If no interlacing were used, then the y coordinate part would be simply y times 80. However, since the y coordinate part is split into two lumps, the even coordinates can be represented by (y div 2) * 80. The odd coordinates follow immediately after the even coordinates. The even coordinates fit into a block of memory which is 80*200/2 bytes or 8000 bytes long. In fact, it is 8192 bytes long because of the way in which memory is organised, so the odd coordinates all need to have 8192 added to them. This is achieved by (y and 1)*8192.

The final formulae for a monochrome CGA screen are:

address = (x div 8) + (y div 2) * 80 + (y and 1) * 8192

mask = 128 shr (x and 7)

Data compression competition

APC's hints and tips on compression strategies continue this month, as the great competition progresses and the halls of respectable banks and retail chains echo with the musings of programmers all chasing the $30,000 first prize.

Just in case you missed it (and you certainly couldn't expect your friends to tell you about it), *APC* in conjunction with Microsoft is offering a $30,000 prize to whoever can design and construct the best data compression algorithm.

While we covered all the details last month, the general idea is to write two programs: one to read a file and compress it, and the other to read a file and decompress it. The programs must be written in a Microsoft language (such as GW-Basic or Quick C), and must run on either an IBM PC compatible under MS-DOS, or Macintosh Plus or SE. The primary objective is to achieve the maximum possible degree of compression. Speed is not as important a factor — details of the exact relationship between speed and compression achieved in judging the winner of this competition will be published next month.

This month, we continue introducing some of the well known, and not so well known compression techniques, which you may choose to draw upon.

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execution speed, but also reap the added benefit of reducing the saved program size and associated load time.

There are two catches with the string replacement technique. Firstly, there must be some way of differentiating the token from normal data. This can be done using an 'escape' sequence, for example, hex FE could be the token marker with the byte following it indicating the token number. When a true FE appears in the data, we encode it as FEFE, thereby providing for a maximum of 254 replaceable tokens per unit of compressed data.

Fig 1 shows some sample Pascal source code and some of the string table entries which could be identified for it. Notice that the algorithm has detected a number of important points about the syntax of Pascal and the coding habits of this particular programmer. It has detected that lines often end with semicolons, and has generated a symbol to represent that sequence. It has recognised that many lines are indented by three spaces, and that other lines are indented by six spaces. It knows that the sequence ':=' appears often, that BEGIN is always followed by a carriage return, and that the identifier CALC features heavily. These are all useful facts when it comes to data compression, and an algorithm can recognise them automatically for any type of data simply by identifying repeated strings.

Similar patterns emerge even in machine language programs, as can be verified by dumping a few k of Lotus 1-2-3 in hex and looking closely.

When given a page or so of program code, text, data or machine language, it is surprising just how many patterns are identified.

However, as is starting to become clear, it is not always a good idea to replace a string by a token everywhere it is possible. The reason for this is simply the overhead of making an entry in the string table, plus the overhead of the token marker, less the saving produced. This can easily be programmed heuristically so that the algorithm always makes the optimal choice.

For example, if we use the FE marker followed by a token number, then we know that it takes two bytes to fully represent the string within the compressed data. If each table entry consists of a one byte token number, followed by a one byte token length, followed by the token expansion, then we can get down to specifics.

If we let L be the length of the repeated string, and N be the number of times it occurs, then the total space occupied in the original file is simply given by

$$L * N$$

and the total space occupied in the compressed file will be

$$(N * 2) + (L + 2)$$

this being the length of the table entry plus the length of the token. The program can then easily determine whether a space saving is actually achieved, and either tokenise the string or not.

Once the file has been passed and tokenised, ideally we are left with more sequences of repeated material. This time, it will be tokens which are repeated as well as uncompressed text. By iteratively applying the same strategy, the algorithm is able to form a concise picture of the structure of the information being compressed and arrive at an optimal usage of tokens.

The resources required in scanning a block of data for repeated sequences of bytes are quite significant. There are many techniques which can be employed to make this process several orders of magnitude faster, but speed is not of the essence.

Nine-bit bytes

Although initially it may seem counterproductive, utilising longer bytes is sometimes used to good effect.

In the example above, we were obliged to consume two bytes to represent a token number within the compressed data stream. Moreover, if the chosen marker, FE, appeared in the true data, then we would also have to consume two bytes to represent it. All of this can add up to quite an overhead.

One approach is to utilise a 9-bit byte instead of the usual 8-bit byte. This does not imply soldering another bit onto the side of your PC, rather it is a software approach and we are considering the word 'byte' to mean a unit of storage. In software terms, this is achieved by dealing with normal numbers in the range zero to 511. These numbers can be represented using whatever language feature seems best, whether they be 16-bit integers or 8-byte IEEE reals. Arrays can be con-

```
VAR A , B : INTEGER ; CR
CR
FUNCTION CALC ( X : INTEGER ) : INTEGER ; CR
   BEGIN CR
      CALC : = X * 2 ; CR
      END ; CR
   CR
BEGIN CR
      A : = 1 ; CR
      B : = CALC ( A ) ; CR
      END. CR
```

01	: CR
02	: INTEGER FE 01
03	BEGIN CR
04	: =
05	FE 01 CR
06	CALC
07	END
08	SP SP SP
09	SP SP SP FE 08

Fig 1 Sample source code and associated string table

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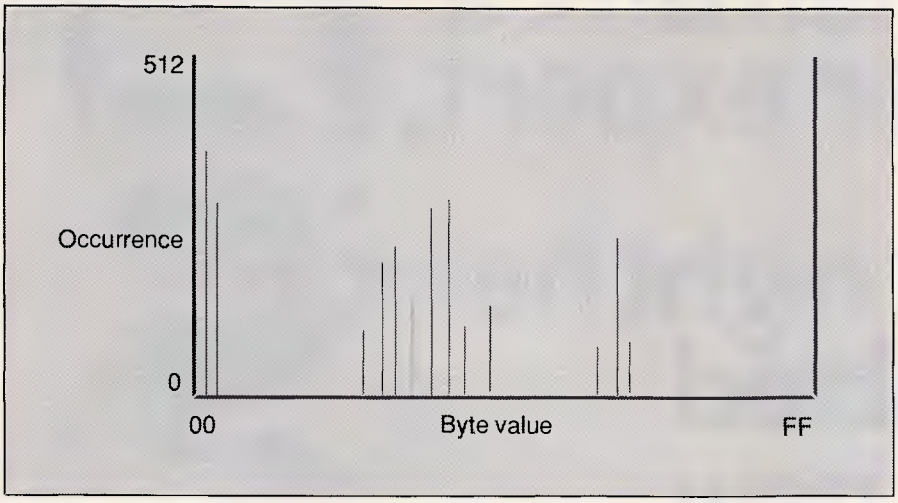

Fig 2 Histogram showing the typical relative abundancy of byte values within a given block of data. Unused values may then be usefully redeployed

structed and the numbers processed normally. The trick comes when finally writing the numbers to the file, as it is here that the program must perform a mapping from 9-bit bytes to 8-bit bytes.

The easiest, but least efficient way to go about the job is to pass through the intermediate stage of dealing with single bits. A subroutine is written to transfer a single bit from a 9-bit input area to an 8-bit output area, and takes care of accessing another 9-bit quantity when required and writing the 8-bit quantity when required.

Bit manipulation is easy to do in any language, especially assembler, and most Microsoft languages provide good features designed for this purpose. Logical AND operators can be used on numeric quantities via a mask to isolate individual bits, and merged into the output area using an OR. The mask can be shifted a bit at a time simply by halving and doubling.

Alternatively, you can utilise the fact that if a number is odd, then its lowest bit is a one, and vice versa. By doing this and dividing by two, the bits just peel straight off. To load them into the output area, all you need do is add the bit value and double the number. This will actually load the bits in the wrong order, which doesn't really matter.

The ninth bit may then be used as the token marker, as we can be damn sure that we won't encounter any naturally occurring 9-bit data in the input stream. This means that there is no need to assign special significance to a particular value such as FE, thereby eliminating the problems of naturally occurring FE values, and reducing the total length of a token from 16 bits down to only nine.

Of course, it has also increased the length of non-tokens from eight bits to nine. However, if we can be reasonably sure of getting at least one token every eight bytes, then the strategy pays dividends.

Unused byte values

We have already mentioned that many data streams do not fully exploit the possible bandwidth which may be carried by a byte. For example, textual material only features the displayable subset of all possible byte values.

Most data compression strategies are based around blocks of information. This is very appropriate for data communications applications, where the data is broken into blocks anyway to be enclosed in error detecting packets. It is also convenient from the compression point of view, as by treating each block as a separate unit of information, compression algorithms can better adjust to local variations in the type of data being transmitted. There is also a downside, however, as the compression algorithm may waste possible opportunities by considering each block in isolation. Generally, the best approach is to tune for an optimal block size, thereby allowing the algorithm to adjust to local trends while also getting a fair run for its money within a block.

By performing statistical analysis on information stored within computers, it is possible to determine that in any reasonable sized block of data, very few byte values will actually be used.

Again, but slowly.

A byte is capable of representing 256 different values. It could be argued that across all types of data (machine code, database, text), that the occurrence of each byte value should be considered as a random distribution. In other words, that each byte value should occur about the same number of times, with perhaps a slight variation for zero and other key values.

However, when considered in the context of a single block, the reverse is quite true. For example, if the data is

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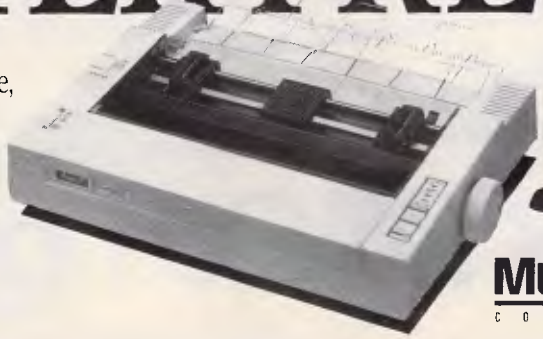

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broken into blocks of 512 bytes, and a histogram constructed showing the relative frequency of each possible byte value, we almost always find that less than half of the 256 possible values actually appear in the block. Sometimes less than one quarter of the possible values are actually used.

Experimentation shows that on an average hard disk, more than 95 per cent of sectors will contain less than half of the possible values. This is easily explained, as some of those sectors will contain textual material which implicitly under-utilises the byte domain, while others may be spreadsheet data in which binary zero will feature heavily. Spreadsheet data also tends to inherently contain 'favoured' values, the details of which depend on the details of what are actually stored in the spreadsheet. Machine language files contain areas of text, areas of uninitialised buffers or variable space which may contain zeros, and areas of instruction codes. Normally, instruction codes are considered the most difficult to compress, but in any given portion of code, various instructions will be 'favoured', for example, pushes and pops near a subroutine call, and many more instructions. This is particularly true since compilers and assembly language programmers tend to utilise only a very small subset of the available instructions (this being the argument behind RISC machines). Even the operands to the instructions will tend to be favoured, as given portions of code tend to refer to only a subset of variable offsets.

The details of why it happens don't really matter. The important thing is that in almost all blocks of data, only relatively few byte values will actually be used, and that is a tremendous opportunity.

There are two ways in which this can be taken advantage of.

The simplest is to recognise blocks which use between one half and one quarter of all possible values, and to utilise seven bits instead of eight to represent each byte. Similarly, for those blocks utilising between one quarter and one eighth of the values, only six bits need be used. As always, a map at the start of each block could be used to decode truncated values back to their full 8-bit values. This is different to simply lopping the top one or two bits off textual material, as it works for all types of data and the used subranges of the byte domain need not be contiguous.

A more productive way to utilise the opportunity is to employ the unused values as token numbers. This means that 8-bit bytes can be used throughout the compressed data stream, while still avoiding the overhead of using marker symbols. The formula to compute the total space occupied by a compressed string then becomes

$$N + L + 2$$

which is far more likely to succeed.

The details of which particular values will be unused will be different for each block of data considered, but that doesn't matter. The approach is to internally determine which values are unused, and then utilise those values as the symbol number entries in the string table, not forgetting that as soon as you do so, the value becomes used. From this point, the approach is the same as for any other repeated string elimination technique.

In good blocks, there will be an abundance of unused values and as many tokens as required may be used. In other blocks, there may only be a handful of unused values, in which case the algorithm will have to decide, based on the formulae for space consumption, which strings should be tokenised. Alternatively, that block may be handled by one of the other techniques.

As always, the appropriate choice of block size is crucial. Choosing a block size too large will increase the likelihood that there are very few unused byte values. If the block size is too small, then there may be insufficient data for many series of repeated strings to appear, and the unused byte values will go to waste. Ideally, the block size should be such that the number of tokens required exactly matches the number of unused byte values. That, however, is impossible to arrange.

Some experimentation on a variety of file types will quickly give some indication as to the best block size, and there is no reason why the algorithm could not be adaptive, working with a relatively small block size, but grouping them together when the number of unused values does not diminish greatly by doing so.

A block size of 512 bytes seems to work well, and although this should be tuned, there is probably a benefit in sticking to a block size which is a power of two. Compilers and linkers tend to take powers of two pretty seriously, and programmers who write word processors and database systems do likewise. For example, MultiMate headers are 1024 bytes and dBase database headers are multiples of 32. If the transition between blocks corresponds to a change in the type of data being stored in the file, then your algorithm may better adapt to local effects.

Finding strings

Although we said that execution speed is not important, it may be worthwhile

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mentioning a good way to identify repeated strings of bytes. The obvious ways of doing so do not always work correctly, and sometimes take hours to run. Most readers would want to achieve at least a level of performance which allows them to test their programs.

Perhaps the first thought that comes to mind is to grab a handful of characters and go running through the data, testing at intervals of one byte, to see if that sequence appears anywhere else. Considering the problem, we see that not all repeated strings will be of the same length. A first 'quick and dirty' approach could be to run through a loop looking for strings of various lengths, until all possible lengths have been processed. Naturally, since small repeated strings may occur inside large repeated strings, and since a large repeated string is a much bigger fish, we would start with the large strings and look down to smaller strings as we go.

This approach isn't even worth pursuing. For a start, the order of the algorithm would be N cubed, that is, double the block size and the search will take eight times as long. Although performance is not an issue, you would be lucky to complete one block per hour, and this is only the starting point.

Secondly, things work out much better if you locate the small repeated strings first, otherwise you run the risk of actually missing opportunities. A general purpose approach which leads to good performance is to locate pairs of repeated bytes rather than arbitrary length strings.

The process can be performed iteratively. That is, you pass through the data and locate all repeated byte pairs, replacing them with a single byte marker. Then pass the data again, and keep passing it until there are no more repeated pairs. The advantage of this approach is that repeated substrings within larger repeated strings will be readily identified and handled optimally. Effectively, the process builds an elementary set of symbols and utilises them as building blocks to achieve an optimal result.

The table then consists entirely of byte pair entries, as shown in Fig 3. Notice how in subsequent iterations, pairs are built upon pairs to form longer constructions. For example, by the second pass, a code value of four stands for the word 'the' followed by a space. Since all intermediate results are kept in the table, incredibly efficient coding is possible. Effectively the algorithm optimises its own table entries to eliminate repeated information.

By recursively processing the pairs table, it is a simple matter to obtain the expansion of any given token number. You could choose to either leave the table as a pairs table, or expand each code entry to a simple string of bytes.

Notice, however, that at the completion of all passes, the pairs table contains codes which do not actually appear in the compressed data stream, specifically codes one and two. These codes are intermediate results, but may be of some value in order to reduce redundancy in the pairs table. A separate optimisation procedure is therefore required to determine whether it is more efficient to replace these intermediate symbols as simple byte values into the expansions for the codes in which they are referenced, or whether to leave them as separate entities.

The job of locating the byte pairs can even be optimised greatly, as we know that we are dealing only in strings two bytes long, and know that each byte must be in the range zero to 255. A table can be constructed for each pair, with the first byte of the pair used as a coarse index or hash key to speed access.

This approach works extremely well in conjunction with the technique of

code	pair	
1	T	H
2	E	space
3	A	T
4	1	2
5	3	space

THE CAT SAT ON THE MAT
12C3 S3 ON 12M3
4C5S5 ON 4M3

Fig 3 How to locate repeated strings of any length by constructing byte pair tables

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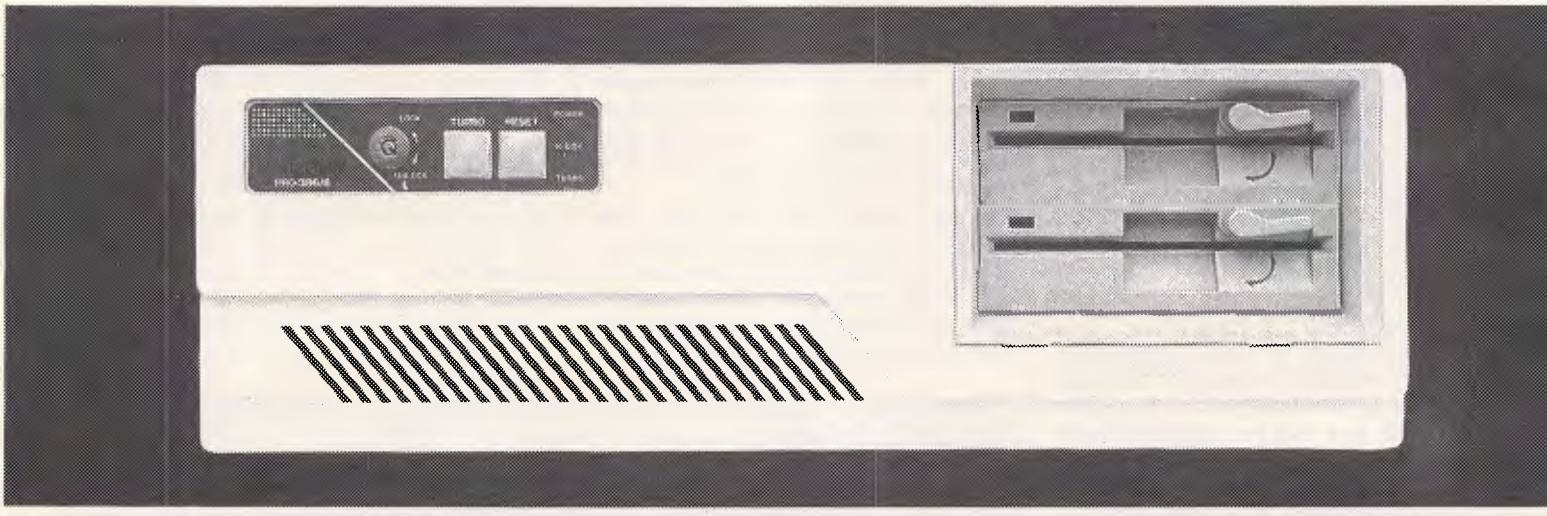

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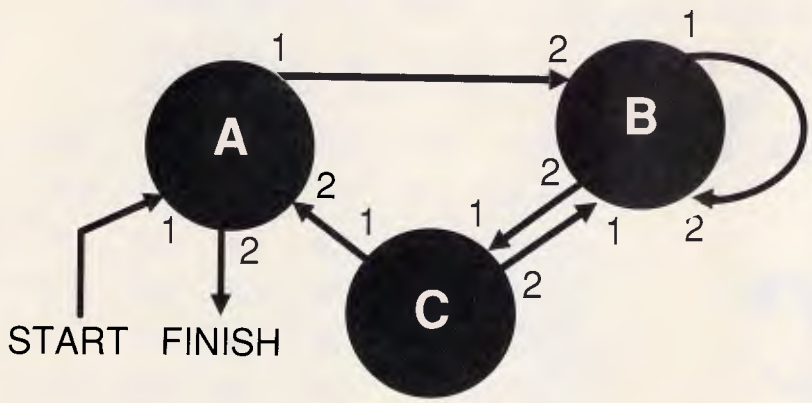

Current state	Input symbol	Next state	Output symbol
A	1	B	2
A	2	Finish	
B	2	C	1
B	1	B	2
C	1	A	2
C	2	B	1

Fig 4 Graphical and tabular representation of a finite state machine

utilising unused byte values, as the number of bits involved remains eight whether we are dealing with real bytes or token numbers. In blocks where relatively few byte values are unused, intermediate table entries can even be reclaimed in order to allow the addition of more beneficial entries.

Algorithmic compression

The approach of utilising unused byte values falls flat on its face for a particular pattern of data. The pattern is, of course, all the byte values between 00 and FF, as no values are unused. Similarly, there are no repeated sequences in that stream, unless one considers it to be a string of 512 4-bit numbers instead of the more conventional 256 8-bit numbers.

Clearly, any really superior compression scheme would have to include some alternative strategies to use in cases such as this. Most simple compression schemes would not handle that data stream very well, but there are some interesting transformations which can be done to improve matters somewhat.

Your compression program will most definitely know when it has struck a block of data as difficult as the one above, by measuring the degree of compaction achieved for that block, and should then start trying different approaches.

For example, if instead of considering each byte value, we represent the sequence as a starting value followed by an offset which must be applied to the previous byte in order to generate the next byte, then the stream reduces to 00, 01, 01, 01 . . . 01. This is clearly a highly compressible sequence of data. There would need to be some mechanism to indicate that this particular transformation has been applied prior to compression, but even taking that into account, it should be possible to reduce the 256 bytes down to around six bytes — far more than any algorithm could achieve without first performing the transformation.

This leads to a whole new approach to compression which yields very good results at just those occasions when traditional techniques fail. The idea is that instead of compressing the data, one could represent the data by an equation or small program which, when run, has the side effect of generating the data.

Now, representing a sequence of data as a program written in 8086 or 68000 machine code seems a little strange. Representing it in Microsoft Fortran would be even stranger. There is, however, a conceptual machine which can be easily used to generate sequences of data. It is the finite state machine, and is shown both conceptually and implemented as a table in Fig 4.

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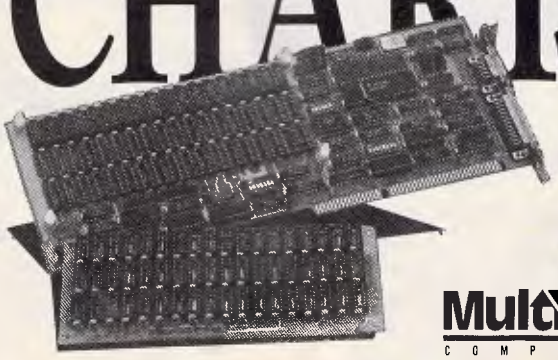

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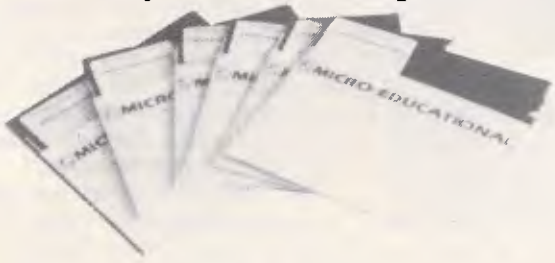

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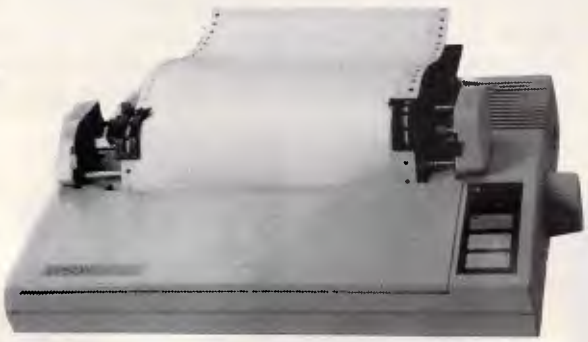

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COMPETITION

A finite state machine consists of a series of states, in this case labelled A, B and C. For each possible input value a state may be given, the lines on the diagram and the entries in the table show what state it should move to next, and what value to pass to that state. States may even lead back to themselves. The process of moving from one state to another (or possibly back to the same one) is called a state transition.

Finite state machines may be exceedingly complex, both in terms of the number of states and the number of input/output symbols. They are able to generate very complex results, and provide parallels of the facilities found in the classic Von Neumann architecture of computers. Finite state machines could be used to represent algorithmic preprocessing of the data stream prior to traditional compression techniques being used, or could even be made to generate the data stream directly.

'If you're at a loss where to start, or are lacking fresh ideas, there is a very simple solution.'

Conclusion

If you're at a loss where to start, or are lacking fresh ideas, there is a very simple solution.Grab some randomly chosen blocks of data from your hard disk, spreadsheets, databases, program source code, text or machine language files, and dump portions of them in hexadecimal.

Then sit down and take a long slow look at it. If you, as a human being, were given the job of compressing the data such that another intelligent human being would be able to decompress it, how would you go about it? Forget about computers and programming the solution, just think of the problem in pure terms assuming you had access to the limitless pattern matching and intellectual ability of a person. It often leads to new revelations and lateral ideas.

Then all you have to do is program it.

Next month we'll be looking at totally variable length bytes, and how to utilise them to achieve better degrees of data compression.

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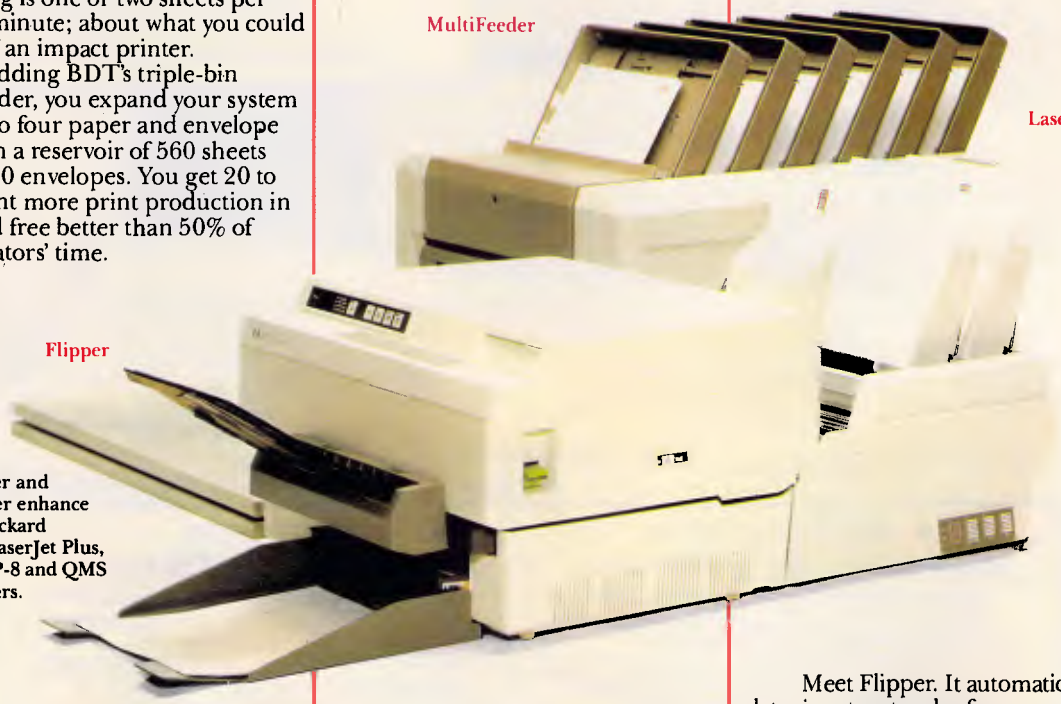

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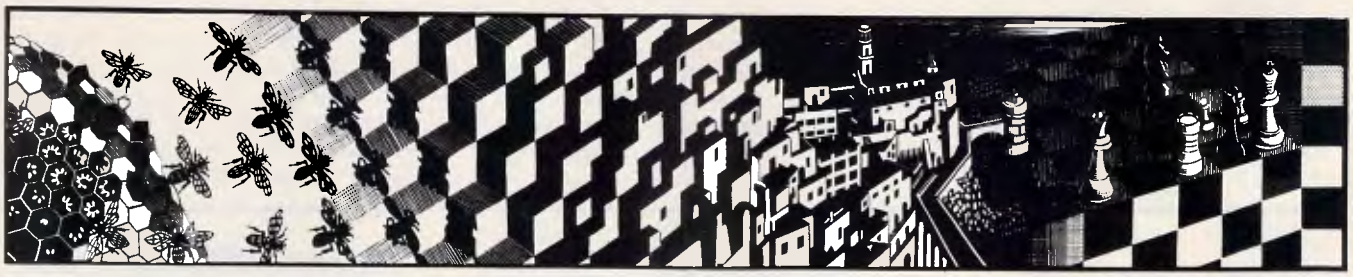


In this month's selection of game reviews, Stephen Applebaum's busy chasing evil uncles around volcanoes and ravaging cities in search of petrol.

Under the volcano

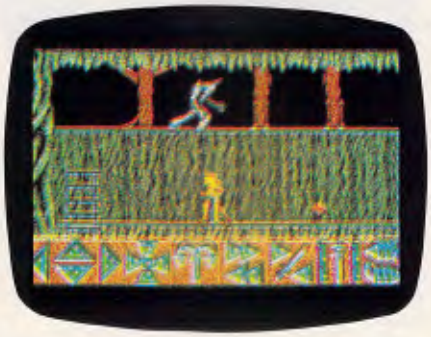
Title: Barbarian
Computer: Commodore Amiga
Supplier: Ozi Soft
Price: $79.95

Psygnosis has been around for some time, but the company has never really made its mark on the games market because its products, which are always visually stunning, have lacked gameplay. This is not the result of insufficient programming talent, but the company's apparent belief that if a game looks good it will sell, regardless of whether it is fun to play.

Arena, a sports simulation, suffered badly from this philosophy. Not even its excellent graphics could hide the fact that it was just an overblown Track and Field rip-off — and an expensive one at that. What a surprise it was, therefore, to discover that Barbarian not only offers the best graphics, but also a degree of gameplay far in excess of any previous Psygnosis product.

Barbarian is an arcade (graphical) adventure set in a world where good and evil battle for supremacy. As Hegor, a dragon-slaying, beer-swilling, womanising barbarian, you must descend into the Tartarean depths of Durgan, a volcano, in pursuit of Necron, your evil uncle. When found, he has to be destroyed: only then can the people of Thelston, the village in which you grew up, escape from the dark shadow Necron has cast over them.

The only problem with this plan is that Necron lives in the deepest region of an underground kingdom. To catch him, you have to battle your way past the many creatures that guard the tunnels leading to his lair; the most terrible of which is a giant dragon, Vulcuran, who guards the final entrance to Necron's *sanctum sanctorum*.



Vulcuran is a lumbering mass of scales, made fat on the flesh of countless human victims. His sheer size makes it impossible for Hegor to kill him with a sword — only a bow is potent enough to dispatch him.

On his way through Durgan, Hegor must find a bow and collect as many arrows as he can; one is not enough to kill Vulcuran. When the dragon and his master have been destroyed, Hegor can then return to the surface before Durgan finally erupts. The amount of time Hegor has to get back depends on how long it takes to reach Necron and destroy him.

Barbarian, like previous Psygnosis titles, relies heavily on visual impact. As soon as the title screen depicting a Tarzan-like figure swinging a broadsword appears, you just *know* you are in for something special.

When the game has loaded, the display divides horizontally to form two windows. The larger of these takes up about two thirds of the screen and features a view onto the current scene; the bottom one contains numerous options for controlling Hegor's movements and posture.

David Lawson and Garvan Corbett, Barbarian's programmers, have done their best to make sure players feel at home with the game's controls. Rather than dictating the type of control device that must be used, they have configured the program to accept input from a joystick and the mouse and keyboard, none of which needs to be specified at the beginning of a game since all these can be used at any time.

Unless the keyboard is being used, all actions are initiated by icons chosen from a range of twelve. These make Hegor run, jump, flee, fight, defend himself, pick up and use a weapon, and climb up and down ladders.

Hegor and Necron's wicked minions are all depicted as large and extremely finely detailed animated characters, and how Hegor attacks and defends is dependent on the foe encountered at any one time. If things get too hot, he can be made to run away using the aforementioned 'flee' option. Selecting flee causes Hegor to let out a fearful scream, drop everything he is carrying and bolt towards safety. Running from danger does not always pay off, however, as Hegor sometimes simply runs from one creature into the clutches of another.

Fearsome as his appearance is, Hegor does not cut quite as awesome a figure as his assailants, who range from dog-like men in chain-mail to blue rhinos and zombies. Although these look dangerous, most can be killed with one swing of Hegor's sword. Once hit they change into a cloud of vapour, in which

can just be seen some skeletal debris, composed of a skull and rib cage.

On top of its amazing graphics, Barbarian also boasts the best digitised sound. Here you have screams, grunts, groans, growls and the clanking of metal.

Although Psygnosis would appear to have changed its approach to game design, it has made little headway toward improving its quality check. My copy of Barbarian, like other Psygnosis products I have used, failed to load unless the disk was held down inside the drive, and even then the game did not always load correctly.

Loading problems aside, Barbarian is an impressive game of outstanding graphics and audio quality. Psygnosis has taken a turn for the better with this one, and has at last overcome the memory of albatrosses like Arena and Brattticas. I look forward to the company's other new titles.

On the road

Title: Roadwar 2000
Computer: Atari ST; IBM; C-64; Apple
Supplier: Ozi Soft
Price: $69.95 (ST & IBM); $49.95 (Apple & C-64)

Roadwar 2000 is set in an America torn apart by bacteriological warfare at the dawn of the twenty-first century. Law and order has crumbled and small pockets of survivors have formed themselves into road gangs who battle for petrol.

Your role in the game is that of a gang leader still loyal to the last remaining fragment of the Federal Government. You are on a mission to find eight scientists who collectively hold the formula for a vaccine to destroy the virulent microbes which continue to poison the land, long after the war has ended. When you have located the scientists, they have to be transported to an underground lab where they can develop the vaccine. Finding the scientists depends on your ability to survive the hostile gangs who control whole regions of America.

Roadwar 2000 is a kind of futuristic dungeons and dragons, in as much as it plays like games of that ilk. Instead of adventurers, however, you have cars. A gang can comprise as many as 15 vehicles, each with its own individual ratings in 24 categories. To acquire the maximum number of cars can take a long time, so, as in most other adventures, it is possible to save a game at any point. I am not sure how long it would take to complete Roadwar 2000, but the packaging cites 50-plus hours as the average playing time.

Roadwar 2000 is played on a map of America. In the Atari ST version tested here, a small icon, representing your gang's position, is moved around the map using the numeric keyboard. At certain instances, messages appear warning of an encounter with another gang. Generally, you have to fight your way out of such a meeting.

The majority of people in a gang come from one of the categories known as armsmaster, bodyguard, commando, dragoon and escort; the list being in order of decreasing effectiveness. Other members, known as 'cronies', can be doctors, drill sergeants or politicians, and are usually recruited as a result of forays into towns and cities.

Recruiting in cities is dangerous because they swarm with mercenaries, street gangsters, armed rabble and cannibals, among a host of other undesirables. And, as if these were not bad enough, the residents include survivalists, renegade national guardsmen and satanists. Sometimes it is possible to negotiate with the locals, especially if you have a politician in your gang, but, more often than not, *force* is the only way to get what you want.

Road combat is different to foot combat and is considerably more complex. In all there are three modes available: abstract, tactical and quick. When an encounter occurs, you begin your attack by allocating gang members to whatever vehicles are at your disposal. Depending on how quickly you want to complete this phase, you can either deploy the men manually or get the computer to do it.

After you have deployed all your men, the display changes to show a tactical map whereupon small icons indicate the positions of your vehicles. These can be moved — within certain limitations — to positions where they will be most effective during combat.

Also shown on the map are the positions of the opposing gang's vehicles. Moving one of your cars into an occupied position causes a 'ram' to occur; the amount of damage caused by this move depends on the speeds and masses of the vehicles involved. Before ramming another car it is possible to accelerate, thus increasing the damage potential of the manoeuvre.

Cars need not only be rammed: they can be shot at using a variety of weapons, and even boarded and their crews killed (which is how you increase the number of vehicles under your control). You start a game with six vehicles and increase your total by one each time you win a battle with a rival road gang.

Quick combat is much faster than tactical combat but does not allow enemy vehicles to be captured. Using this method, you are required to set the ram ratio and aiming priorities for each of your groups.

The ram ratio determines the size of enemy vehicles which your vehicles ram. Aiming priorities, on the other hand, refer to the targets you want your men to shoot.

If the pressures of life on the road get you down, you can enter a town or city under the control of another gang, defeat it in combat and take the location for yourself.

Having to worry about rival gangs and mutant bikers means that it's quite easy to forget about the scientists you are supposed to find. Your search can be shortened considerably by a piece of kit called a Radio Direction Finder (RDF). This picks up signals being sent out from a homing device worn by the scientists.

Roadwar 2000 is an imaginative twist on the dungeons and dragons-type scenario. It is intelligent, challenging and, above all, entertaining. What more could you ask for?

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Hacking is a dirty word

Hackers, intelligent modems and Telecom come under the spotlight this month, as Steve Withers presents the latest news on the local communications scene.

It seems to me that the press have come up with yet another definition of 'hacker': someone who owns a computer and modem, and also commits fraud. It doesn't seem to matter if the modem isn't used in the crime — in one recent case the term seemed to be applied simply because the defendant had used his home computer to store credit card numbers.

It was bad enough that a previously honourable title was distorted to apply to those who break into other people's systems, but this latest variation goes too far. Unfortunately, even *Computing Australia* has adopted this usage. To quote from one article, 'a charge of stealing the modem would be laid . . . It would be the first charge for computer hacking laid in the ACT.' It may be that the defendant intended to use the modem to hack into systems, but so far as I can see that does not justify describing the theft as 'computer hacking'.

Smart modems

The latest Trailblazer modems take the idea of intelligence one step further. As you probably read in July's *APC*, the Trailblazer provides error-free transmission at extremely high speeds by the use of its own protocol. If you superimpose another protocol (such as Xmodem), performance suffers. The trouble is that many systems really like to talk to each other using a specific protocol.

To get around the problem the new Trailblazers can handle Xmodem, Ymodem, Kermit, and UUCP protocols. The Trailblazer is able to strip out the data from the blocks or packets, transmit it using its own PEP protocol and then re-wrap the data with whatever protocol the computer at the other end expects. So instead of computer talking to computer with the modem acting as a passive element in the communications channel, we now have the computer talking to the modem, modem to modem, and modem to computer.

Another advantage to this arrangement is that you wouldn't need to match protocols with the other computer. If your favourite comms program only supports Xmodem, and the remote mainframe only talks Kermit, file transfer would still be possible with Trailblazer.

One thing doesn't seem to change about computing — the prices. Ten years ago it was floppy disks, now it's CD-ROM drives and fast modems.

The material in this column is presented in good faith, but as it is collated from material provided by readers, *APC* cannot take responsibility for its accuracy. New information and corrections are always welcome (but please mention whether or not you can vouch for accuracy of the material provided), and should be sent to:
Steve Withers, C/- Computer Publications, 47 Glenhuntly Road, Elwood, Vic 3184 or to Viatel mailbox 063000030.
Acknowledgements will normally be made through this column. You may also like to send a copy of the information to the Australian PAMS Coordinator at one of these addresses:
PO Box E41, Emerton, NSW 2770.
ASCnet prophet@runx
Prophet BBS (02) 628 7030.

Telecom

There are signs that Telecom is beginning to understand the nature of bulletin board systems. One sysop has recently been advised by Telecom that, providing no fee or surcharge is made for the use of his system, the phone bill will be calculated at residential rates rather than the business rate which was being applied. However, Telecom made it clear that this did not mean the system would be exempt from the proposed time charges for data calls.

On the other hand, *Computing Australia* reported that Telecom has

suggested to the Public Remote Access Computer Systems Association of Australia that bulletin boards may be exempted from time charges if call durations are restricted.

System news

Last month the update section included a new number for Omen V. The number printed was the one I was given, but unfortunately it wasn't that of Omen V. The correct number appears below. My apologies to those affected by the error.

Apple Hackers United BBS finds its way back into the listings — for some mysterious reason it dropped out of my index some time ago.

Acknowledgments: Neil Barker, Jeff Campbell, Larry Lewis, Greg Noonan, Brendan Pratt, Neil Robertson, Rupert Russell, and The Wizard.

New systems

NSW

Alcoholics (02) 588 8804. Michael Aldiholic. 9pm-6am weekdays, 24 hours weekends. V21, V23.

GCS (02) 570 9861. Mark Ivanhoe. V21, V22.

Lodestone (02) 456 3264. Ian McWhirter. V21, V22, V22bis, Bell 103. FidoNet 711/407.

Shore (02) 959 3936. MV. David Kok. 6pm-7.30am weekdays, 24 hours weekends.

Guild FRP (047) 21 8625. MV. Stafford Hewitt. 9pm-8am daily.

HighTech (060) 25 1813. MV. Ross Wheeler. V21, V22, V22bis, V23, Bell 103, 212. Also packet radio. FidoNet 712/201.

Matrix (049) 38 5057. MV. Andrew Pike.

Sorcim Micros (043) 69 3658. MV. John Caine. V21, V22, V22bis, V23. FidoNet 711/405.

ACT

ACT Amiga #2 (062) 59 1440. MV. Mike Hurst-Meyers. 24 hours daily. V22, V22bis, Bell 103, 212. FidoNet 626/219.

Vic

Big Tedd's (03) 527 4945. Big Tedd. 9pm-8am daily.

Brainstorm (03) 758 7086. Rowan Stevens. V22. FidoNet 631/322.

Compusoft (03) 386 6019. George Tsoukas. V22.

Engbase (03) 29 6336. Greg Furlong. V21, V22.

PC User (03) 819 5392. P. Charles Sandercock.

Prodergy (03) 562 0489. Michael White. 3pm-8.30pm weekdays, noon-6pm weekends. V21, V22, V22bis, V23.

Qld

Marlin Coast (070) 51 7220. V21, V22, V22bis, V23, Bell. FidoNet 640/501.

Sun City (077) 74 1552. MV. Tony Smith. V21, V22, V22bis, V23. FidoNet 640/702.

SA

Cadzow (08) 79 3091. P. Scott Cadzow. V21, V23.

Olympic (08) 265 4232. P. Greg Sanderson. FidoNet 680/801.

WA

Apple (09) 381 6061. P. Don Pugh.

Omen Mini (09) 279 8555. Greg Watkins.

Nemo 3 (09) 370 3333. M. Graeme Platt. V21, V22, V22bis, V23.

Nemo Games Machine (09) 370 2666. MV. Graeme Platt. V21, V22, V22bis, V23.

Pegasus (09) 242 1515. P. Michael Russell. 5pm-9am weekdays, 24 hours weekends. V21, V22, V22bis, V23.

Updates

NSW

Alpha Juno (02) 774 1543. Kevin Withnall. 6pm-6am daily. V21, V22, V22bis. FidoNet 620/701.

Amstrad (02) 981 2966. MV. Riccay Schmahl. V21, V22, V22bis, V23. FidoNet 711/903.

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Microlink (02) 477 7509. P. Tony Callahan. 24 hours daily. V21, V22.
NABA-Prophet Offline.
Prophet (02) 628 5222. P. Larry Lewis. V21, V22, V22bis, V23. FidoNet 713/600.
Realtors Offline.
Renegade Offline.
Samilon Possibly offline.
Sentry (02) 428 4687. MV. Trev Roydhouse. 9pm-6am weekdays, 8pm-6am weekends. V21, V22, V22bis, V23. FidoNet 711/401.
Software Tools (02) 449 2618. MV. Bill Bolton. 24 hours daily. V22bis, Trailblazer. FidoNet 711/403.
Sorcerer Users Group (02) 626 8020. MV. John Cepak. 24 hours daily. V21, V22.
Sydney PC Users Group Possibly offline.
Your Computer (02) 669 1385. MV. Andy Farkas. 24 hours daily. FidoNet 712/622.
Zeta (02) 627 4177. MV. Nick Andrew. 24 hours weekdays, 7pm-7am weekends. V21, V22, V22bis, V23, Bell 103, 212. FidoNet 713/602.
Abcom (047) 36 4165. MV. Ben Sharif. 24 hours daily. V21, V22, V22bis, V23. FidoNet 713/304.
Newcastle Microcomputer Club (049) 68 5385. MV. Tony Nicholson. 5pm-8.30am weekdays, 24 hours weekends. V21, V22, V22bis, V23.

ACT

ACT Amiga #1 (062) 59 1137. MV. Mike Hurst-Meyers. 24 hours daily. V21, V22, V22bis, V23, Bell 103, 212. FidoNet 626/218.

Vic

AmigaLink (03) 792 3918. Bohdan Ferens. 24 hours daily. V21, V22, V23. FidoNet 631/324.
Apple Hackers United (03) 762 1582. John Forbes. 24 hours daily.
AUSOM MacSIG (03) 435 9152. P. 24 hours daily. V21, V22, V22bis, V23.
BERT (03) 602 1552. P. Resource Data. 24 hours daily. Also (03) 670 7371 for V23/videotex.
BUGM Offline.
Custom Programming (03) 848 3331. MV. Alan Williamson. 24 hours daily. V21, V22, V23, Bell 103, 212. FidoNet 630/303.
DECUS Melbourne (03) 62 5806. M. Peter Hill. 24 hours daily. V21, V22, V22bis, V23.
Devil's Playground Offline.
Down Under Software (03) 429 8079 and 429 5819. P. Greg Hudson. 24 hours daily. V21, V22, V22bis, V23. FidoNet 630/306.
Eastwood (03) 870 4623. MV. Mick Stock. 24 hours daily. V21 (midnight-10am), V22, V23. FidoNet 630/314.
Further Regions Offline.
Harbourd Offline.
Melbourne Data Exchange (03) 560 6556. Robert Broomhead. V21, V22. FidoNet 631/321.
Microbee (03) 882 1571. Mike Thompson. 24 hours daily.
Microlink (03) 233 0230 (but temporarily offline). P.
Anonymous 24 hours daily. V21, V23.
National (03) 25 6904. P. John Blackett-Smith. 24 hours daily. V22, V22bis. FidoNet 630/301.
Osborne Australia Possibly offline.
PC Connection (03) 528 3750. Lloyd Borrett. 24 hours daily. V21, V22, V22bis, V23.
PC Oasis (03) 465 5257. P. Craig Wilson. 24 hours daily.
Profit Offline.
Public Resource #2 Offline. NB The number is now used for fax — you might think you hear carrier, but you won't get a connection!
SCUA (03) 754 5081. MV. David Woodberry. 24 hours daily. V21, V22, V23.
Supermicros Offline.
Ten to One Amiga Offline.
Termicomnet Offline.
Thunder-Net Amiga Offline.
Village Idiot (03) 428 2178. P. Rupert Russell and James Milne. 24 hours daily. V21, V22, V23, Bell 103, 212 (Nice Modem II). Formerly *Magic Pudding.*

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Abacus (057) 83 1964. P. Maurice Copeland. 8am-noon, 4pm-11pm weekdays, 24 hours weekends. V21, V22, V23, V23 originate.

Qld

AMPAK (07) 263 7070. MV. Brian Wendt and John Bews. 24 hours daily. V21, V22, V22bis, V23, Bell 103, 212, packet radio.
Cynthia Offline.
Rock Cave (07) 395 1809. MV. Rick Dalley. 24 hours daily. Formerly *BEX*.
BMUG (07) 366 4833. MV. Graham Scott. 24 hours daily. V21, V23. User Works Node 2.
Educational (07) 266 3369. MV. Andrew Waddell. 24 hours daily. V21, V22, V22bis, V23. User Works Node 2.
Focus Offline.
Hi Tech (07) 366 6872. Clyde Smith-Stubbs. 24 hours daily. V21, V22, V23.
Kangaroo Point TAFE Offline.
Tomorrowland (07) 394 2300. Dave Drummond. 24 hours daily. V21, V22, V23.
CAD Permanently offline.
Sidecar (075) 46 3252. MV. Brendan Pratt. 24 hours daily. V21, V22, V22bis, V23, Bell 103, 212. User Works Node 7. Formerly *SVI*.

SA

Multiple (08) 255 5116. MV. Danny Vozzo. 9pm-9am daily. V21 only.
Omen V (08) 356 7939. MV. Richard Siggs. 24 hours daily.
SAC64 Offline.

NT

Outback (089) 27 7111. P. Phil Sampson. 24 hours daily. V21, V23.

WA

Atari Forever Offline.
Mouse Exchange (09) 339 6890. P. Leonard Hollings. 24 hours daily. V21, V23. FidoNet 690/902.
Nemo Multiple (09) 370 1855. Graeme Platt. 24 hours daily. V21, V22, V22bis, V23. Previously listed as Nemo.
WA Atari Computer Enthusiasts (09) 306 2134. MV. Graham Basden. V22.

Tas

Hobart Users Offline.
Tassie Bread Board System (003) 26 4248. MV. Ian Campbell. 24 hours daily. V21, V22, V22bis, V23. FidoNet 630/310.

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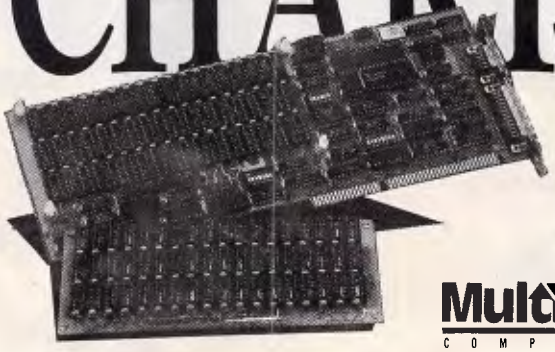

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Bridged LANs

Product	Manufacturer	Network hardware supported	Connects differing hardware networks	Product form	Connects 2 LANs at a distance
AST Advanced NetWare 86 or 286 (100-user versions)	AST Reseach	Ethernet, Starlan, Token-Ring, ARCnet	•	software that runs on common PC	•
IB/Family	Bridge Communications	Ethernet, broadband, fibre optic	•	stand-alone	•
GS/Family	Bridge Communications	Ethernet, fibre optic	•	stand-alone	•
OmniNet	Corvus System	NetBIOS	•	software and hardware that runs on a network PC	•
G Remote Bridge	Gateway Communications	Ethernet, ARCnet, Token-Ring, G/Net	•	software and hardware that runs on common PC	•
HarrisNet 300	Lanier Business Systems	Ethernet, Token-Ring, H-Net		software and hardware that runs on common PC	•
NetWare Local Bridge	Novell Inc	Token-Ring, Starlan, Ethernet, ARCNet (total of 27)	•	software than runs on common PC	•
PCNet	Orchid Technology	NetWare	•	add-on card	•
PCNet Advanced NetWare (8-user version)	Orchid Technology	NetWare, baseband	•	software and hardware that runs on common PC	•
PCNet Advanced NetWare (50-user version)	Orchid Technology	NetWare, baseband	•	software and hardware that runs on common PC	•
PCNet Advanced NetWare/286 (50-user only)	Orchid Technology	NetWare, baseband	•	software and hardware that runs on common PC	•
NetBIOS	Orchid Technology	NetWare, baseband	•	software and hardware that runs on common PC	•
P4200 Gateway	Proteon Inc	Ethernet, ARCnet, ProNet	•	stand-alone device connected simultaneously to both networks	•
Model 8050	Sytek Inc	Ethernet	•	stand-alone device connected simultaneously to both networks	•
Model 8080	Sytek Inc	Ethernet	•	stand-alone device connected simultaneously to both networks	•
Model 8200	Sytek Inc	Ethernet	•	stand-alone device connected simultaneously to both networks	•
3+ Network Operating System	3Com Corp	Ethernet, Token-Ring, AppleTalk	•	software and hardware that runs on common PC	•
Net/One Ethernet-Ethernet Data Link Bridge	Ungermann-Bass	IEEE 802.3 (Ethernet), 802.4 (MAP), 802.5 (Token-Ring)	•	software and hardware that runs on common PC	•

CONNECTIVITY

This table concludes APC's Connectivity section on Bridged LANs, which appeared in the September issue. Refer to the accompanying articles which appeared on pages 155 and 161 in last month's issue.

Limit on number of networks bridged	Limit to number of devices that cross bridge	Limit to software that cross bridge	E-Mail transparent	Price structure	Price	Supplier
			•	included with network, or as external add-on	$870	Data Peripherals (02) 888 5733
			•		POA	Network Solution Australia (02) 957 2733
		•			POA	Network Solution Australia (02) 957 2733
4			•	card & cable	$656	SuperNet Systems (02) 498 6611
64			•	software, documentation, 2 cards, 2 networks, cabling	$5595	Micro Networks (02) 969 6922
64			•	one per station (interface card and cable)	$792	Harris Lanier Australia (02) 816 3555
			•	included with network, or as an external add-on	$870	Data Peripherals (02) 888 5733
1				adaptor card	$950	Porchester Computers (03) 537 2722
1			•	2 cards, cable, 2 terminators, documentation	$4050	Porchester Computers (03) 537 2722
4			•	2 cards, cable, 50-user version software, terminators, documentation	$4995	Porchester Computers (03) 537 2722
4			•	2 cards, cable, 50-user/ 286 software, terminators, documentation	$5895	Porchester Computers (03) 537 2722
1				software	$95	Porchester Computers (03) 537 2722
			•	stand-alone with network cards	POA	Data Peripherals (02) 888 5733
2					POA	Network Solution Australia (02) 957 2733
2					POA	Network Solution Australia (02) 957 2733
2					POA	Network Solution Australia (02) 957 2733
500			•	software with network capabilities (up to 5 users)	$2110	Imagineering (02) 697 8666
			•		POA	Data Bridge (02) 819 6474

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CD-10 CGA
- CGA Color Monitor
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- 640 by 200 resolution

CD-14M
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- Amber, green, paper white (option)

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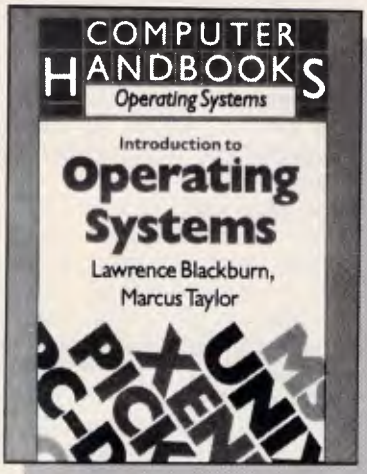
BIBLIOFILE

Under the spotlight this month come books on operating systems, and dBase. Our reviewers help you sort out the good buys from the bad.



Introduction to Operating Systems

Authors: Lawrence Blackburn and Marcus Taylor
Publisher: Pitman
Price: $9.95

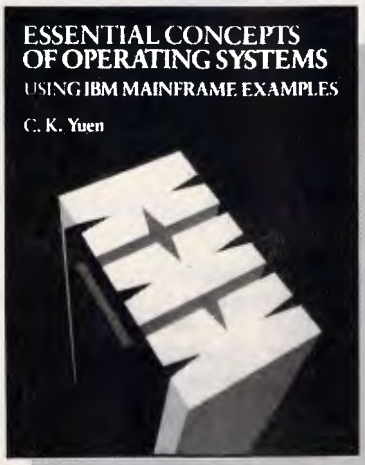
I have rather a penchant for handbooks, and I do mean *handbooks,* not those massive volumes that masquerade under the description and yet would have Popeye reaching for his extra can of spinach.

It's probably because I do equate the idea of something being explained simply with the reality of short and unambiguous statements. Why say in 100 words what could be said in 20? You may have guessed by now that I wholly approve of the *Pitman Handbook: Introduction to Operating Systems.* Any book that I can read as comfortably as a novel and yet pick up and dip into at any point really counts a lot with me: two books for the price of one, really.

This book can be used as a general introduction, summary, top-up or leader volume for other 'handbooks' in the series on 'Operating Systems'. (Unix and CP/M are also available as separate books by the same authors.) *'This short text attempts to touch upon the general design principles used to build operating systems which will efficiently manage the resources of the system.'* No space is wasted: a general introductory chapter encompasses all the most important principles, followed by specific chapters on 'Storage Management' through to 'File Management'. 'Chapter 8: Systems Management' ties up all these ideas by considering the management of the system as a whole rather than as separate parts and 'Chapter 9' is invaluable as a brief guide to contemporary popular operating systems for microcomputers, with pages devoted to Unix, Pick, CP/M and MS-DOS among others.

It's not going to answer every question that you may have on operating systems, but then that really wouldn't give any incentive to future authors, would it?

Lorna Kyle



Essential Concepts of Operating Systems

Author: CK Yuen
Publisher: Addison-Wesley
Price: $34.95

Professor CK Yuen states that this book is mainly *'concerned with the concepts of operating systems, rather than the systems themselves.'* If he can make 'concepts' last nearly 200 pages, it makes you wonder what he could do with a fully-blown detailed analysis. It is pretty serious stuff and not a book for light reading or to be dipped into occasionally, especially as mainframe examples are quoted. You are either the type of user who needs and wants to know more about mainframe operating systems or one who wouldn't touch a book like this with a bargepole.

Topics discussed have been organised by operating system functions but the reader is advised to leave 'Chapter 3: Memory Management' and 'Chapter 6: Data Management' until after 'Chapter 2: I/O Operations', 'Chapter 4: The Management of Concurrent Processes' and 'Chapter 5: Device Management and Resource Sharing' have been covered. If you can try and keep the basic definition in mind, namely *'an operating system is a set of interconnected programs that control the hardware and data resources of a computer and perform system-related functions on behalf of users and user programs',* then all will not appear lost when diving into the realms of channel programs: that is,

CP CCW X'11', DATA,X'40',80

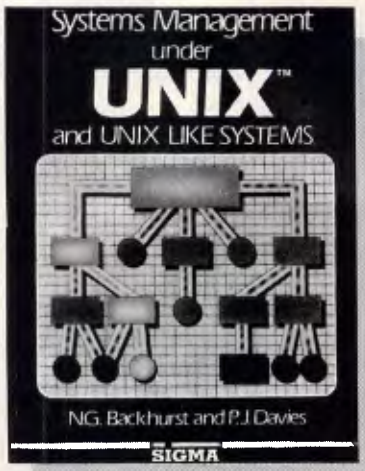
monoprogramming, multiprogramming, dynamic partitions of memory management, paging registers, address buffers, task control tables, context switching and PSW registers.

The benefits of an 'industry-standard' operating system, such as Unix, versus machine-incompatible system programs are discussed and the author feels that the concurrent task call facilities of ADA makes it one of the forerunners for a general system programming language.

Each, rather long, chapter ends with a very short summary. Odd exercises are dispersed throughout the text. These are mainly of a discussion type, with twenty additional exercises provided at the end of the book. The diagrams consist mainly of memory maps, block figures and tables. *Essential Concepts of Operating Systems* is a tool for the enthusiast rather than the vaguely interested.

Lorna Kyle

BIBLIOFILE



Systems Management under Unix

Authors: NG Backhurst and PJ Davies
Publisher: Sigma Press/Jacaranda Wiley
Price: $46.65

Unix — the book, also from Sigma Press, is accepted by most as the best introduction to Unix for new users. *Systems Management under Unix* is a companion volume for those privileged few who consider themselves system managers. It is intended to be an understandable reference book to sit alongside those cryptic system manuals and steer you in the right direction when problems occur; reading it from cover to cover is a tedious and fruitless task.

The book leads off with a brief description of the history of Unix from its origins in the failure of Multics, through its years with the academics, to its acceptance as a small multi-user business system. It was reassuring to hear the authors express some doubts as to the suitability of Unix for a business environment, and by the end of the first chapter it's made clear that:

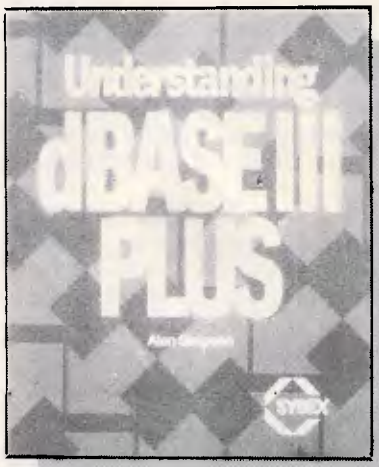
- there are better business operating systems but they may not have the applications you need;
- the authors are not blinkered academic Unix gurus; and
- the job of a Unix system manager is not an easy one.

I felt particular empathy with the quote from a toilet wall in a large Unix installation: *'We were promised a pearl, but it turned out to be cultured and there are signs that it might be artificial.'*

The book then continues with 18 chapters that address the majority of situations a Unix system manager might encounter. The emphasis throughout is on the 'management' of 'business' installations, which is exactly what it should be. In general, the non-technical explanations of the vagaries of Unix were excellent, particularly the chapter on the cryptic, but immensely powerful, Unix filing system. The discussion of the human factors involved, however, was less satisfactory — an area better described in many general management books.

Overall, I found this book a worthy companion to *Unix — the book;* although I feel it would be of more use in the home of a system manager to be read the night before performing any major task.

Graham Wood



Understanding dBase III Plus

Author: Alan Simpson
Publisher: Sybex
Price: $39.95

Understanding dBase III Plus is one of those books which tags along, trying to catch a ride on the success of some product or other. That doesn't make it unique, in fact the book shops are full of them. It was probably highly tempting for the author to retitle it 'Yet Another dBase Book'.

Understanding dBase III Plus also doesn't contain any great revelations which cannot already be found in the standard manuals. As far as the common problems which plague dBase users go, they don't even rate a mention.

But then, they're not supposed to.

Many people spend thousands of dollars on computer software, only to find that the manual tries to be all things to all people, and ends up missing the target altogether. The standard dBase manual would have to be one of the better ones around, yet still fails to guide the novice user towards rewarding features and away from features fraught with danger or frustration.

There is a definite need for a book for those people who sit down and regurgitate the manual, but in an intelligible format. And that is exactly what *Understanding dBase III Plus* does. It starts from the basics, leaves out most of the topics novices don't want to know about, doesn't break itself into four different volumes and leave you wondering which one you should be looking in, and provides that vital guiding hand to the newcomer.

The book deals with database basics, using the dBase menus, sorting, screen design, report creation, multiple data files, memory variables and in general, sticks mainly to the ASSIST menus. It finally gets into command files in Chapter 11, providing the reader with ample opportunity to get good value out of the menu driven front-end before doing battle with dBase programs. It then spends a lot of time laying groundwork in an attempt to pre-empt the types of problems people usually have with command files. And, best of all, it doesn't mention which registers to use when writing assembly language subroutines to be called from within dBase.

In short, a reader of this book would be in good shape to graduate to the dBase manuals, and one could not ask for more than that. The only criticism is that the author could have spent just a little more time covering the pros and cons of database design. Nevertheless, a book which can be well recommended to the beginner with absolute zero computer or database experience.

Ian Davies

END

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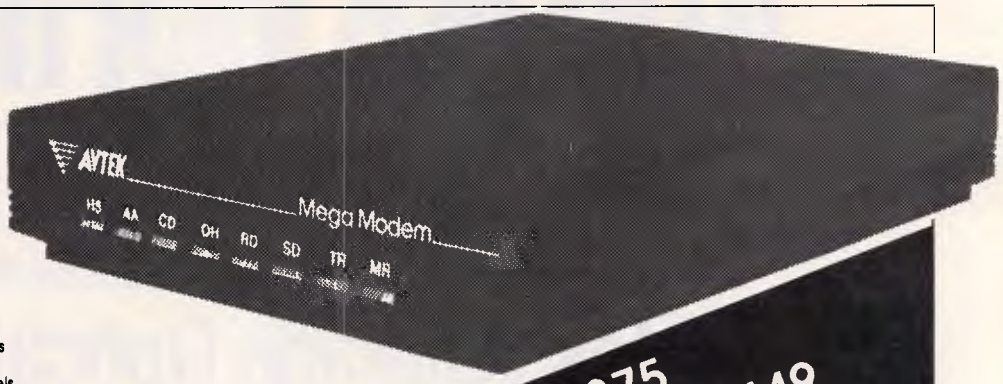

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you crop (or trim the edges from) bit-mapped images, and Version 1.1 also lets you crop line art.

Installation and support

Ventura runs on an IBM PC/XT/AT or compatible running DOS 2.1 or later, with a minimum 512k RAM, a 10Mbytes hard disk, mouse, and graphics card with monitor.

The full Ventura Publisher package with utilities comes on 11 disks and takes about 15 minutes to install. The installation process for Version 1.1 has been improved over 1.0 in that you can modify your configuration — change your mouse or monitor, for example — without having to reinstall the entire package.

Ventura comes with a short tutorial that takes you through basic features in a few hours. In our experience, the tutorial alone does not answer all questions that come up for new users. The 350-page manual is comprehensive and clear, but it is still a formidable task to learn all of Ventura's features on your own. More than any other package reviewed here, Ventura invites hands-on training from an experienced user. There are a number of companies offering training courses but a quick ring around has revealed heavy attendances, so book early.

Ventura Publisher offers more controls and options than any other package reviewed here. The only trade-off is that it is difficult to learn and master its many features, making it well suited for publishing departments with centralised page layout responsibilities but less suited for casual users with occasional publishing needs. Its flexible and comprehensive style sheet options, plus the ability to use a word processor to edit text throughout the production cycle, make Ventura the strongest desktop publishing package on the market under $2000.

END

Results at a glance

Our first choice for professionals (with the persistence and stamina to survive the learning curve) is Ventura Publisher. The ability to include ruled lines and boxes as part of a style sheet specification, link a series of 'chapters' and automatically renumber them, include figure captions and footnotes, control ruled line widths and leading in decimal increments, and edit text in a word processor after it has been placed in a Ventura document makes this a high-volume workhorse. However, we'd like to see an option that lets us format text without a style sheet, since complex documents can require an unmanageably long list of styles. Given the vast improvements of the current version, 1.1, over 1.0, we can expect Ventura to remain at the head of the pack.

For those who want a simple and flexible package, we recommended PageMaker. It supports a wide range of word processors and graphics packages and is by far the easiest package to learn and use. However, without a style sheet feature and the ability to flow more than one column or page at a time, PageMaker falls short of the other three products as a productivity aid.

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Performance tests: page composition software

Our performance tests are designed to indicate the length of time it takes for these packages to perform some frequently used functions. We used two versions of our newsletter for these tests: one version that contains both text and graphics; the other, text only.

We performed all tests using an 8-MHz IBM PC AT with 640k of RAM and a 30Mbytes hard disk. For our printing tests, we used the Apple LaserWriter, since it is currently the most commonly used PostScript-compatible printer. We did not perform our printing tests on the Hewlett-Packard Laserjet or Laserjet Plus because we could not do so without changing some elements in the newsletter design, such as the sizes of some of the fonts. For PageMaker (Mac version), we used a Macintosh Plus with 1Mbyte of RAM, a 20Mbytes hard disk, and an Apple LaserWriter.

We conducted all tests three times; the results given are an average.

File size

File sizes among the packges reviewed vary from 22k to 361k for text files alone, and from 57k to 513k for files containing graphics and text. These differences are due primarily to the way the packages store and interact with the origin files.

Moreover, files for different purposes are stored differently. For instance, some packages, such as Ventura Publisher and The Office Publisher, store print files differently from edit files. Moreover, there is no standard method used by these packages to store files. We therefore measured the included file sizes of all files necessary for editing our entire four-page newsletter.

Sizes shown for PageMaker on both the Macintosh and the PC include the size of the PageMaker document file and the size of the file used to store the scanned face on page 3 of our newsletter.

Ventura Publisher stores file formatting information, text, and graphics in separate files. The file sizes recorded here are the sum of the sizes of all those files. Because Ventura is linked to all source files, it requires all those files to be resident for editing the files. Since The Office Publisher uses the same method as Ventura, we included the sum of file sizes for all source files.

GEM Publisher uses a single file that includes all text and graphics.

Turn page

We timed how long it took to turn from page 1 to page 2 in each package. Because the screen must be redrawn each time you turn a page, this process takes longer than you might expect.

Some programs will store graphics in RAM after they have been loaded; calling them up a second time is, therefore, much quicker than the first time. For these tests, however, we loaded the map on page 2 into memory each time.

Open or save a four-page file

We began the test for opening a file after the program was up and running. We started the timing after we entered the command to call up the four-page file and ended the timing once the program had drawn page 1 on the screen.

For the save test, we made the same text edit to a headline in the newsletter file of each package, then saved the file. Some programs save only the file, or that part of the file, that was changed since the last save. GEM Publisher and The Office Publisher save the entire file, requiring more time for each save.

Print to Apple LaserWriter

The time it takes to print a document could be the most significant variable in a heavy production environment. Even though the print engine in the LaserWriter is technically capable of printing 8 pages per minute, the fact is that graphics take a long time to print. (Notice that we timed these tests in minutes and decimal minutes.)

The most time-consuming part of printing a document is processing that document for printing. We timed printing from the moment the print command was invoked until the edge of the page first appeared out of the printer.

In each timed test, the first time was recorded after reinitialising the printer, since most programs send down a PostScript file that stays resident in the printer for all subsequent printing. The second and third times were taken without reinitialising the printer; results shown are an average of all three times.

	File size (bytes)		Open a four-page file		Save a four-page file		Turn page		Print to Apple LaserWriter (min)	
	Text only	Text and graphics	Text only	Text and graphics	Text only	Text and graphics	Text only	Text and graphics	Text only	Text and graphics
GEM Desktop Publisher	45k	57k	41.7	43.7	72.0	93.0	4.3	23.7	3.18	43.8
The Office Publisher	61k	513k	36.9	46.9	25.4	37.3	9.4	14.4	4.77	21.1
PageMaker (Mac vers)	343k	370k	8.8	10.3	2.2	3.0	5.9	6.1	3.00	11.6
PageMaker	361k	370k	11.0	14.3	1.8	1.9	4.8	5.9	2.73	12.5
Ventura Publisher	22k	165k	14.1	17.3	12.3	16.5	2.1	7.8	4.12	16.3

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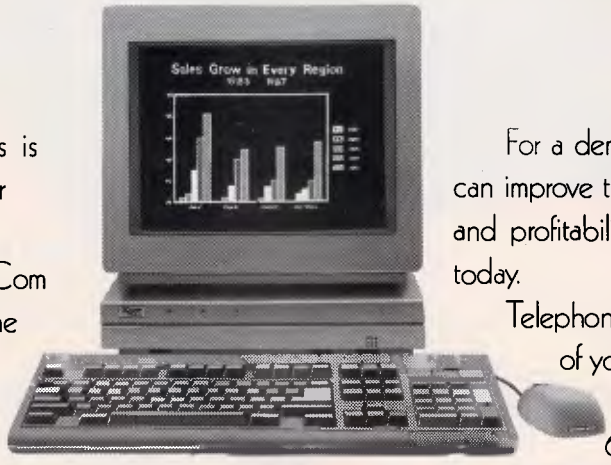

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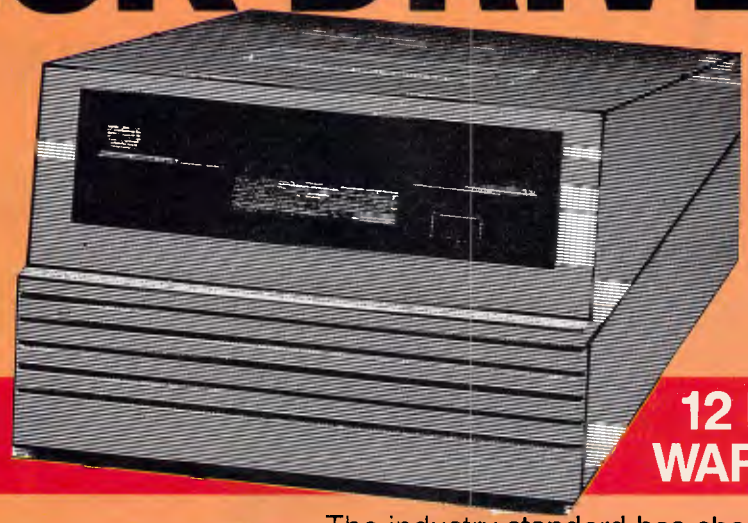

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Text features

	GEM Desktop Publisher	PageMaker (Mac version)	PageMaker (PC version)	Ventura Publisher	The Office Publisher
Text formatting					
Links page layout to text files	○	Optional	○	●	○
Retains some wp formats	○	●	●	●	●
Saves indents and tabs from wp	○	●	●	○	○
Retains typefaces from wp	○	●	●	○	○
Embeds type codes	●	○	○	●	●
Has style sheets	●	○	○	●	●
Uses dictionary hyphenation	○	●	●	●	●
Uses logic/formula hyphenation	○	○	○	●	●
Hyphenates foreign languages	○	○	○	●	●
Has kerning tables	○	●	●	●	●
Allows manual kerning	○	●	●	●	●
Increments by leading	Hundredths of an inch	Half point	Half point	Hundredths of an inch	Tenths of a point
Tabs	●	●	●	●	●
Tab leaders	○	●	●	●	●
Max. no. of typefaces	2	Unlimited	Unlimited	Unlimited	Unlimited
No. of type styles	4	4	4	4	4
Small caps, all caps	○	●	●	●	All caps
Superscript/subscript	○	●	●	●	●
Reverse type	●	●	●	●	●
Size range (points)	7-72	4-127	4-127	1-254	5-252
Size increments (points)	8 predefined	Integers	Integers	Integers	Integers
Text editing					
Edits text globally	○	○	○	(using word processor)	○
Changes type specs globally	●	○	○	●	●
Changes paragraph form globally	●	○	○	●	●
Has Undo command	○	●	●	●	○
Text import					
ASCII	●	●	●	●	●
DCA	●	●	●	●	●
Microsoft Word 3.0	○	●	●	●	●
MultiMate	●	●	●	●	●
WordPerfect	●	●	●	●	●
WordStar	●	●	●	●	●
Xerox Writer	○	○	○	●	○
XyWrite	○	●	●	●	○
Windows Write	○	●	●	●	○
GEM Write	●	○	○	○	○
Other word processors	○	●	○	○	○

● — Yes ○ — No

* The Office Publisher issues a warning about widow and orphans, calling for user intervention.

† With The Graphics Link from PC Quik-Art.

‡ PageMaker 2.0 for the Macintosh accepts bit-mapped images and PICT files from the PC.

†† Digital Research offers free driver packs for these printers, but they are not packaged with GEM Desktop Publisher.

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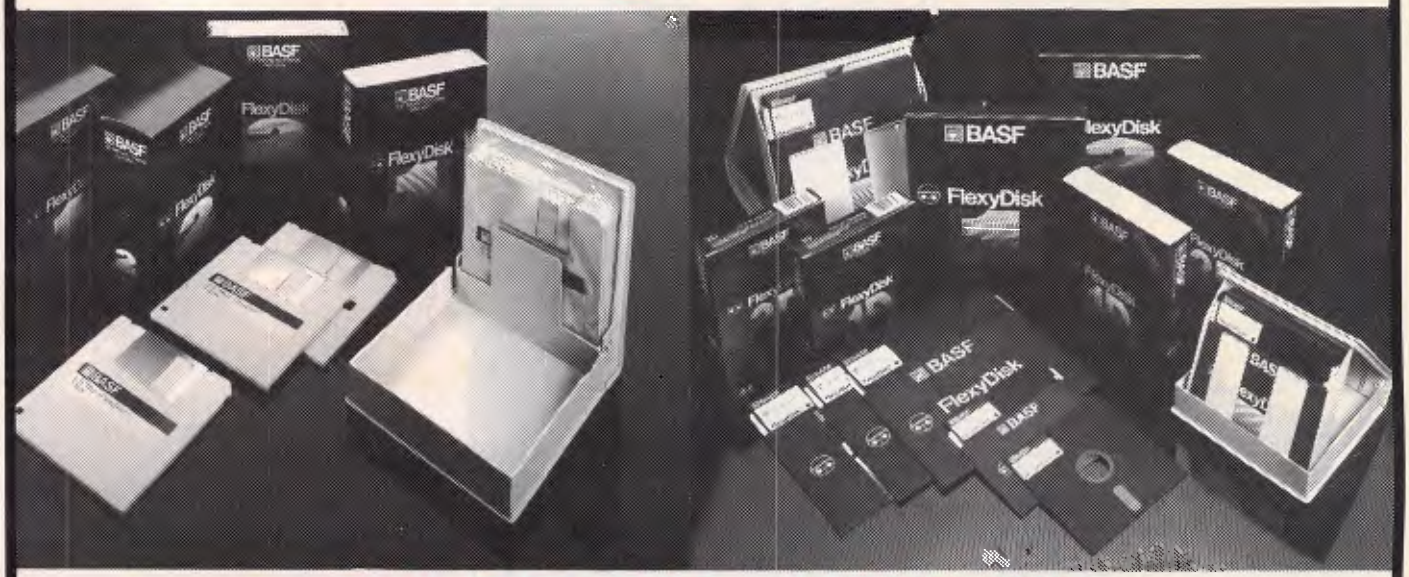

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Page layout features

	GEM Desktop Publisher	PageMaker (Mac version)	PageMaker (PC version)	Ventura Publisher	The Office Publisher
Max. no. of columns	4 per frame	20 per page	20 per page	8 per frame	29 per frame
Allows unequal column widths	●	●	●	●	●
Adjusts text if columns change	●	○‡	○	●	●
Automatic text flow	●	○	○	●	●
Stores text overflow	●	●	●	●	●
Inserts/removes pages	●	●	●	●	●
Rearranges pages	○	○	○	○	○
Headers/footers	●	●	●	●	●
Automatic page numbering	●	●	●	●	●
Automatic index generation	○	○	○	●	●
Table-of-contents generation	○	○	○	●	●
Automatic footnoting	○	○	○	●	○
Automatic figure numbering	○	○	○	●	○
Automatic widow/orphan control	○	○	○	●	●
Automatic continued lines	○	○	○	●	○
No. of ruler measures	2	4	4	3	4
Shows cursor position on ruler	○	●	●	●	●
Shows cursor coordinates	●	○	○	○	○
Shows size of a selected graphic	●	○	○	○	(floating ruler)
Stores unused text/graphics	List	Pasteboard	Pasteboard	List	List

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Printers supported

	GEM Desktop Publisher	PageMaker (Mac version)	PageMaker (PC version)	Ventura Publisher	The Office Publisher
Laser printers					
AST TurboLaser	○	○	○	●	○
Canon LBP-8A1 and LBP-8A2	○	○	○	○	●
Cordata printers	○	○	○	●	○
Epson GQ-3500††	○	○	○	○	○
Epson LQ series printers	●	○	○	○	○
HP Laserjet and compatibles	●	○	●	●	●
IBM Quietwriter Models 2 and 3	○††	○	○	○	○
IBM Pageprinter	○††	○	●	○	○
Interpress printers	○	○	○	●	○
Apple LaserWriter	●	●	●	●	●
Other PostScript printers	○††	●	●	●	●
Printware Model 720IQ	○	○	○	○	●
Ricoh PC LASER 6000	○	○	○	○	●
Ricoh LP 4080R	○	○	○	○	●
Xerox 4045 Laser CP	○	○	○	●	●
Controller board					
Tall Tree JLaser	○	○	○	●	○
Colour ink jet					
Diablo C150 colour ink jet	○††	○	○	○	○
Hewlett-Packard ThinkJet	○††	○	○	○	○
IBM Colour Jetprinter	●	○	○	○	○
Quadram Quadjet 9000	○††	○	○	○	○
Xerox Model 4020	●	○	○	●	○
Other colour ink jet printers	●	○	○	○	○
Dot matrix					
Apple ImageWriter	○	●	○	○	○
Epson FX-80	●	○	●	●	●
IBM Proprinter	●	○	●	●	●
Other dot matrix printers	●	○	●	●	●
Other devices					
Diablo 630 Daisywheel	●	○	○	○	○
Plotters	○††	○	○	○	○
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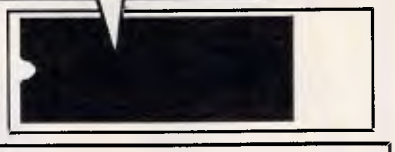

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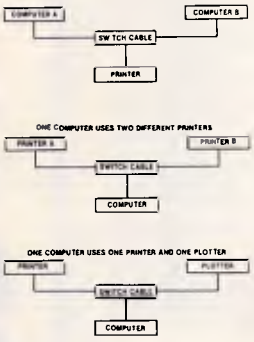

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Graphics features

	GEM Desktop Publisher	PageMaker (Mac version)	PageMaker (PC version)	Ventura Publisher	The Office Publisher
Graphics import					
AutoCAD	○	○	●	●	○
Windows Draw	●†	○	●	○	○
HPGL	○	○	○	●	○
GEM Draw	●	○	○	●	●
Mentor Graphics	○	○	○	●	○
GDI Metafiles	○	○	●	○	○
.PIC Files	●†	○	●	●	●
In*a*Vision .PIC	●†	○	●	○	○
GEM Graph	●	○	○	○	○
Video Show	○	○	○	●	○
Macintosh PICT	○	●	○	●	○
PC Paintbrush	●†	●	●	●	●
PC Paint	●†	●	●	●	●
Publisher's Paintbrush	●†	●	●	●	●
Windows Paint	●†	●	●	○	●
GEM Paint	●	○	○	●	●
Halo DPE	○	○	○	○	●
MacPaint	●†	●	●	●	○
Encapsulated PostScript	○	●	●	●	○
Scanned Images	●	●	●	● (via PC Paintbrush)	●
Built-in elements					
No. of rules	None	17 widths	17 widths	Unlimited no. of widths	Unlimited no. of widths
Reserve rules (white lines)	○	●	●	●	○
Rectangles	●	●	●	●	●
Rounded corners	○	●	●	●	○
Circles/ovals	○	●	●	●	○
Polygons	○	○	○	○	●
No. of fill patterns	9	17	17	9 (plus colours)	6
Freehand-drawing options	○	○	○	○	○
Manipulation					
Scaling	●	●	●	●	●
Cropping	●	●	●	●	●
Rotation	○	○	○	○	○
Undo	○	●	●	●	○

General features

	GEM Desktop Publisher	PageMaker (Mac version)	PageMaker (PC version)	Ventura Publisher	The Office Publisher
Version	1.0	2.0	1.0a	1.1	1.0
Manufacturer	Digital Research	Aldus Corp.	Aldus Corp.	Xerox Corp.	Laser Friendly
Price	$746	$1295	$1795	$1750	$1995
No. of pages per document	100	128	128	Memory dependent	Unlimited
Colour options	●	○	○	●	○

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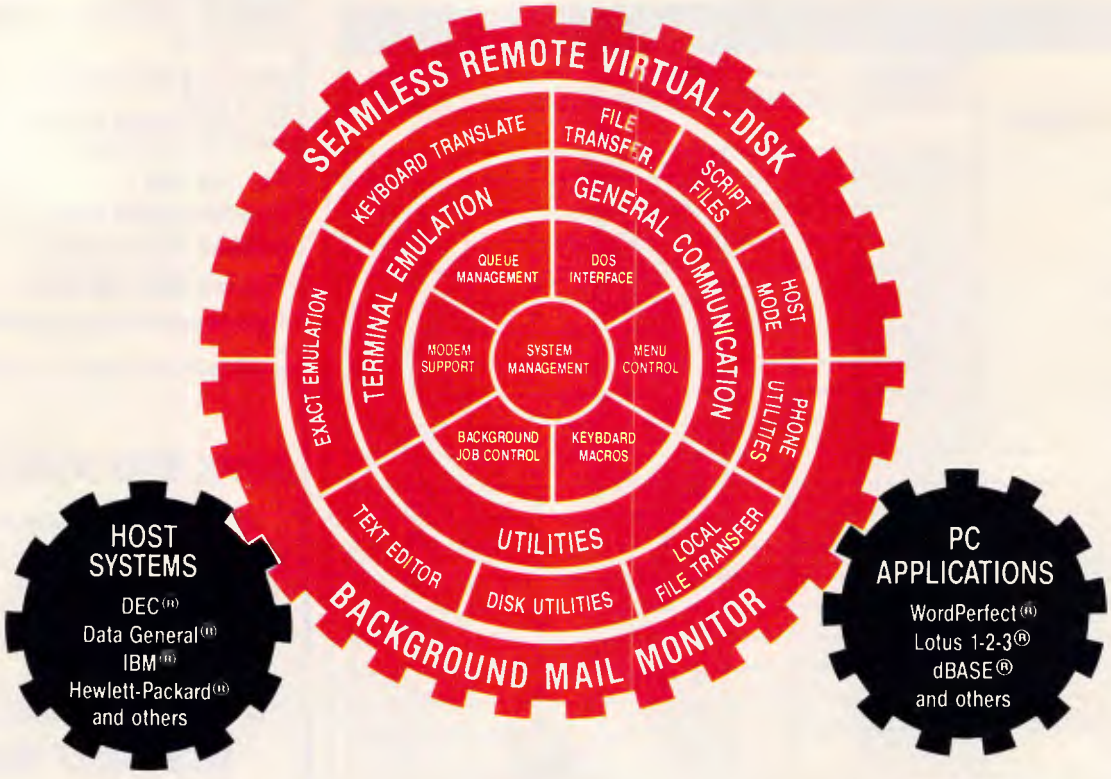

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PageMaker v XPress

After last month's review of Quark's XPress, we just couldn't resist pitting it against the old favourite, PageMaker, from Aldus. We asked Kester Cranswick, editor of Computing Australia, to make his choice.

In the beginning was the word processor. And Apple said "Let there be MacWrite". And there was MacWrite. Then Apple had all the software houses create all manner of applications for the Macintosh. And it was good.

Then Apple created the LaserWriter. A company called Aldus saw the LaserWriter and decided that it could be the basis of a new species of application — desktop publishing. So Aldus invented PageMaker and desktop publishing was born.

Seeing the success of desktop publishing, Apple's arch-enemy, Big Blue, decided it wanted a slice of the action. All its minions went about writing desktop publishing software and many believed that the IBM PC standard would take over from Apple in this field, as in so many others.

Apple's supporters were not to be outdone though. Aldus went back to its programmers and had them write an improved version of PageMaker, called PageMaker 2.0, with which to cream all the opposition. But, out of nowhere, came a company called Quark International with a desktop publishing package called XPress.

And it came to pass that this reviewer was given the task of deciding which of these two Macintosh desktop publishing packages was the best.

What you get

Neither package is cheap. XPress will set you back some $1600, PageMaker 2.0 is worth around $1300. On top of that you will need a Macintosh Plus with an internal drive or, preferably, a hard disk, a word processor, such as Microsoft Word, a graphics package, such as MacDraw and a LaserWriter. Desktop publishing is an expensive pastime for the casual user.

PageMaker comes with two 800k disks (start-up and program), an installation guide, a user manual, a reference manual and a small book called Basic Design. A 400k disk version is available on special request from the distributors. Aldus also supplies some useful extras with its program, such as the latest LaserWriter Plus drivers, updated Times and Helvetica fonts (with Font/DA mover) and two documents outlining the information on using System 4.1 and Finder 5.5, plus additional information that did not find its way into the manuals.

Quark provides three 800k disks in its package (start-up, program and installation/data), but only one all-in manual. For the money, PageMaker seems to offer a better deal.

Installation

Both programs can be run, in theory, on a Macintosh 512. However, you will need an 800k drive, either internally or externally, or the 400k disks in the case of PageMaker. With this basic configuration, PageMaker users will suffer from poor letter spacing and kerning, as the Mac Plus' 128k ROM is used by the program. So, realistically, a Mac Plus is essential.

To install PageMaker, simply copy the contents of the program disk and a number of files from the start-up disk to either your hard disk, or blank, formatted disks. In a few minutes, you are in business. To have on-screen help though, a desk accessory needs to be installed, and the 157k help file copied to the hard disk or system disk. There is no copy protection and no need to have a master disk to insert each time you boot the application.

Quark is a little less trusting of users. There are two installation programs, one for hard disk and one for floppies. Each allows you to install the program three times, following the on-screen prompts. The installation program automatically copies all relevant files to a folder on the hard disk, or to new disks.

If you wish to move XPress to a new volume, install a new system, re-build the desktop, back-up the hard disk or optimise disk space, XPress has to be removed from the hard disk with the installation program. The installation count is upped by one when this is done. Trashing the program would lose you one installation token. Fortunately, the actions which necessitate XPress being removed should be fairly rare, and once installed, you can lock away the original disks.

PageMaker is suitable for use on a network, with each user having their own version of the program, or each user sharing the one application file. This latter method is slower, but conserves valuable hard disk space.

XPress does not like networks. When I tried to install it on an Apple network, I got nothing but system errors. It is a single-user application, and this is something that may give PageMaker an edge.

Concepts

Desktop publishing, like any application area, is a concept that can be applied in a number of ways. Not one package is suitable for every class of user.

Some may want a package that is easy to use and not too complicated. Such applications often lack the features of those designed for users prepared to take the time to study manuals and learn to use all the features of a more powerful program.

Both XPress and PageMaker are professional applications, in the sense that they can be used to produce almost any type of document. If all you want to produce is an occasional flyer or a jazzed-up memo, there are simpler desktop publishing applications to look at, such as Ready Set Go! 3.

Which is to say that both these programs are *sophisticated*. They are not the sort of programs you sit down and master in a day. To get at their full power, be prepared to put in many hours of study.

Because of the Macintosh interface, there are many similarities in the way both programs run. Both adhere to standard Macintosh techniques of cutting, pasting, scrolling, sizing and mouse manipulation of on-screen elements. If you are familiar with Mac techniques, you will be a long way ahead in learning to use either program.

PageMaker is the old stagehand. It is designed to reflect the traditional paste-up desk that a type compositor might work at. The screen is the desk.

On it is displayed the one or two pages on which you are currently working. Text, pictures and other design elements are put down freely on the page, according to the design. In essence, you establish a basic page format and then flow text or pictures into it. Columns of text can be lengthened or shortened, pictures re-sized or re-scaled, and overmatter put onto other pages or onto the Mac clipboard. It is essentially a columnar approach where anything can go anywhere.

XPress adopts a box approach. Boxes, be they text or graphics, are defined on the page, and the appropriate text or graphics loaded into the box. These boxes are then re-sized or re-scaled, and their contents adjusted to fit. Page formats can be defined, type size set and spacing varied.

The XPress approach is more technical, while that of PageMaker is more intuitive. For the professional typesetter, XPress has a degree of functionality that gives far more control over the finished page than the Aldus product. However, it needs a more disciplined approach to page design. This is a fundamental difference in approach that could be the deciding factor as to which package is best for your needs.

Specifications

When it comes to technical details, XPress has it all over PageMaker if you want an all-singing, all-dancing desktop publishing application.

For instance, it can tackle bigger documents (914mm square compared to 432mm x 556mm). It allows up to seven documents to be open at once. PageMaker allows only one at a time. It has direct interfaces to Linotronic typesetting devices, can produce colour separations, or colour pages with an ImageWriter printer. It also has a feature that allows you to get into other applications without going to the Finder.

Other features of XPress include a spell checker and word search facility, versatile commands for kerning, letter spacing, tracking and hyphenation that are way ahead of similar features in PageMaker, plus an application to design customised frames and borders, easy flowing of text around pictures and better graphics facilities.

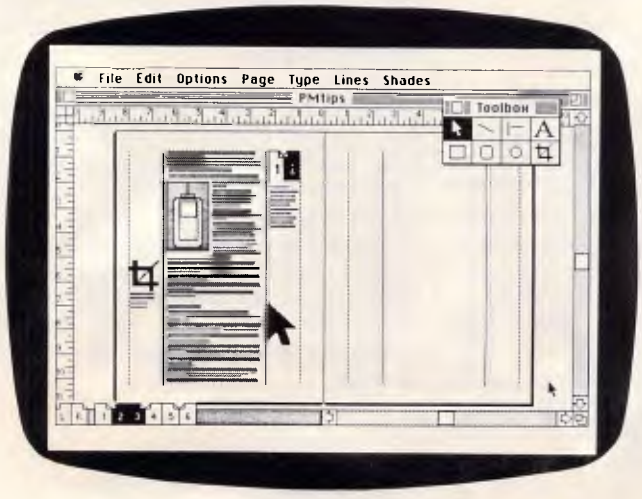
Against this, PageMaker hits back with the ability to collate pages as they are printed, print in reverse order, a superior display and better file import and export facilities. That's not to say it does not have all the features the average user is likely to need, but XPress has either more sophistication in these features, or more professional features not found in PageMaker.

First things first

Both packages come with a selection of sample documents and a tutorial. This introduces the main features of the software, the commands and some of the facilities. After that it is over to the manual and the on-screen help that both packages have.

The Help option in XPress is presented as a window listing topics, with each topic having associated text. It is comprehensive, and almost as comprehensive as the manual.

Aldus has adopted a help system developed by a company called Owl International. A desk accessory called Guidance brings up a clever help system in which clicking on a word or topic brings up the relevant text. There are also menus to be opened, with each option again leading to help text. It is a comprehensive system which, al-



PageMaker's 'Facing pages' option allows the user to work on two pages at a time

XPress' 'Get picture' option enables the user to scroll the picture until it is correctly placed in the pre-defined box

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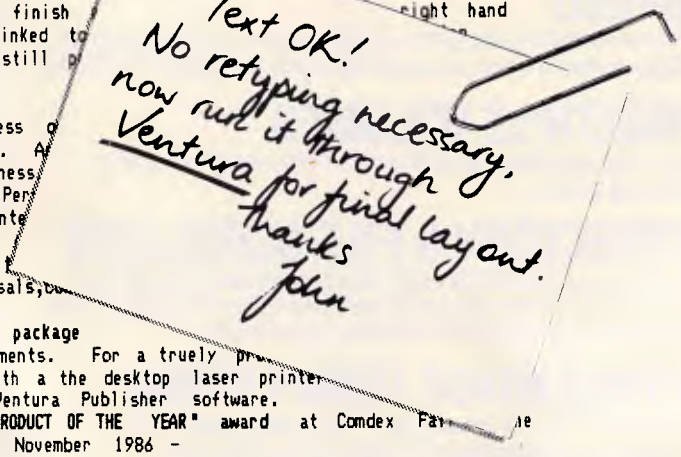

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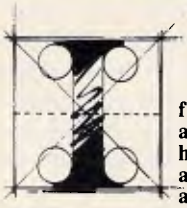

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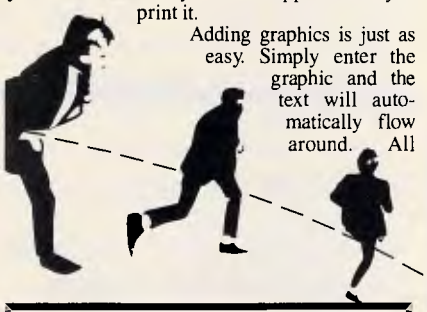

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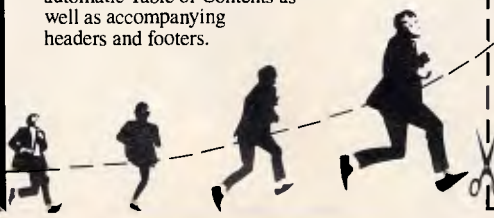

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APC 10/87

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All prices include SalesTax **TOTAL** _____

though hungry on disk space, is the sort of help facility users have always dreamed of.

In the manual department, again PageMaker has the edge. The three manuals cover everything about the product you would want to know, while the design book has some useful guidance on the principles of page design. The tutorial successfully introduces the main features of the application and the other sections cover the finer points in more detail. In short, there is very little you would want to call the distributors about.

XPress' manual is comprehensive in that it covers all the commands. However, it is short on things such as what error messages mean, and how the package is best used. XPress is a program which the user will need to sit down and work out for himself, as far as mastering all the power it has goes. The tutorial is a good introduction to the main features, but there is plenty of ground that is not covered.

Display options

The on-screen look of both programs is typically Macintosh. PageMaker has the edge in this area though, because of the concepts behind the display and the control over what is displayed.

Both programs display rulers that help align text or boxes for graphics on a page. Preferences allow the user to choose between rulers in inches, centimetres or points, depending on how familiar the user is with printer's terms. Both programs allow guides to be put on the page, to, for instance, set off areas of the page that might carry headers or folio numbers. Both programs also have 'snap to' features which will automatically align a page element with a column measure.

PageMaker's advantage is that it has a greater display area. The toolbox, which contains the icons with which tasks are accomplished, can be repositioned or turned off. Scroll bars can be switched off, to show more of the page. Guides can be locked so they are not accidentally moved. The ruler can be reset to zero on any selected part of the page. All these are things which may make the task of page design a little easier.

The PageMaker display is also more logical. The user sees the page or spread which is being worked on. At the base of the screen are miniscule icons representing other pages in the publication, with a maximum of 128 per publication possible. Getting from page to page, without using a 'go to page X' command, is simple. And PageMaker also has the useful feature of doing a 'mini-save' each time there is a change of page display. This means that if you do something you don't want to, you can restore the last mini-saved version quickly.

In XPress, different pages of the same document are positioned on the same virtual screen and reached by scrolling the display. It is a little more tedious than the PageMaker approach, though not entirely unworkable.

With both programs, the user can display actual size, double size, half, quarter and three-quarter actual size, as well as having the page sized to fit the available screen area.

Each program uses a master page approach to page design. This is quite logical. You design a skeleton for a publication and modify it to suit each

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page of the publication. In the case of PageMaker, the design involves selecting the page size, the number of columns and their spacing. It is fast, simple and easy to comprehend.

In XPress, you lay picture and text boxes down on the master page. This requires either a little more thought or leaves more to be done on each page as it is designed. The best approach will depend on the type of publication you are working on. The columnar approach is fine for publications which adhere to a pre-determined number of columns and fit everything into that format. The XPress approach is the more flexible. It is a case of 'horses for courses'.

Text handling

In this area, XPress has it all over PageMaker, unless you simply want to flow in text to columns without too much bother about kerning, tracking and the like.

Kerning, tracking, line spacing and so on are what makes a page professional. It is easy to flow in text and, if it is too long, cut a word or character here and there. However, professional typesetters use kerning to increase or decrease the amount of space between letters, line spacing to alter the amount of space between lines and tracking to determine how close letters are in unkerned body copy. Such flexibility allows the odd letter in a headline to be accommodated, the extra line of text to be squeezed in and the words you want on a page to be fitted in.

The key in XPress is the preferences menu. In this you have a huge amount of control over the way text is handled. For instance, you can adjust justification to have space only between words, or, between all characters, you can set the minimum and maximum allowable space. PageMaker has this sort of control, though to a lesser degree.

XPress also allows the user to finely tune copy in a text box, with a Modify command. A novel feature is that you can stretch text out across a box by adjusting its horizontal scaling. This can be varied from 25 per cent to 400 per cent. So if kerning is not working on a headline, the text can be stretched or squashed to fit. As headlines are often the most difficult part of a page, this is a welcome feature.

With both desktop publishing programs, the leading on lines can be adjusted to increase or decrease the horizontal space between characters. XPress allows values with just 0.01 of an em difference to be used. PageMaker has 0.5 em increments. It could be argued that 0.5 ems is all you need, but if we are to decide between the two packages, then any area of difference could be important.

On type size, XPress has the edge again. It allows any type size from 2 to 500 points. The PageMaker range is 4 to 127 points. XPress also allows characters to be shaded, in percentages of black, or to be in colour, though this will only be visible if separations are printed, or a colour printer is used.

With hyphenation, XPress allows you to specify the smallest word size allowable before hyphenation begins. It allows you to specify a minimum number of letters before a hyphen, and you are able to optionally break with convention and hyphenate proper nouns.

For hyphenation, both applications have a hyphenation dictionary as standard, and a user dictionary. The PageMaker dictionary is 110,000 words,

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with a supplementary dictionary of up to 1300 words. XPress has no stated limit on the size of the supplementary dictionary, which can also be used to dictate exceptions to normal hyphenation.

There are more XPress goodies too, in the shape of a text search feature and a spelling checker. If you are loading files from a program such as Word 3.0, you will already have these features, and it may seem a little pointless to double up on them with a desktop publishing package, but, when it comes to checking proofs or editing on screen, they are valuable. In short, XPress lets the professional proofreader get on with the job far more expediently than he or she would with PageMaker.

PageMaker does have a few novel text handling features of its own though. It has a routine that will convert selected text to upper or lower case, small or large capitals, and has a text mode called Strikethrough. XPress has Outline and shadow formats that are not found in PageMaker.

PageMaker scores on being able to import more types of text documents, many with extensive formatting. It can handle ASCII, Word, MacWrite, Works and WriteNow documents. It can also export text in Word 3.0 format. XPress can only import text from Word and MacWrite documents. If you are using Microsoft Works, PageMaker has a definite advantage.

When it comes to adding text to a story, XPress allows you to define whether the text is to be added at the end of a story, a section, a document, automatically, or manually around the current page. PageMaker has only the manual options. This makes XPress better suited to the designing of publications that have long chapters and undetermined plans as to where the pages will fall.

Flowing text between pages is not difficult with either application. In the case of XPress, your linked boxes and text will automatically flow from one box to another. With PageMaker, you flow text into one column or page and if there is an overspill, flow it into the other.

XPress' method of linking allows for more versatility, as you can easily change the links to alter where the text flows. It also has a good screen display, using directional arrows, of what boxes are linked to other boxes. And you can set up an auto-linking facility too.

Graphics

Graphics fall into two considerations — the importing of graphics from other applications and the creation of graphics and borders on the page.

In the first area, PageMaker has the edge. It is able to read files that are bitmapped (from MacPaint for instance), PICT or PostScript (EPS) formatted. So too can XPress. But PageMaker can also read documents that are input from an optical scanner, such as Thunderscan. This gives the user greater flexibility to feed in line artwork or halftones. With XPress, spaces would have to be left for such illustrations, and the images scanned at a typesettering house for later inclusion on the page.

But, when it comes to on-page graphics, borders and the like, the advantage is again back to XPress.

For a start, it has an infinite variety of borders than can be used. If the choice presented in the original application is not good enough, you can create your own frames with the Frame Editor utility.

Simple borders are easy enough with both applications. Lines can be drawn around boxes in a variety of widths and variety of patterns. PageMaker even has six corner patterns to choose from. But XPress, with its Modify command, allows a greater variety of lines, with colour and/or shading. And it has the tremendous variety of frames.

Coupled with this is an easier method to get text flowing around pictures or boxes which intrude into the main text area. It involves the use of transparent and opaque boxes. A few minutes practise will get you familiar with the process.

In the case of PageMaker, to get text flowing around irregular shapes, you have to manually insert carriage returns, or reset column widths to achieve the effect. In this area, XPress is a clear winner.

Output

In printing, apart from the range of printers and XPress' ability to produce colour separations, there is little to choose between the two.

Both will produce 'roughs' of a page, with pictures replaced by blank areas. Both with produce thumbnails — miniature layouts of several pages on the one page. PageMaker is slightly more versatile in this regard.

Both will reduce or enlarge the final printout, with PageMaker producing a tenfold enlargement at maximum, XPress a fourfold enlargement. Both will produce mirror or inverted images too.

PageMaker has one more trick up its sleeve, in that it will print a file to disk. The disk could then be taken to a typesetting house equipped with a Macintosh and a Linotronic typesetting machine, and the page output in PostScript format.

Different strokes

Which of the two is the best package for you? That is not a straightforward question.

I started off being a firm PageMaker fan. It is an established product, able to do most things the average desktop publisher would want, and not too difficult to use. However, the extra features of XPress won me over.

There are several cases in which PageMaker would be the best buy. The first is if you do most of your text editing with a word processor such as Microsoft Word 3.0. If all you want to do is throw the text at the page and get it to fit, PageMaker is the best bet.

It is also more suitable if you are a user of Microsoft Works, and your proposed publications are not picture intensive, or if you want to desktop publish on a network.

XPress comes into its own when you want to start using the skills of the typesetter — experimenting with kerning, tracking, line spacing, headline fitting and so on. It is also better if you want to use images that break out of columns, or have a page design that relies on different column measures on a page.

PageMaker is more suited to the first time user. It is easier to use, has a better manual, better help facilities, and a more thorough tutorial. It is also a must if you are using a scanner, or printing your text through a bureau's Linotronic machine.

XPress is for more experienced users who may want to experiment with colour and shading and who want the ultimate in typographical control. For my money, it is the better product, but then I need a more professional product. If it could be networked, it would be perfect.

So, PageMaker, you have met your match! And all those PC products that think they have set a new standard in desktop publishing can think again. XPress is now the yardstick, and I think it will be some time before it is beaten.

END

PageMaker costs $1295 and is available from InfoMagic on (02) 858 4111. XPress costs $1600 and is available from PICA on (03) 370 3566.

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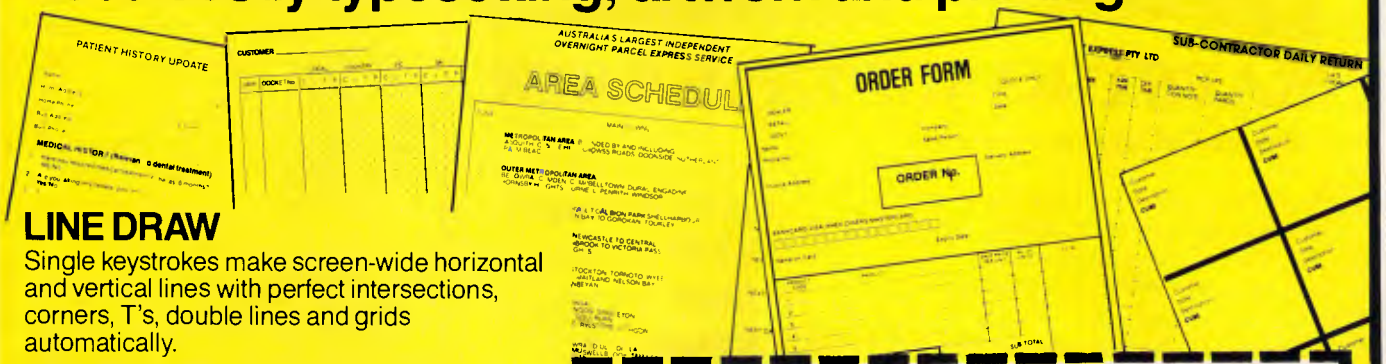

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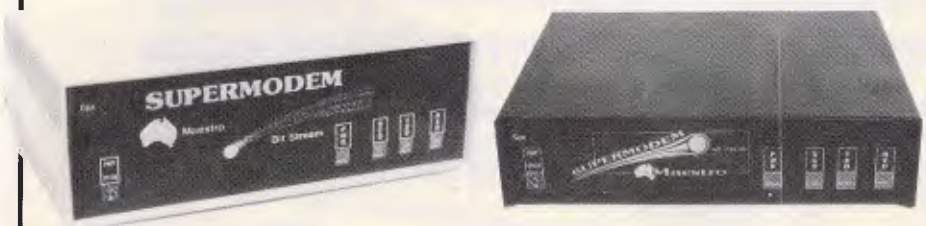

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The Novix 4000 has many of the qualities of the Transputor or the RISC-type processors, but even more incredible is its ability to jump to subroutines and back in one cycle!

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Expanding DOS

Jeff Prosise shows you how to get colours that stick, commands that stack, DOS keyboard macros, a command line editor, and a CLS that doesn't stop at line 25 — all in one handy TSR program.

If beginners are confused by the complexity of the DOS command interface, power users are infuriated by its limitations. My own wish list of DOS additions has long been headed by colour handling, keyboard macros, improved editing capabilities, and a command stack. And, as every EGA user quickly discovers, while DIR and TYPE work well with more than 25 screen rows, CLS does not.

Refining the list with a view to implementing it myself (you'd grow old waiting for Microsoft) the colour scheme should be one that you can set on the fly and that remains intact no matter what DOS throws at it — specifically including leaving Basic.

The keyboard macros should work only on the command line and not interfere with applications programs. Editing functions should more closely resemble those of word processors. The command stack should let you recycle whole sets of commands the way the F3 key now lets you reissue the last one. And, of course, CLS must be able to handle 38, 43, or even 50-line displays.

To do it justice, DOS makes at least half-hearted provision for some of my wants. The ANSI.SYS driver included with every purchase of the operating system allows you to assign strings to any key or key combination that normally produces a buffered keycode. It also lets you introduce colour to the white-on-black world of DOS and provides a device-independent scheme for manipulating the cursor.

On the other hand, the instructions for ANSI.SYS are buried in the DOS *Technical Reference* manual, a document most users will never see. This may actually have been a clever move by IBM, for the shortcomings of ANSI.SYS far outweigh its merits. With ANSI.SYS, for example, communications have to be routed through the standard output device and must conform to a less-than-intuitive command syntax. The driver does nothing that might help you implement a command stack, and its code is hardwired for a 25-row screen. Even DIR and TYPE default to 25 lines with ANSI.SYS loaded.

Enter DOSKEY, a memory-resident utility designed to make working with DOS a little bit easier. DOSKEY lets you assign macros to function keys F3 through F10 (plus F11 and F12 if you have an enhanced keyboard), buffers the last 15 commands so you can flip through them with the Up and Down Arrow keys, implements command line editing, adds colour to the teletype interface, and makes sure that CLS clears the entire viewing area. All in 4k of RAM.

The easiest way to get a copy of DOSKEY is to download it by modem from Microtex on Telecom's Viatel (page *6663#), or by sending a blank formatted disk with a stamped self-addressed packet to 'DOSKEY' *c/- APC*, 124 Castlereagh Street, Sydney 2000. For the intrepid keyboarder, DOSKEY.ASM and DOSKEY.BAS programs are listed here.

Using DOSKEY

DOSKEY is a resident utility that is to be loaded once and only once sometime before its services are required. Including it as a line in your AUTOEXEC.BAT file makes the installation automatic every time you boot up. Alternatively, from the DOS prompt, enter

[*d*:][*path*]DOSKEY

With DOSKEY installed, the F2 function key sets the background screen colour. Each press of F2 clears the display and flips the background to the next colour in the standard eight-colour background palette. Shift-F2 does the same, except that it moves through the circular palette in reverse order. F1 and Shift-F1 work in exactly the same way here for the 16 different selectable text (foreground) colours.

The screen attributes you select won't change until they're intentionally altered with F1 or F2 or by an applica-

tions program that takes over and defines its own colour scheme. When a program terminates and returns to DOS, you'll sometimes find yourself back in DOS's default white on black, but a quick CLS will always return you to your selected colours. Should you ever need to return to the DOS default intentionally, just put a space after CLS on the command line before you hit Enter. A subsequent CLS (without the trailing space character) will restore your customised interface. And, as advertised, even if you're working with a more-than-25-line EGA screen, CLS will work as it should: every line displayed on the screen will be blanked.

Next come DOSKEY's function key macros. As program defaults, DOSKEY assigns the following strings to F3 through F10:

F3	dir
F4	type
F5	copy
F6	delete
F7	chdir
F8	path
F9	browse
F10	cls

Pressing a function key on the command line will type out the text automatically, just as if you had manually entered it a character at a time. The Basic interpreter does the same sort of thing with the function keys and appropriate Basic commands.

If you have an extended keyboard and your BIOS supports it (see the box 'The Enhanced Keyboard') DOSKEY takes advantage of the new F11 and F12 function keys. By default, F11 spells out 'backup' on the command line, waiting for you to enter a file specification and appropriate parameters after it and press Enter. F12 does the same with 'restore'. DOSKEY also modifies interrupt 16h to allow other programs, like Basic, to take advantage of F11 and F12.

As you'll see in detail shortly, it's easy to modify DOSKEY's default keyboard macros to output the commands of your choice. Since each function key can handle a string of up to 31 characters, the potential keystroke economy is high. Further, when you add your own command macros, you can choose either to have them automatically executed when the function key is pressed or to have DOS wait for you to press Enter. The former is useful for commands like CLS; the latter allows you to incorporate commands that are meaningless without additional command line parameters, such as TYPE and DELETE.

Stack'em up

Every time you enter a DOS command, DOSKEY intercepts it and stores it away where it can be recalled and recycled. Try it: with DOSKEY loaded, enter four or five commands (CHKDSK,DIR *.COM, etc.) that you typically use during a PC session. Then press the Up Arrow key a few times. You'll see the commands you just entered replayed in the reverse order to entry. The Down Arrow key moves you back towards the front of the stack and your last command, ultimately returning you to an empty command line. If you want to reset the current-command pointer quickly back to the head of the stack, just press Esc. Then the next press of Up Arrow will display the most recently entered command, regardless of where you were in the stack when you hit the Esc key.

When you reach a command you want to execute, just press Enter. DOSKEY buffers the last 15 commands in a rotating internal command stack. When its limit is surpassed, the 15th command is pushed off the stack to make room for the latest one you have entered.

If you haven't accidentally discovered them already, you'll want to take some of DOSKEY's command-line editing features for a test drive. For editing DOS commands, DOSKEY gives you everything you'd expect from a small text editor. You can edit any command line, whether you typed it yourself, invoked a function key macro, or recalled it from the stack. The Left and Right Arrow keys let you move around on the command line, and if your entry extends beyond one screen line, you're no longer prevented from going back a line. Del and Backspace erase characters, drawing in anything to the right of the cursor. The Home and End keys pop you instantly to the beginning and end of the line, respectively, and Esc erases the command line completely.

If you hit the Ins key, you'll find you can insert characters on the fly. As with DOS, overstrike is the default mode, but if you toggle the Ins mode on in DOS, then run a program in which it gets changed, when you return to DOS the Ins mode will be just as you left it.

Inside DOSKEY

The primary difference between DOSKEY and other resident utilities is that it must be strictly restricted to working only on the DOS command line. You can't grab the function and cursor keys indiscriminately and avoid interfering with applications programs and other TSRs.

When DOS wants to read a command line entry from the standard input device (usually the keyboard), it executes an interrupt 21h with AH set to 0Ah and DS:DX pointing to an internal DOS buffer space. Function 0Ah takes care of reading each character, echoing it to the screen and placing it in the DOS command line buffer. It's here that DOS's editing inadequacies originate; for, apart from a few clumsy capabilities tacked onto function keys F1 through F5, DOS function 0Ah lets you do little more than type characters and backspace over them.

DOSKEY implements its own function 0Ah handler. This custom routine provides the full editing, command stack, macro, and colour features described above. The only trickery involved is in understanding some of function 0Ah's subtleties. The first byte in the function 0Ah buffer is set by the calling program to the maximum number of characters to be accepted, including the terminating carriage return. The second byte is filled in by the input routine and indicates the number actually entered, excluding the carriage return. Following that is the buffer space itself, where the text is deposited.

Most memory resident utilities use the BIOS to read keystrokes and write to the screen. The BIOS routines are convenient and fast, and the DOS routines may not be available. But DOSKEY's replacement for function 0Ah uses the slower DOS functions to read the keyboard and write to the screen. This restriction must be imposed to ensure that redirection of standard input will function on the DOS level. It is also necessary to generate an interrupt 23h properly when the Ctrl-Break key combination is typed.

To maintain compatibility further, DOSKEY mimics DOS by repeatedly issuing interrupt 28h while awaiting a keystroke on the command line. This enables TSRs like SideKick to assume control safely when the INDOS flag is set. DOSKEY must faithfully duplicate that feature to remain compatible with resident utilities that employ DOS services.

The input loop is only ended when Enter or Esc is pressed. Hitting the Enter key puts an ASCII 13 immediately after the last character. DOSKEY handles Esc in a slightly different way, clearing the buffer and the command line but continuing to solicit input without ever handing control back to DOS.

Les Stein's Envelope

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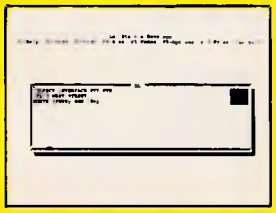
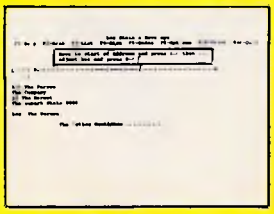
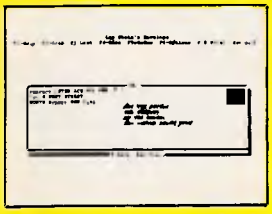


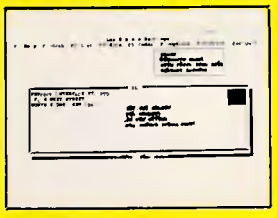
1. Hit ALT +



2. Point to the address.



3. Hit F2 — position address on envelope.



4. Hit FIO print.

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Address _____

Phone No. _____

```
;DOSKEY.COM for the IBM Personal Computer - 1987 by Jeff Prosise
;
bios_data       segment at 40h                  ;BIOS Data Area
                org 17h                         ;shift status byte
shft_stat       db ?
                org 84h
crt_rows        db ?                            ;number of display rows
                org 87h
ega_info        db ?                            ;EGA info byte
bios_data       ends
;
code            segment para public 'code'
                assume cs:code
                org 100h
begin:          jmp initialize
;
copyright       db 'Copyright 1987 Ziff-Davis Publishing Co.'
author          db 'Jeff Prosise'
;
cls_text        db 'CLS',13                     ;text of clear screen command
stackptr        dw 0                            ;primary command stack pointer
locptr          dw ?                            ;secondary command stack pointer
zcount          db ?                            ;stack pointer relative to zero
ega_flag        db 0                            ;0=no EGA, 1=EGA installed
insert_flag     db 0                            ;status of insert state
foreground      db 7                            ;current foreground color
background      db 0                            ;current background color
dos_segment     dw ?                            ;DOS input buffer segment
columns         db ?                            ;max display column number
bufferptr       db ?                            ;buffer index
;
ftext           db 4,'dir ',27 dup (0)          ;command linked to F3 key
                db 5,'type ',26 dup (0)         ;command linked to F4 key
                db 5,'copy ',26 dup (0)         ;command linked to F5 key
                db 4,'del ',27 dup (0)          ;command linked to F6 key
                db 6,'chdir ',25 dup (0)        ;command linked to F7 key
                db 5,'path ',26 dup (0)         ;command linked to F8 key
                db 7,'browse ',24 dup (0)       ;command linked to F9 key
                db 3,'cls',255,27 dup (0)       ;command linked to F10 key
                db 7,'backup ',24 dup (0)       ;command linked to F11 key
                db 8,'restnre ',23 dup (0)      ;command linked to F12 key
;
dos_int         label dword
old21h          dw 2 dup (?)                    ;interrupt 21h vector
old_int_16      dd 0                            ; old vector
;
;-----------------------------------------------------------------------
;DOSINT routine intercepts calls to interrupt 21h.
;-----------------------------------------------------------------------
dosint          proc near
;
;See if this is a request for DOS function 0Ah.
;
                sti                             ;restore interrupts
                cmp ah,0Ah                      ;function 0Ah?
                je dos1                         ;yes, then continue
dos_exit:       jmp dos_int                     ;no, then exit to DOS routine
dos1:           cmp dos_segment,0               ;has entry occurred before?
                jne dos3                        ;yes, then branch
;
;Initialize command stack and record DS value if this is the first call.
;
                mov dos_segment,ds              ;record DOS data segment
                push cx                         ;save CX and SI
                push si
                mov cx,20                       ;initialize command stack area
                mov si,offset initialize
dos2:           mov byte ptr cs:[si],0
                add si,128
                loop dos2
                pop si                          ;restore registers
                pop cx
;
;See if the function call came from DOS.
;
dos3:           push bx                         ;save BX register
                mov bx,ds                       ;get DS in BX for compare
                cmp bx,dos_segment              ;call generated from command line?
                pop bx                          ;clean up the stack
                jne dos_exit                    ;no, then exit
;
;Get a command line entry from the standard input device.
;
                push ax                         ;save all registers to be used
                push bx
                push cx
                push dx
                push si
                push di
                push ds
                push es
                push dx                         ;resave buffer offset
                call input                      ;read an input string
;
;Copy the entry into the command stack.
;
                pop dx                          ;recover buffer offset
                mov si,dx                       ;point SI to input buffer
                mov al,[si+1]                   ;get length of input string
                or al,al                        ;is the length zero?
                je dos6                         ;yes, then exit now
                inc si                          ;advance SI to count byte
                push cs                         ;point ES to command stack segment
                pop es
                mov di,stackptr                 ;get command stack pointer
                mov cl,7                        ;convert it to an offset address
                shl di,cl
                add di,offset initialize
                mov cl,al                       ;transfer string length to CL
                inc cl                          ;increment to include count byte
                xor ch,ch                       ;byte to word in CX
                cld                             ;clear DF
                rep movsb                       ;copy string to command stack
                inc stackptr                    ;update pointer
                cmp stackptr,15                 ;wrap around if necessary
                jne dos4
                mov stackptr,0
dos4:           mov ax,stackptr                 ;set LOCPTR = STACKPTR
                mov locptr,ax
                mov zcount,0                    ;initialize base zero pointer
;
;See if the command just entered was CLS.
;
                mov si,dx                       ;point DS:SI to new string
                add si,2
                mov di,offset cls_text          ;and ES:DI to 'CLS' text
                mov cx,4                        ;four bytes to check
dos5:           lodsb                           ;get one byte
                and al,0DFh                     ;capitalize character
                scasb                           ;do the bytes match?
                jne dos6                        ;no, then CLS wasn't entered
                loop dos5                       ;yes, then check another byte
                call clear_screen               ;clear the screen
                sub si,5                        ;reset SI to count byte
                mov [si],0D00h                  ;clear string from DOS buffer
;
;Restore registers and exit.
;
dos6:           pop es                          ;restore registers and exit
                pop ds
                pop di
                pop si
                pop dx
                pop cx
                pop bx
                pop ax
                iret
dosint          endp
;
;-----------------------------------------------------------------------
;INPUT reads an input string from the standard input device.
;-----------------------------------------------------------------------
input           proc near
;
;Record video information and initialize parameters.
;
                mov ah,15                       ;get video page and columns
                int 10h
                dec ah                          ;calculate max column number
                mov columns,ah                  ;save it
                push ds                         ;point ES:DI to buffer
                pop es
                mov di,dx
                add di,2
                mov si,dx                       ;point DS:SI to character count
                inc si
                mov byte ptr [si],0             ;zero initial count
                mov bufferptr,1                 ;set initial index value
                cld                             ;clear DF
;
;Wait for a keycode to appear in the keyboard buffer.
;
getkey:         mov ah,0Bh                      ;check keyboard buffer for keycode
                int 21h
                or al,al                        ;anything there?
                jne getchar                     ;yes, then go get it
                int 28h                         ;no, then execute interrupt 28h
                jmp getkey                      ;loop back for another try
;
;Read the keycode and process it if it's not an extended code.
;
getchar:        mov ah,0                        ;read character from buffer
                int 21h
                or al,al                        ;is it an extended code?
                je excode                       ;yes, then branch
                cmp al,8                        ;backspace key?
                jne getc1                       ;no, then branch
                call backspace                  ;rub out a character
                jmp getkey                      ;return to loop
getc1:          cmp al,27                       ;ESC key?
                jne getc2                       ;no, then branch
                call clear_line                 ;yes, then clear input line
                mov ax,stackptr                 ;reset LOCPTR
                mov locptr,ax
                mov zcount,0                    ;reset base zero pointer
                jmp getkey
getc2:          cmp al,13                       ;ENTER key?
                je enter                        ;yes, then branch
                call printchar                  ;no, then print the character
                jmp getkey
enter:          call eol                        ;place cursor at end-of-line
                mov byte ptr es:[di],13         ;insert carriage return code
                mov ah,2                        ;advance to next line
                mov dl,13
                int 21h
                ret
;
;Read the extended code and see if one of the keys F3 thru F12 was pressed.
;
excode:         mov ah,8                        ;get extended code
                int 21h
                cmp al,133                      ;F11?
                je fkey
                cmp al,134                      ;F12?
                je fkey
                cmp al,61                       ;less than F3?
                jb ex1                          ;yes, then not F3-F10
                cmp al,86                       ;greater tah 68?
                ja ex1                          ;yes, then not F3-F10
fkey:           test al,80h                     ;high bit set (F11 or F12)?
                jz fkey1                        ;no, then branch
                sub al,64                       ;adjust extended code
fkey1:          sub al,61                       ;normalize extended code
                cbw                             ;convert byte to word
                mov cl,5                        ;multiply by 32
                shl ax,cl
                add ax,offset ftext             ;calculate string address
                call write_command              ;output command
                cmp al,255                      ;AL 255 on return?
                je enter                        ;yes, then send entry to DOS
                jmp getkey                      ;return to input loop
;
;See if F1 or F2 (or either of the two shifted) was pressed.
;
ex1:            cmp al,59                       ;F1?
                jne ex2
                inc foreground                  ;rotate foreground color forward
                cmp foreground,10h              ;wrap around if necessary
                jne clear
                mov foreground,0
                jmp clear                       ;jump to clear screen routine
ex2:            cmp al,84                       ;Shift-F1?
                jne ex3
                dec foreground                  ;decrement foreground color
                cmp foreground,0FFh             ;wrap around if necessary
```

DOSKEY.ASM: the source code for DOSKEY.COM

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```
                jne clear
                mov foreground,0Fh
                jmp clear
ex3:            cmp al,60                       ;F2 key?
                jne ex4
                inc background                  ;rotate background color forward
                cmp background,8                ;wrap around if necesaary
                jne clear
                mov background,0
                jmp clear
ex4:            cmp al,85                       ;Shift-F2?
                jne ex5
                dec background                  ;decrement background color
                cmp background,0FFh             ;wrap around if necessary
                jne clear
                mov background,7
clear:          call clear_screen               ;clear screen and home cursor
                mov [si],0D00h                  ;clear input buffer
                ret
;
;See if either Home or End was pressed.
;
ex5:            cmp al,71                       ;Home?
                jne ex6
                call home                       ;home the cursor
                mov bufferptr,1                 ;reset pointers
                mov di,si
                inc di
                jmp getkey
ex6:            cmp al,79                       ;End?
                jne ex7
                call eol                        ;move cursor to end-of-line
                jmp getkey
;
;See if either the left or right-arrow key was pressed.
;
ex7:            cmp al,75                       ;Cursor-Left?
                jne ex8
                call move_left                  ;move left one space
                jmp getkey
ex8:            cmp al,77                       ;Cursor-Right?
                jne ex9
                call move_right                 ;move right one space
                jmp getkey
;
;See if either INS or DEL was pressed.
;
ex9:            cmp al,82                       ;INS?
                jne ex10
                xor insert_flag,1               ;toggle insert flag
                jmp getkey
ex10:           cmp al,83                       ;DEL?
                jne ex11
                call delete                     ;delete character at cursor
                jmp getkey
;
;Output the last command in the stack if Cursor-Up was pressed.
;
ex11:           cmp al,72                       ;Up?
                jne ex12
                cmp zcount,15                   ;at upper limit of stack?
                je up_exit                      ;yes, then ignore keypress
                mov ax,locptr                   ;get current stack index
                dec ax                          ;move back one command
                cmp ax,8FFFFh                   ;wrap around if necessary
                jne up1
                mov ax,14
up1:            mov dx,ax                       ;save AX in DX
                mov cl,7                        ;calculate address of command
                shl ax,cl
                add ax,offset initialize
                push si                         ;save SI
                mov si,ax                       ;transfer address to SI
                cmp byte ptr cs:[si],0          ;is there a valid command there?
                pop si                          ;restore SI
                je up_exit                      ;no, then ignore keypress
                mov locptr,dx                   ;set LOCPTR
                inc zcount                      ;increment base zero pointer
                call write_command              ;output the command string
up_exit:        jmp getkey
;
;Output the next command in the stack if Cursor-Down was pressed.
;
ex12:           cmp al,80                       ;Down?
                jne ex13
                cmp zcount,0                    ;at head of command stack?
                je ex13                         ;yes, then ignore keypress
                mov ax,locptr                   ;get current stack index
                inc ax                          ;advance one command
                cmp ax,15                       ;wrap around if necessary
                jne dn1
                xor ax,ax
dn1:            mov locptr,ax                   ;set LOCPTR
                dec zcount                      ;decrement base zero pointer
                jnz dn2                         ;branch if not at head of stack
                call clear_line                 ;clear command line
                jmp getkey                      ;return to input loop
dn2:            mov cl,7                        ;calculate address of command
                shl ax,cl
                add ax,offset initialize
                call write_command              ;output the command string
ex13:           jmp getkey
input           endp
;
;-----------------------------------------------------------------------
;PRINT_STRING writes an ASCII string to the command line.
;Entry:  DS:SI - string address
;        CX    - number of characters
;-----------------------------------------------------------------------
print_string    proc near
                jcxz ps_exit                    ;exit if no characters
                mov ah,2                        ;DOS function 2 - output char
ps1:            lodsb                           ;get a byte
                mov dl,al                       ;transfer it to DL
                int 21h                         ;output character
                loop ps1                        ;loop until done
ps_exit:        ret
print_string    endp
;
;-----------------------------------------------------------------------
;WRITE_COMMAND outputs a command string.
;Entry:  AX - string offset address      Exit:  AL - character after string
;-----------------------------------------------------------------------
write_command proc near
                push ax                         ;save address
                call clear_line                 ;clear input line
                pop ax                          ;retrieve string address
                push ds                         ;save DS and SI
                push si
                push cs                         ;point DS to string segment
                pop ds
                mov si,ax                       ;point SI to the string
                mov cl,[si]                     ;get string length
                xor ch,ch
                mov byte ptr es:[di-1],cl       ;store string length
                inc si                          ;advance SI to string text
write1:         mov ah,2                        ;print one character
                mov dl,[si]
                int 21h
                movsb                           ;transfer character to buffer
                inc bufferptr                   ;advance pointer
                loop write1                     ;loop until done
                lodsb                           ;get first character after string
                pop si                          ;restore registers
                pop ds
                ret
write_command endp
;
;-----------------------------------------------------------------------
;BACKSPACE deletes the character left of the cursor.
;-----------------------------------------------------------------------
backspace       proc near
                cmp bufferptr,1                 ;at beginning of command line?
                je bs_exit                      ;yes, then ignore it
                mov cl,[si]                     ;get count
                sub cl,bufferptr                ;calculate distance to end-of-line
                inc cl
                xor ch,ch
                push cx                         ;save it
                jcxz bs1                        ;branch if at end-of-line
;
;Shift all characters right of the cursor in the buffer one slot left.
;
                push si                         ;save SI and DI
                push di
                mov si,di                       ;position them for shifts
                dec di
                rep movsb                       ;shift characters right of cursor
                pop di                          ;restore registers
                pop si
;
;Display the new string and update input parameters.
;
bs1:            call move_left                  ;move cursor left
bs2:            pop cx                          ;retrieve shift count
                push dx                         ;save cursor position
                push si                         ;save SI
                mov si,di                       ;point SI to new part of string
                call print_string               ;print the new part
                mov ah,2                        ;blank the last character
                mov dl,32
                int 21h
                pop si                          ;restore registers
                pop dx                          ;restore cursor address
                mov ah,2                        ;reset the cursor
                int 10h
                dec byte ptr [si]               ;decrement character count
bs_exit:        ret
backspace       endp
;
;-----------------------------------------------------------------------
;PRINTCHAR writes a new character to the input buffer and echoes it.
;-----------------------------------------------------------------------
printchar       proc near
                cmp insert_flag,8               ;insert state on?
                jne print3                      ;yes, then branch
;
;Print a character in overstrike mode.
;
                mov cl,[si]                     ;get count
                cmp cl,bufferptr                ;end-of-line?
                jae print2                      ;no, then branch
                mov cl,[si-1]                   ;get maximum length
                sub cl,[si]                     ;subtract current length
                cmp cl,1                        ;buffer full?
                je beep                         ;yes, then branch
print1:         inc byte ptr [si]               ;increment count
print2:         stosb                           ;deposit new character
                mov ah,2                        ;then print it
                mov dl,al
                int 21h
                inc bufferptr                   ;advance buffer pointer
                ret
beep:           mov ax,0E07h                    ;print ASCII 7 thru BIOS
                int 10h
                ret
;
;Print a character in insert mode.
;
print3:         mov cl,[si-1]                   ;get maximum length
                sub cl,[si]                     ;subtract current count
                cmp cl,1                        ;buffer full?
                je beep                         ;yes, then branch
                mov cl,[si]                     ;get count
                cmp cl,bufferptr                ;end-of-line?
                jb print1                       ;yes, then branch
                sub cl,bufferptr                ;calculate number of shifts
                inc cl
                xor ch,ch
                push cx                         ;save shift count
                push si                         ;save SI
                add di,cx                       ;position DI to end-of-line
                mov si,di                       ;position SI just before it
                dec si
                std                             ;set DF for now
                rep movsb                       ;make room for new character
                cld                             ;clear DF
                pop si                          ;restore SI
                mov es:[di],al                  ;deposit new character
                mov ah,3                        ;get cursor position
                int 10h
                pop cx                          ;retrieve shift count
                inc cx                          ;increment it
                push dx                         ;save cursor position
                push si                         ;save SI
                mov si,di                       ;point SI to current location
                call print_string               ;print new part of string
                pop si                          ;restore SI and DX
                pop dx
                mov ah,2                        ;reset cursor position
                int 10h
                inc byte ptr [si]               ;add to character count
                jmp move_right                  ;move cursor right
printchar       endp
;
;-----------------------------------------------------------------------
;DELETE deletes the character at the cursor.
;-----------------------------------------------------------------------
```

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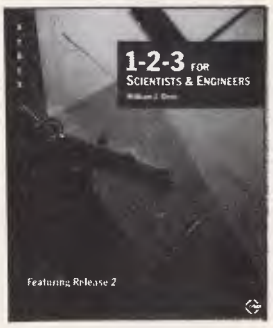

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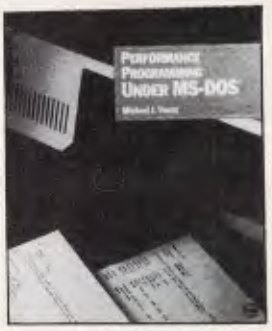

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```
delete          proc near
                mov cl,[si]                     ;get count
                cmp cl,bufferptr                ;end-of-line?
                jb del2                         ;yes, then ignore keypress
                sub cl,bufferptr                ;calculate number of shifts
                xor ch,ch                       ;byte to word in CX
                push cx                         ;save shift count
                jcxz del1                       ;branch if no shifts
                push si                         ;save SI and DI
                push di
                mov si,di                       ;position registers for shift
                inc si
                rep movsb                       ;shift characters right of cursor
                pop di                          ;restore registers
                pop si
del1:           mov ah,3                        ;get cursor position
                int 10h
                jmp bs2                         ;exit through BACKSPACE routine
del2:           ret
delete          endp
;
;-----------------------------------------------------------------------------
;MOVE_LEFT moves the cursor one character left.
;-----------------------------------------------------------------------------
move_left       proc near
                cmp bufferptr,1                 ;at beginning of line?
                je left3                        ;yes, then ignore keypress
                mov ah,3                        ;get cursor position
                int 10h
                or dl,dl                        ;column 0?
                je left1                        ;yes, then branch
                dec dl                          ;decrement column number
                jmp left2
left1:          mov dl,columns                  ;position at end of previous line
                dec dh
left2:          mov ah,2                        ;set new position
                int 10h
                dec dl                          ;decrement pointers
                dec bufferptr
left3:          ret
move_left       endp
;
;-----------------------------------------------------------------------------
;MOVE_RIGHT moves the cursor one character right.
;-----------------------------------------------------------------------------
move_right      proc near
                mov cl,[si]                     ;get count
                cmp cl,bufferptr                ;end-of-line?
                jb rt3                          ;yes, then ignore keypress
                mov ah,3                        ;get cursor position
                int 10h
                cmp dl,columns                  ;at end-of-line?

                je rt1                          ;yes, then branch
                inc dl                          ;increment column number
                jmp rt2
rt1:            xor dl,dl                       ;beginning of next line
                inc dh
rt2:            mov ah,2                        ;position cursor
                int 10h
                inc di                          ;advance pointers
                inc bufferptr
rt3:            ret
move_right      endp
;
;-----------------------------------------------------------------------------
;HOME relocates the cursor to the beginning of the command line.
;-----------------------------------------------------------------------------
home            proc near
                mov cl,bufferptr                ;get position pointer
                dec cl                          ;calculate distance from start
                xor ch,ch
                jcxz home_exit                  ;exit if already there
home1:          push cx                         ;save count
                call move_left                  ;move left one space
                pop cx                          ;retrieve count
                loop home1                      ;loop until done
home_exit:      ret
home            endp
;
;-----------------------------------------------------------------------------
;EOL advances the cursor to the end of the command line.
;-----------------------------------------------------------------------------
eol             proc near
                mov cl,[si]                     ;get count
                cmp cl,bufferptr                ;already at end?
                jb eol_exit                     ;yes, then exit
                sub cl,bufferptr                ;calculate distance from end
                inc cl
                xor ch,ch                       ;byte to word in CX
eol1:           push cx                         ;advance right CX times
                call move_right
                pop cx
                loop eol1
eol_exit:       ret
eol             endp
;
;-----------------------------------------------------------------------------
;CLEAR_LINE clears the command line.
;-----------------------------------------------------------------------------
clear_line      proc near
                mov cl,[si]                     ;get count
                xor ch,ch
                jcxz cline2                     ;exit if no characters
                push cx                         ;save count
                call home                       ;home the cursor
                mov ah,3                        ;get cursor position
                int 10h
                pop cx                          ;restore CX
                push dx                         ;save cureor address
                mov ah,2                        ;print ASCII spaces
                mov dl,32
cline1:         int 21h
                loop cline1
                mov ah,2                        ;home cursor again
                pop dx
                int 10h
                mov byte ptr [si],0             ;reset parameters
                mov bufferptr,1
                mov dl,si
                inc dl
cline2:         ret
clear_line      endp
;
;-----------------------------------------------------------------------------
;CLEAR_SCREEN clears the display to the currently selected colors.
;-----------------------------------------------------------------------------
clear_screen    proc near
                push ds                         ;save DS
                mov ax,bios_data                ;point DS to BIOS Data Area
                mov ds,ax
                assume ds:bios_data
                mov dl,columns                  ;set number of columns
                mov dh,25                       ;set number of screen rows
                cmp ega_flag,0                  ;is there an EGA installed?
                je clear1                       ;no, then branch
                test ega_info,8                 ;is the EGA the active monitor?
                jnz clear1                      ;no, then branch
                mov dh,crt_rows                 ;get number of screen rows
clear1:         mov bh,background               ;formulate attribute for clear
                mov cl,4
                shl bh,cl
                or bh,foreground
                mov ax,0600h                    ;video function - scroll screen
                xor cx,cx                       ;designate entire screen
                int 10h                         ;clear the display
                mov ah,15                       ;determine active video page
                int 10h
                mov ah,2                        ;home the cursor
                xor dx,dx
                int 10h
                pop ds                          ;restore DS
                assume ds:nothing
                ret
clear_screen    endp
;
;-----------------------------------------------------------------------------
;This enhancement for Int 16 is installed only on machines that use it.
;-----------------------------------------------------------------------------
int_16          proc    far
        assume  cs:code, ds:nothing, es:nothing, ss:nothing

                pushf                           ;save the flags
                sti                             ;allow interrupts


                cmp ah,2                        ;affects only fn 0,1
                jb bios_1
bios_0:
                popf                            ;restore flags
                jmp old_int_16                  ;continue on
bios_1:
                or ah,10h                       ;make extended fn

                call old_int_16                 ;call old handler
                pushf                           ;save flags

                cmp al,0e0h                     ;If low byte isn't E0
                jne bios_2                      ; continue normally

                or ah,ah                        ;If char(224)
                jz bios_2                       ; continue
                xor al,al                       ;else make normal extended
bios_2:
                popf                            ;restore these flags
                ret 2                           ;discard original ones

int_16          endp

;-----------------------------------------------------------------------------
;INITIALIZE leavee DOSKEY resident in memory.
;-----------------------------------------------------------------------------
initialize      proc near
                assume ds:code
;
;Determine whether an EGA is installed.
;
                mov ah,12h                      ;BIOS video function 12h
                mov bl,10h                      ;return EGA info subfunction
                int 10h                         ;get info
                cmp bl,10h                      ;did BL return unchanged?
                je init1                        ;yes, then there's no EGA here
                inc ega_flag                    ;no, then there is an EGA
;
;Save and replace interrupt vectors.
;
init1:
                mov ax,3521h                    ;save and replace int 21h vector
                int 21h


                mov old21h,bx
                mov old21h[2],es
                mov ah,25h
                lea dx,dosint
                int 21h
;
; Determine if BIOS supports enhanced keys.
;
                xor     ax,ax
                mov     es,ax
        assume  es:nothing
                xor     byte ptr es:[417h],80h
                mov     ah,12h
                int     16h
                cmp     al,byte ptr es:[417h]
                jne     no_support
                xor     byte ptr es:[417h],80h
                mov     ah,12h
                int     16h
                cmp     al,byte ptr es:[417h]
                jne     no_support

                mov     ax,3516h
                int     21h
                mov     word ptr old_int_16,bx
                mov     word ptr old_int_16[2],ss
                mov     ah,25h
                mov     dx,offset int_16
                int     21h
no_support:
;
;Terminate but leave interrupt handling code and buffer space resident.
;
                mov dx,offset initialize+1920 ;point DX to end of reserved area
                int 27h                         ;terminate-but-stay-resident
initialize      endp
;
code            ends
                end begin
```

(DOSKEY.ASM ends)

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```
100 REM -- BASIC PROGRAM TO CREATE DOSKEY.COM
110 OPEN "DOSKEY.COM" AS #1 LEN = 1
120 FIELD #1,1 AS A$
130 CHECKSUM = 0
140 FOR I = 1 TO  206
150     LINESUM = 0
160     FOR J = 1 TO 8
170         READ BYTE
180         CHECKSUM = CHECKSUM + BYTE
190         LINESUM = LINESUM + BYTE
200         IF (BYTE < 256) THEN LSET A$ = CHR$(BYTE)
210         PUT #1
220     NEXT J
230     READ LINECHECK
240     IF LINECHECK <> LINESUM THEN PRINT "Error in Line";200 + 10 * I
250 NEXT I
260 CLOSE
270 IF CHECKSUM = 133451 THEN PRINT "Successful Completion!" : END
280 PRINT "COM file is not valid!" : END
290 DATA    233,     6,     8,    87,   111,   112,   121,   114,   770
300 DATA    105,   103,   104,   116,    32,    49,    57,    56,   622
310 DATA     55,    32,    90,   105,   102,   102,    45,    88,   599
320 DATA     97,   118,   105,   115,    32,    80,   117,    98,   762
330 DATA    108,   105,   115,   104,   105,   110,   103,    32,   782
340 DATA     67,   111,    46,    74,   101,   102,   102,    32,   635
350 DATA     80,   114,   111,   115,   105,   115,   101,    67,   808
360 DATA     78,    83,    13,     0,     0,     0,     0,     0,   172
370 DATA      0,     0,     7,     0,     0,     0,     0,     0,     7
380 DATA      4,   100,   105,   114,    32,     0,     0,     0,   355
390 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
400 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
410 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
420 DATA      5,   116,   121,   112,   101,    32,     0,     0,   487
430 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
440 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
450 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
460 DATA      5,    99,   111,   112,   121,    32,     0,     0,   480
470 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
480 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
490 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
500 DATA      4,   100,   101,   108,    32,     0,     0,     0,   345
510 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
520 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
530 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
540 DATA      6,    99,   104,   100,   105,   114,    32,     0,   560
550 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
560 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
570 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
580 DATA      5,   112,    97,   116,   104,    32,     0,     0,   466
590 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
600 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
610 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
620 DATA      7,    98,   114,   111,   119,   115,   101,    32,   697
630 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
640 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
650 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
660 DATA      3,    99,   108,   115,   255,     0,     0,     0,   580
670 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0

680 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
690 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
700 DATA      7,    98,    97,    99,   107,   117,   112,    32,   669
710 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
720 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
730 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
740 DATA      8,   114,   101,   115,   116,   111,   114,   101,   780
750 DATA     32,     0,     0,     0,     0,     0,     0,     0,    32
760 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
770 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
780 DATA      0,     0,     0,     0,     0,     0,     0,     0,     0
790 DATA    251,   128,   252,    10,   116,     5,    46,   255,  1063
800 DATA     46,   136,     2,    46,   131,    62,    68,     1,   492
810 DATA      0,   117,    25,    46,   140,    30,    68,     1,   427
820 DATA     81,    86,   185,    20,     0,   190,     9,     7,   578
830 DATA     46,   198,     4,     0,   129,   198,   128,     0,   703
840 DATA    226,   246,    94,    89,    83,   140,   219,    46,  1143
850 DATA     59,    30,    68,     1,    91,   117,   207,    80,   653
860 DATA     83,    81,    82,    86,    87,    30,     6,    82,   537
870 DATA    232,   107,     0,    90,   139,   242,   138,    68,  1016
880 DATA      1,    10,   192,   116,    88,    70,    14,     7,   498
890 DATA     46,   139,    82,    59,     1,   177,     7,   211,   702
900 DATA    231,   129,   199,     9,     7,   138,   200,   254,  1187
910 DATA    193,    50,   237,   252,   243,   164,    46,   255,  1440
920 DATA      6,    59,     1,    46,   131,    62,    59,     1,   365
930 DATA     15,   117,     7,    46,   199,     6,    59,     1,   450
940 DATA      0,     0,    46,   161,    59,     1,    46,   163,   476
950 DATA     61,     1,    46,   198,     6,    63,     1,     0,   378
960 DATA    139,   242,   131,   198,     2,   191,    56,     1,   959
970 DATA    185,     4,     0,   172,    36,   223,   174,   117,   911
980 DATA     12,   226,   248,   232,   118,     3,   131,   238,  1208
990 DATA      5,   199,     4,     0,    13,     7,    31,    95,   354
1000 DATA     94,    90,    89,    91,    88,   207,   180,    15,   854
1010 DATA    205,    16,   254,   204,    46,   136,    38,    70,   989
1020 DATA      1,    30,     7,   139,   250,   131,   199,     2,   759
1030 DATA    139,   242,    70,   198,     4,     0,    46,   198,   897
1040 DATA      6,    71,     1,     1,   252,   180,    11,   205,   727
1050 DATA     33,    10,   192,   117,     4,   205,    40,   235,   836
1060 DATA    244,   180,     8,   205,    33,    10,   192,   116,   988
1070 DATA     55,    60,     8,   117,     5,   232,   162,     1,   660
1080 DATA    235,   227,    60,    27,   117,    19,   232,   249,  1166
1090 DATA      2,    46,   161,    59,     1,    46,   163,    81,   539
1100 DATA      1,    46,   198,     6,    63,     1,     0,   235,   550
1110 DATA    204,    60,    13,   116,     5,   232,   207,     1,   838
1120 DATA    235,   195,   232,   195,     2,    38,   198,     5,  1100
1130 DATA     13,   180,     2,   178,    13,   205,    33,   195,   819
1140 DATA    180,     8,   205,    33,    60,   133,   116,    12,   747
1150 DATA     60,   134,   116,     8,    60,    61,   114,    29,   582
1160 DATA     60,    68,   119,    25,   168,   128,   116,     2,   886
1170 DATA     44,    64,    44,    61,   152,   177,     5,   211,   758
1180 DATA    224,     5,    72,     1,   232,    57,     1,    60,   652
1190 DATA    255,   116,   199,   235,   136,    60,    59,   117,  1177
1200 DATA     22,    46,   254,     6,    66,     1,    46,   128,   589
1210 DATA     62,    66,     1,    16,   117,    84,    46,   198,   590

1220 DATA      6,    66,     1,     0,   235,    76,   144,    60,   586
1230 DATA     84,   117,    32,    46,   254,    14,    66,     1,   604
1240 DATA     46,   128,    62,    66,     1,   255,   117,    58,   733
1250 DATA     46,   198,     6,    66,     1,    15,   235,    50,   617
1260 DATA    144,    60,    60,   117,    22,    48,   254,     6,   709
1270 DATA     67,     1,    46,   128,    62,    67,     1,     8,   360
1280 DATA    117,    32,    46,   198,     6,    67,     1,     0,   467
1290 DATA    235,    24,   144,    60,    85,   117,    27,    46,   738
1300 DATA    254,    14,    67,     1,    46,   128,    62,    67,   639
1310 DATA      1,   255,   117,     6,    46,   198,     6,    67,   696
1320 DATA      1,     7,   232,   103,     2,   199,     4,     0,   548
1330 DATA     13,   195,    60,    71,   117,    15,   232,     4,   707
1340 DATA      2,    46,   198,     6,    71,     1,     1,   139,   464
1350 DATA    254,    71,   233,     8,   255,    60,    79,   117,  1077
1380 DATA      6,   232,     4,     2,   233,   254,   254,    60,  1045
1370 DATA     75,   117,     6,   232,   152,     1,   233,   244,  1060
1380 DATA    254,    60,    77,   117,     6,   232,   181,     1,   928
1390 DATA    233,   234,   254,    60,    82,   117,     9,    46,  1036
1400 DATA    128,    54,    65,     1,     1,   233,   221,   254,   957
1410 DATA     60,    83,   117,     6,   232,    63,     1,   233,   815
1420 DATA    211,   254,    60,    72,   117,    56,    46,   128,   944
1430 DATA     62,    63,     1,    15,   116,    45,    46,   161,   609
1440 DATA     61,     1,    72,    61,   255,   255,   117,     3,   825
1450 DATA    164,    14,     0,   139,   206,   177,     7,   211,   940
1460 DATA    224,     5,     9,     7,    86,   139,   240,    46,   756
1470 DATA    128,    60,     0,    94,   116,    13,    46,   137,   594
1480 DATA     22,    61,     1,    46,   254,     6,    63,     1,   464
1490 DATA    232,    69,     0,   233,   151,   254,    60,    80,  1079
1500 DATA    117,    47,    46,   128,    62,    63,     1,     0,   464
1510 DATA    116,    39,    46,   161,    61,     1,    64,    61,   549
1520 DATA     15,     0,   117,     2,    51,   192,    46,   163,   586
1530 DATA     61,     1,    46,   254,    14,    63,     1,   117,   557
1540 DATA      6,   232,   142,     1,   233,   110,   254,   177,  1155
1550 DATA      7,   211,   224,     5,     9,     7,   232,    15,   710
1560 DATA      0,   233,    97,   254,   227,     9,   180,     2,  1002
1570 DATA    172,   138,   208,   205,    33,   226,   249,   195,  1426
1580 DATA     80,   232,   110,     1,    88,    30,    86,    14,   641
1590 DATA     31,   139,   240,   138,    12,    50,   237,    38,   885
1600 DATA    136,    77,   255,    70,   180,     2,   138,    20,   878
1610 DATA    205,    33,   164,    46,   254,     6,    71,     1,   780
1620 DATA    226,   242,   172,    94,    31,   195,    46,   128,  1134
1630 DATA     62,    71,     1,     1,   116,    48,   138,    12,   449
1640 DATA     46,    42,    14,    71,     1,   254,   193,    50,   671
1650 DATA    237,    81,   227,     9,    86,    87,   139,   247,  1113
1660 DATA     79,   243,   164,    95,    94,   232,   174,     0,  1081
1670 DATA     89,    82,    86,   139,   247,   232,   164,   255,  1294
1680 DATA    180,     2,   178,    32,   205,    33,    94,    90,   814
1690 DATA    180,     2,   205,    16,   254,    12,   195,    46,   910
1700 DATA    128,    62,    65,     1,     0,   117,    40,   138,   551
1710 DATA     12,    46,    58,    14,    71,     1,   115,    12,   329
1720 DATA    138,    76,   255,    42,    12,   128,   249,     1,   901
1730 DATA    116,    15,   254,     4,   170,   180,     2,   138,   870
1740 DATA    208,   205,    33,    46,   254,     6,    71,     1,   824
1750 DATA    195,   184,     7,    14,   205,    16,   195,   138,   954
1760 DATA     76,   255,    42,    12,   128,   249,     1,   116,   879
1770 DATA    240,   136,    12,    46,    58,    14,    71,     1,   580
1780 DATA    114,   216,    46,    42,    14,    71,     1,   254,   758
1790 DATA    193,    50,   237,    81,    86,     3,   249,   139,  1038

1800 DATA    247,    78,   253,   243,   164,   252,    94,    38,  1369
1810 DATA    136,     5,   180,     3,   205,    16,    89,    65,   899
1820 DATA     82,    86,   139,   247,   232,    45,   255,    94,  1180
1830 DATA     90,   180,     2,   205,    16,   254,     4,   235,   986
1840 DATA     76,   144,   138,    12,    46,    58,    14,    71,   559
1850 DATA      1,   114,    26,    46,    42,    14,    71,     1,   315
1860 DATA     50,   237,    81,   227,     9,    86,    87,   139,   916
1870 DATA    247,    70,   243,   164,    95,    94,   180,     3,  1090
1880 DATA    205,    16,   233,    83,   255,   195,    46,   128,  1161
1890 DATA     62,    71,     1,     1,   116,    30,   180,     3,   464
1900 DATA    205,    16,    10,   210,   116,     5,   254,   202,  1018
1910 DATA    235,     8,   144,    46,   138,    22,    70,     1,   664
1920 DATA    254,   206,   180,     2,   205,    16,    79,    46,   988
1930 DATA    254,    14,    71,     1,   195,   138,    12,    46,   731
1940 DATA     58,    14,    71,     1,   114,    30,   180,     3,   471
1950 DATA    205,    16,    46,    58,    22,    70,     1,   116,   534
1960 DATA      5,   254,   194,   235,     5,   144,    50,   210,  1097
1970 DATA    254,   198,   180,     2,   205,    16,    71,    46,   972
1980 DATA    254,     6,    71,     1,   195,    46,   138,    14,   725
1990 DATA     71,     1,   254,   201,    50,   237,   227,     7,  1048
2000 DATA     81,   232,   162,   255,    89,   226,   249,   195,  1489
2010 DATA    138,    12,    46,    58,    14,    71,     1,   114,   454
2020 DATA     16,    46,    42,    14,    71,     1,   254,   193,   637
2030 DATA     50,   237,    81,   232,   175,   255,    89,   226,  1345
2040 DATA    249,   195,   138,    12,    50,   237,   227,    35,  1143
2050 DATA     81,   232,   201,   255,   180,     3,   205,    16,  1173
2060 DATA     89,    82,   180,     2,   178,    32,   205,    33,   801
2070 DATA    226,   252,   180,     2,    90,   205,    16,   198,  1169
2080 DATA      4,     0,    46,   198,     6,    71,     1,     1,   327
2090 DATA    139,   254,    71,   195,    30,   184,    64,     0,   937
2100 DATA    142,   216,    46,   138,    22,    70,     1,   182,   817
2110 DATA     25,    46,   128,    62,    64,     1,     0,   116,   442
2120 DATA     11,   246,     8,   135,     0,     6,   117,     4,   527
2130 DATA    138,    54,   132,     0,    46,   138,    62,    67,   637
2140 DATA      1,   177,     4,   210,   231,    48,    10,    62,   741
2150 DATA     66,     1,   184,     0,     6,    51,   201,   205,   714
2160 DATA     16,   180,    15,   205,    16,   180,     2,    51,   685
2170 DATA    210,   205,    16,    31,   195,   156,   251,   128,  1192
2180 DATA    252,     2,   114,     6,   167,    48,   255,    48,   678
2190 DATA    140,     2,   128,   204,    16,    48,   255,    30,   821
2200 DATA    140,     2,   156,    60,   224,   117,     6,    10,   715
2210 DATA    228,   116,     2,    50,   192,   157,   202,     2,   949
2220 DATA      0,   180,    18,   179,    16,   205,    16,   128,   742
2230 DATA    251,    16,   116,     4,   254,     6,    64,     1,   712
2240 DATA    184,    33,    53,   205,    33,   137,    30,   136,   611
2250 DATA      2,   140,     8,   138,     2,   160,    37,   141,   646
2260 DATA     22,   144,     2,   205,    33,    61,   192,   142,   791
2270 DATA    192,    38,   128,    64,    23,     4,   128,   180,   747
2280 DATA     18,   205,    22,    38,    58,     6,    23,     4,   374
2290 DATA    117,    37,    38,   126,    64,    23,     4,   128,   529
2300 DATA    180,    18,   205,    22,    38,    58,     6,    23,   650
2310 DATA      4,   117,    20,   184,    22,    53,   205,    33,   638
2320 DATA    137,    30,   140,     2,   140,     6,   142,     2,   599
2330 DATA    180,    37,   186,   229,     6,   205,    33,   186,  1062
2340 DATA    137,    14,   205,    39,     0,     0,     0,     0,   395
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Why Your Hard Disk May Be Only Seconds Away From Total Failure!

WELCOME TO THE INNER WORLD OF HARD DISKS: WHERE MICROSCOPIC PROBLEMS CAUSE MAJOR CATASTROPHIES.

A typical 20-megabyte hard disk contains over *200,000,000 bits.* If *only one bit* changes or fails, you can lose *everything* on your disk. Hard disks are subject to so many inherent, uncontrollable conditions that random failures occur with alarming frequency. You already may have been tortured by one of these hard disk error messages: **DATA ERROR, GENERAL FAILURE, ERROR READING, WRITE FAULT, BAD SECTOR, SECTOR NOT FOUND, FILE ALLOCATION TABLE BAD, DISK ERROR READING FAT, DISK NOT READY, INVALID DRIVE SPECIFICATION, NON-SYSTEM DISK OR DISK ERROR, READ FAULT, BAD DATA, ABORT-RETRY-IGNORE** — plus hundreds more that we simply don't have space to mention. Here is why:

PROBLEM ONE: OUT OF ALIGNMENT. There are hundreds of circular tracks packed into every inch of your hard disk's magnetic recording media. They are *extremely* thin, about as thick as a single strand of hair. Perfectly aligned tracks on a new, out-of-the-carton hard disk look like those in **figure 1**. Your programs read, but *never* write, to any of the special Track and Sector ID areas shown in black.

When your system has been off and is cold — in the morning, for instance — head positioning mechanics shrink, causing heads to read and write towards the inside. As the unit warms they expand and tend to read and write towards the outside. Add friction, wear-and-tear, play, torquing, repeatability, vibration, irregular platter and surface expansion, etc. — and within a very short time your data, program and system sectors can go out of alignment like those shown in **figure 2**. This is a continual, serious problem: valuable data may be written so far off current head tracking that it is no longer readable, resulting in devastating errors and lost data.

Disk Technician[tm] Automatic AI Software System's early warning detection *must be used daily* to keep data, program and system sectors in perfect alignment. When even the slightest change is detected, Disk Technician safely removes any data and stores it in your computer's RAM, then restores perfect alignment by rewriting the *entire* track, *including* the "read only" Track and Sector ID areas, using Disk Technician's own *factory low-level, Real format.* This new track is then thoroughly retested, *and only if has been perfectly repaired,* will Disk Technician allow your valuable programs and data to use it again. If retesting reveals that any bit is not perfect, data is relocated to a good area and the bad area is safely blocked from future DOS use. When Disk Technician repairs an area, it *specially monitors* that spot on all subsequent tests to make certain it *stays* repaired. *This is a totally automatic, unattended process.*

PROBLEM TWO: MEDIA AND DISTANCE. The typical distance between the head and the media is about 25 millionths of an inch. By comparison, a smoke particle is about 10 times greater and a human hair is over 100 times greater! Expansion and contraction caused by normal heating and cooling, wear-and-tear, media degradation, vibration, humidity, platter wobble and aging all cause this distance to vary (see **figure 3**). *Read and write quality varies directly with these distance changes.*

No matter how carefully the hard disk media was manufactured, there still will be variations in coating thickness, smoothness and magnetic density (see **figure 3**). Add aging and magnetic retentivity changes, and some spots may change from "good" to "unreliable" *overnight.* Magnetic hard disks act just like old photos: they fade away — along with *your* data! *Disk Technician is the only total solution to these problems.*

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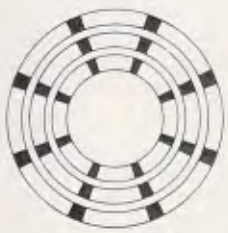

Figure 1* Perfectly aligned tracks. The black areas are "read only." These store *critical* track and sector ID information. The white areas are data sectors and store your system, programs and data.

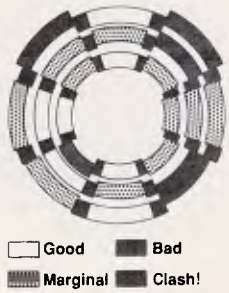

Figure 2* Sectors out of alignment with the track. The most frequent cause of lost or unreadable data. See *Problem One.*

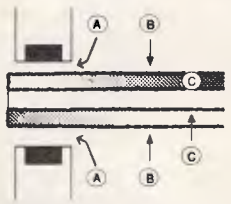

Figure 3* Heads, media and platter. A: The distance from the heads to the media continually changes. **B:** The magnetic coating varies in thickness and smoothness. **C:** Magnetic retentivity varies and decays. See *Problem Two.*

*Magnified and simplified for clarity.

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DOSKEY at a glance

DOSKEY is a memory-resident utility that extends the functions available at the DOS prompt to include changing foreground/background colours, a command stack that holds up to 15 immediately reissuable commands, and command macros keyed to function keys F3 through F12. In addition, editing functions have been added for the DOS command line and the CLS (Clear screen) command has been modified to operate with colour (CGA or EGA) and with displays of more than 25 lines.

DOSKEY is normally loaded through a line in your AUTOEXEC.BAT file but may be loaded if you wish from the command line using the following syntax:

[*d:*][*path*]DOSKEY

Operation: After loading, pressing the F1 key successively cycles through the 16 foreground (text) colours, while F2 acts similarly for the eight available background colours. Pressing the Shift key with either F1 or F2 reverses the direction of the cycling. CLS remembers the last-set colour scheme. If a space is typed between CLS and Enter, the colour will revert to the DOS defaults (black and white).

Function keys F3 through F12 are assigned by default to the following command macros:

F3	dir
F4	type
F5	copy
F6	delete
F7	chdir
F8	path
F9	browse
F10	cls
F11	backup
F12	restore

Any of these assignments may be changed using DEBUG, as described in the body of the article. Use of the F11 and F12 keys requires an enhanced keyboard and appropriate BIOS support.

The command stack uses the Up and Down Arrow keys to bring previously issued commands to the command line for reissue. The command line editor supports Left and Right Arrow cursor motion without deletion, Home and End keys for moving to the ends of the line, and Del and Backspace for character deletion. Pressing Esc clears the command line, and pressing Ins toggles the editor between insert and overwrite modes.

One final consideration in implementing the custom 0Ah handler is to restrict activating it when the function 0Ah request comes from DOS. A few other applications, notably DEBUG and certain utilities, use it just as COMMAND.COM does. The very first time DOSKEY intercepts a call, it assumes the caller is DOS and fingerprints it by saving the value of the DS register. Then it can determine whether subsequent calls came from DOS simply by looking at the segment address of the caller's reserved buffer.

The method isn't foolproof, of course. You could fool DOSKEY into working only in DEBUG by loading it and immediately invoking DEBUG, if both were done from inside an AUTOEXEC file. That way, since DOSKEY would see DEBUG's function 0Ah call before it saw the DOS command line, it would think DOSKEY is DOS. Indeed, you could even take advantage of this fact to customise a copy of DOSKEY that would assign DEBUG commands to the function keys, then enhance DEBUG with DOSKEY by following the scenario outlined above. DEBUG would suddenly become easier than ever to use, complete with command-line editing capabilities, a command stack, colour, and macros.

The input routine

When DOSKEY is loaded, it saves the original interrupt 21h vector and points it to its own DOSINT routine. All subsequent calls to the interrupt-requesting DOS services thereafter go to DOSKEY. The DOSINT routine first looks to see if function 0Ah is requested. If not, execution jumps to the previous interrupt 21h handler. If function 0Ah were requested, DOSKEY checks the DS register to see if the call came from COMMAND.COM. Calls from other sources are routed right back to the original interrupt code.

The procedure labelled INPUT in the source code is DOSKEY's functional but enhanced equivalent of DOS's function 0Ah. INPUT is the heart of DOSKEY. It accepts input from the command line just like DOS but adds a variety of new features.

To the calling application (in this case COMMAND.COM), INPUT's handling of function 0Ah is transparent. It takes control with an empty buffer addressed by DS:DX and terminates with the entry copied to the buffer and the count byte at offset 1 inside the buffer reflecting the command length. The difference is that it gives us more ways to create that entry.

INPUT itself does nothing more than read keystrokes from the standard input device and act on those it recognises. The GETKEY loop uses DOS function 0Bh to determine whether a character is waiting to be read. When one is, it's read through DOS function 8; when one is not, interrupt 28h is executed and the status is checked again, looping endlessly until a character appears. When the device is the keyboard, pressing a key presents a character to function 0Bh.

Extended codes (ie, keycodes which are reported in the form of two bytes rather than one) are handled slightly differently by function 8 than by interrupt 16h. When input is to be read solely from the keyboard, interrupt 16h is the preferred method. The BIOS represents an extended code by returning a zero in AL and the keycode in AH. But function 8 returns only 8 bits of information. When function 8 returns with AL zero, it must be called again to read the extended code. Programmers used to dealing with input through the BIOS will find this to be a mild departure from their accustomed practice.

The remainder of the INPUT routine is self-explanatory. After retrieving a keycode, INPUT compares it sequentially against all those it supports. A match results in the execution of a corresponding portion of code, while a failure to match causes the keypress to be ignored. Routines in the source code such as BACKSPACE and PRINTCHAR are invoked to rub out the character left of the cursor or to print and buffer a character. A quick scan of the .ASM listing will reveal the mechanics of the process.

The command stack

Every time DOSKEY intercepts a call from DOS to function 0Ah, it invokes its own INPUT routine to read a command. But before returning control to DOS, DOSKEY copies the new entry from the DOS buffer to a location set aside within its own data area. That location is the command stack. DOSKEY maintains a 1920-byte area just beyond its own code that has room for 15 128-byte entries. Each slot can hold the longest command DOS can handle (127 characters), plus one byte that indicates the length of the entry.

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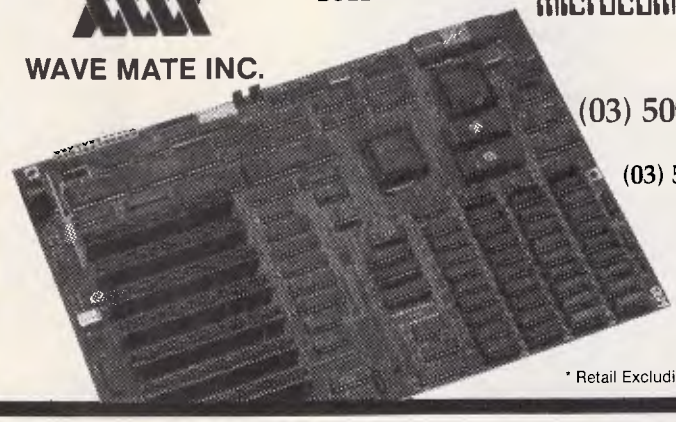

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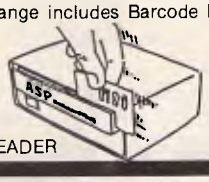

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The enhanced keyboard

The short history of the PC has seen nearly as many (IBM) keyboards as does a touring concert pianist. Offerings to date have included the original PC keyboard, with its misplaced and undersized keys, two versions for the ill-begotten PC*jr*, the improved AT keyboard, and finally the 'Enhanced' keyboard. Easily recognised by the 12 function keys across the top and by its dedicated cursor pad, the Enhanced keyboard is IBM's current favourite.

Parallel to these improvements, the ROM BIOS that IBM puts into each machine has undergone a slow but continuous evolution. Changes have included support for new disk drives, video displays, and operating modes. Obviously, one of the more recent additions has been BIOS support for the new keyboard. Specifically, three new interrupt 16h functions have been added: AL = 10h (keyboard read), 11h (keystroke status), and 12h (shift status). In IBM's jargon, an 'Enhanced' keyboard requires 'extended' BIOS functions.

These new functions are used in the same way as were the old functions 0, 1, and 2. The values returned, however, differ slightly. The old functions do not recognise function keys F11 or F12, and they return the same values for duplicate keys. For example, loading the AH register with 0h and executing interrupt 16h causes the BIOS to wait until a key is struck. Pressing the Home key on the numeric pad (with NumLock off) returns AL = 0 (indicating an extended code) and AH = 47h — the same value as does the Home key on the dedicated pad. But using function AH = 10h returns AL = E0h when the dedicated Home key is used. This allows programs to distinguish, at the BIOS level, between different keys that have the same nominal meaning.

To take advantage of the Enhanced keyboard, programs must be able to determine whether the keyboard is supported by the BIOS installed in a

```
CSEG    SEGMENT PARA PUBLIC 'CODE'              ;Start CODE segment
        ASSUME  CS:CSEG,DS:CSEG,ES:CSEG,SS:CSEG ;Set by DOS Loader
                ORG     100H                    ;COM file format

ENTPT:          JMP     MAIN

NO_MSG          DB      "No "
SUPPORT_MSG     DB      "BIOS support for extended keys$"

MAIN    PROC    NEAR

                XOR     AX,AX                   ;Address low memory
                MOV     ES,AX                   ; with ES
        ASSUME  ES:NOTHING                      ;Tell assembler

                MOV     DX,OFFSET NO_MSG        ;Assume no support
                MOV     AH,12H                  ;Extended shift status
                INT     16H                     ;BIOS keyboard int
                CMP     AL,BYTE PTR ES:[417H]   ;Does data returned match?
                JNE     NO_SUPPORT              ; no

                XOR     BYTE PTR ES:[417H],80H  ;Toggle insert mode
                MOV     AH,12H                  ;Ask again
                INT     16H
                CMP     AL,BYTE PTR ES:[417H]   ;First match might be
                JNE     NO_SUPPORT              ; an accident

                MOV     DX,OFFSET SUPPORT_MSG   ;Success
NO_SUPPORT:
                XOR     BYTE PTR ES:[417H],80H  ;Restore insert state
                MOV     AH,9                    ;Display message
                INT     21H                     ; Thru DOS

                MOV     AX,4C00H                ;Terminate program
                INT     21H                     ;Thru DOS
MAIN    ENDP
CSEG    ENDS
        END     ENTPT
```

KBTEST.ASM: the source code for KBTEST.COM, a program that checks your BIOS to see whether it supports the Enhanced keyboard

A variable called STACKPTR is maintained that points to the next location in the command stack into which a string will be copied. As a new one is inserted, STACKPTR is incremented. And when the last increment causes STACKPTR to exceed the boundaries of the stack, it wraps back around so that the next command will overwrite and replace the first one. Thus, the command stack forms a circular queue in which up to 15 DOS commands are stored in their order of entry.

Each time a new command is entered, a second variable, LOCPTR, is set equal to STACKPTR. LOCPTR keeps track of the current position within the stack. When you press Up Arrow or Down Arrow, LOCPTR is decremented or incremented by one, a new address in the stack is calculated from it, and the text of the command at that address is output. Since DOSKEY sets aside 128 bytes for each entry, formulating the offset of the current command in the stack is as simple as multiplying LOCPTR by 128.

A third variable, called ZCOUNT, is functionally equivalent to LOCPTR but is different in value. ZCOUNT maintains a record of where we are in the command stack relative to a zero base. Each time LOCPTR is set equal to STACKPTR, ZCOUNT is zeroed, and each press of Up or Down Arrow in turn increments or decrements it. DOSKEY uses ZCOUNT to determine whether a request to go backward or forward by one more command will violate the boundaries of the command stack.

It usually doesn't take long to stock the stack with the maximum of 15 commands. But until capacity is reached, DOSKEY must prevent attempts to go back beyond the first one. Thus, the first time function 0Ah is called, DOSKEY initialises the command stack by writing a zero to the first byte in each entry. Then, before it replays a command, it checks the first byte. If that byte is zero, the command is invalid and DOSKEY ignores the keystroke. Once the buffer is full, all entries will begin with a legitimate count byte. To make sure this scheme works (and to be efficient), DOSKEY doesn't buffer the null entry you make when you press Enter without typing a command beforehand.

In order to output a command from the stack, DOSKEY calls the subroutine WRITE_COMMAND. WRITE_COMMAND takes as input the offset address of the string to be sent, and it assumes that the first byte of the string

```
100 REM -- BASIC PROGRAM TO CREATE KBTEST.COM
110 OPEN "KBTEST.COM" AS #1 LEN = 1
120 FIELD #1,1 AS A$
130 CHECKSUM = 0
140 FOR I = 1 TO  12
150    LINESUM = 0
160    FOR J = 1 TO 8
170       READ BYTE
180       CHECKSUM = CHECKSUM + BYTE
190       LINESUM = LINESUM + BYTE
200       IF (BYTE < 256) THEN LSET A$ = CHR$(BYTE)
210       PUT #1
220    NEXT J
230    READ LINECHECK
240    IF LINECHECK <> LINESUM THEN PRINT "Error in Line";280 + 10 * I
250 NEXT I
260 CLOSE
270 IF CHECKSUM = 7517 THEN PRINT "Successful Completion!" : END
280 PRINT "COM file is not valid!" : END
290 DATA    235,    35,   144,    78,   111,    32,    66,    73,   774
300 DATA     79,    83,    32,   115,   117,   112,   112,   111,   761
310 DATA    114,   116,    32,   102,   111,   114,    32,   101,   722
320 DATA    120,   116,   101,   110,   100,   101,   100,    32,   780
330 DATA    107,   101,   121,   115,    36,    51,   192,   142,   865
340 DATA    192,   186,     3,     1,   180,    18,   205,    22,   807
350 DATA     38,    58,     6,    23,     4,   117,    20,    38,   304
360 DATA    128,    54,    23,     4,   128,   180,    18,   205,   740
370 DATA     22,    38,    58,     6,    23,     4,   117,     3,   271
380 DATA    186,     6,     1,    38,   128,    54,    23,     4,   440
390 DATA    128,   180,     9,   205,    33,   184,     0,    76,   815
400 DATA    205,    33,     0,     0,     0,     0,     0,     0,   238
```

KBTEST.BAS: a Basic program that will also create KBTEST.COM

particular machine. KBTEST.ASM is a short assembly language program you can use to test your own BIOS version for support for the Enhanced keyboard. A Basic program that will generate KBTEST.COM when you run it once is listed as KBTEST.BAS.

Although IBM publishes a test for the presence of extended functions, it is long, slow and more complex than necessary. KBTEST determines if the functions are present by using the extended shift status function call to read the settings of the Shift keys and comparing the returned result directly to the BIOS status byte maintained at 0:417h. If they don't match, the extended functions are not supported. If they do match, a single bit is changed in the status word and the function is called again. The results must match both times to verify that the extended functions are present.

Robert Hummel

will define its length. This is convenient, as the input buffer holds text in the same format. The string is then copied to the buffer and echoed to the display. Before it gets written to the screen, the routine CLEAR_LINE is called to clear the former contents of the command line.

Fixing CLS

Immediately after it transfers a new entry to the stack, DOSKEY checks to see if the command were CLS. If it were, the text of the command is eliminated in the DOS buffer so that DOS never knows it was entered. DOSKEY places a zero in the byte that holds the count of characters entered and overwrites the first character of the CLS string with a carriage return. Thus, DOS thinks you simply pressed Enter without typing a command.

DOSKEY then clears the screen itself. The reason is twofold. First, if DOS does the clearing, it will revert to black and white. Second, DOS will clear only 25 rows no matter how many are actually displayed.

DOS calls interrupt 10h, function 6, to blank the screen. Function 6 requires that the caller explicitly define the region to be cleared with the CX and DX registers. To determine the number of columns displayed (usually 40 or 80), DOS correctly pulls the value from a byte in the BIOS data area. But it automatically assumes there are 25 rows. That's why only a portion of your screen is cleared and the rest is left untouched when you're working with more than 25 rows.

DOSKEY implements an intelligent clear-screen function that clears all displayed lines and uses the attributes you have set. The EGA's programmable character height supports a variety of row densities. A peek inside the EGA *Technical Reference* manual shows that the EGA BIOS (which supplants the normal BIOS interrupt 10h routines) sets aside some additional information bytes in the BIOS data area, beyond those already there.

Of primary interest are the bytes at offsets 84h and 87h within segment 40h. The first keeps a record of the number of displayed text lines minus one; with the normal 25-row display, this byte holds the value 24. The byte at 87h is referred to as the EGA information byte. Among the many things you can glean from examining it is whether or not the EGA is currently the active display adaptor. Bit 3 is set to zero if the EGA is active, and to 1 if it's not. Not active means that either a CGA or a monochrome adaptor (either of which can coreside with an EGA without causing trouble) has been switched to and is in control of video output.

Function key macros

When DOSKEY detects a press of one of the function keys F3 through F12, it queues an ASCII text string for output in the same way it readies commands from the command stack: by addressing them with AX and invoking WRITE_COMMAND. The extended code for the key pressed is normalised and transformed to the offset address of the corresponding string.

The only trick DOSKEY must pull here is to sense when F11 or F12 has been pressed. When IBM introduced the enhanced keyboard, new BIOS functions were introduced to support it (see the box 'The Enhanced Keyboard'). These new functions are not supported by the old BIOS. Many programs, DOS included, do not provide any support for the enhanced keyboard. The end result is that F11 and F12 are normally useless in DOS, Basic, and most applications.

DOSKEY performs a simple test to see if the BIOS supports the enhanced functions. If so, it modifies the original keyboard interrupt 16h to use the extended functions. The end result is an improved DOS. Any program loaded after DOSKEY can now read the F11 and F12 keys the same as any other function key DOS could read before.

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CGA or an EGA normally has 16 foreground colours and eight background colours available to it in text mode. Without ANSI.SYS, the DOS interface uses only black and white. But DOS is sympathetic to colour in all respects but one. If you clear the screen to the colours you want, they remain there until a CLS is issued. By intercepting and handling the CLS command itself, DOSKEY negates the operating system's means of enforcing its own colourless scheme.

When you press F1 or F2, DOSKEY increments the variable FOREGROUND or BACKGROUND, respectively. Pressing either of them when shifted causes the associated value to be decremented. Then the procedure CLEAR_SCREEN is called, the same one DOSKEY invokes when it traps a CLS command. CLEAR_ SCREEN forms the attribute byte it needs before calling interrupt 10h, function 6, from FOREGROUND and BACKGROUND. And just before it terminates, the procedure homes the cursor to restore the DOS prompt to the top-left corner of the screen, where it belongs.

If there's a partially completed entry on the command line when you change screen colours, that entry is automatically cleared. The INPUT routine wipes the input buffer clean by zeroing the character count that has accumulated and simulating a press of the Enter key.

Modifying macros

If the strings assigned by default to function keys F3 through F12 don't suit your needs, they're easily changed with DEBUG. The rules for new macro strings are simple: (1) each string consists of the text of the string preceded by a byte indicating the string length, and (2) the total length of the string (including the length byte) cannot exceed 32 bytes. You need not end a string with a carriage return (ASCII 13, or 0D in hexadecimal). The offset addresses corresponding to the beginning of each string, together with the associated command, are listed here:

F3	0148h	dir
F4	0168h	type
F5	0188h	copy
F6	01A8h	delete
F7	01C8h	chdir
F8	01E8h	path
F9	0208h	browse
F10	0228h	cls
F11	0248h	backup
F12	0268h	restore

You install a new string simply by overwriting the text of the old one with that of the new. If you want the command string to be automatically executed when the function key is pressed, terminate the string with a byte of value FFh. Do not include the FFh delimiter in the string's character count. If you omit the FFh, the string will be output, but you'll have to press Enter yourself to execute it. The default settings for the function keys F3 through F9 illustrate this. When you press F4 'type', for example, you have to enter a filename after it. Without the file specifier, the command is meaningless.

'It's easy to modify DOSKEY's default keyboard macros to output the commands of your choice.'

Following is the script of a 'DEBUG' session that changes the macro associated with the F10 key to CHKDSK. A delimiter of value FFh is coded into the command to produce automatic execution. If you've never used DEBUG before, this is a great chance to get acquainted with it. It's quite a powerful tool and comes with DOS at no extra cost. The documentation for it is quite adequate and, in all versions of DOS except 3.3, is found inside the DOS manual. (Version 3.3 relocates it to the DOS *Technical Reference* manual.)

First, make sure that DOSKEY.COM is in your current directory and that DEBUG.COM is in the current subdirectory or one in your PATH. Then, at the command line, enter

```
DEBUG DOSKEY.COM
E 0228 06 "CHKDSK" FF
W
Q
```

The first command invokes DEBUG from the command line and automatically loads (but doesn't execute) DOSKEY. The second enters the length byte, the text of the new command, and the FF delimiter (hex for decimal 255; DEBUG always thinks in hexadecimal) into the space set aside for the F10 macro. The 'W' command saves the revised DOSKEY back to disk, and 'Q' quits DEBUG.

Default colour changes

DOSKEY initially assumes you want to use the DOS default drab. So until you customise your display with F1 or F2, the CLS command works as it normally does: it clears to white on black. But you can reassign the initial colour selection to anything you want, again using DEBUG. If you prefer white text on a blue background, for instance, DOSKEY can be modified to set that combination the first time CLS is issued. The advantage is that you aren't forced to hammer the F1 and F2 keys every time you boot up. A simple CLS will do.

Two bytes inside DOSKEY define the startup colour selection. The byte at offset 0142h, labelled FOREGROUND in the source listing, determines the text colour (07, or white), and the one following it at 0143h is the initial background colour (00, or black). The first byte can take on any value from 0 to 15, and the second anything from 0 to 7, inclusive.

Colour attributes have the following numerical values:

0	Black
1	Blue
2	Green
3	Cyan (Light Blue)
4	Red
5	Magenta
6	Brown
7	White

The colours 8 through 15 are simply brighter ('intense') hues of the first eight colours. You can obtain the number corresponding to a bright colour by adding 8 to the original number. Colour 15, for example, is bright white, while 7 is normal white. Colour 14, yellow, is nothing more than bright brown, whose number is 6. Attributes (which we think of as 'colours' in a colour system) take on an entirely different meaning in monochrome systems.

DOSKEY should prove compatible with most other programs, including resident utilities. It can be loaded in any order relative to other TSRs. The only conflict I can foresee is with other TSRs that take over DOS function 0Ah. Fortunately, very few programs other than command line enhancers (like DOSKEY) have any interest in that particular service. Nonetheless, I must issue the standard ukase that it's an unfortunate but presently unavoidable fact of life that memory-resident programs carry no guarantees of compatibility. But even if it meant giving something else up, once you start using DOSKEY, I don't think you'll want to be without it.

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Underline

The underlining capability of the EGA can be restored in colour mode with this terminate-and-stay-resident program.

Text-based applications on IBM PCs and compatibles are most often used on the IBM monochrome display. Users of word processors appreciate its sharp characters formed by a 9x14 pixel matrix, as well as its ability to display underlined and bolded text. An Enhanced Colour Display connected to an EGA can provide virtually the same level of sharpness with an 8x14 pixel character cell, and it can do this in 16 colours. But on a colour monitor, the EGA does not display underlined text.

The EGA is capable of underlining, and it does so when connected to a monochrome monitor. The hardware is designed to produce underlining for characters with video attributes of 1 or 9 for the foreground and zero for the background, provided that the contents of the Underline Location Register contains a value between 0 and 13. This value is the scan line on which the underline will appear: 13 provides normal underlining, while lower values move the line upwards in the character cell to produce strike-over or overline effects. The EGA BIOS enables underlining whenever the adaptor is switched to video mode 7 (monochrome), and disables it for the colour modes.

It is easy to write a program to re-enable underlining by setting the UnderLine Location Register; however, most software resets the video mode when it loads, thus nullifying any changes made to the EGA registers. The solution is to install a terminate-and-stay-resident (TSR) program that intercepts all the video mode setting calls and applies the fix after the mode is changed. An example is reproduced in UNDERLIN.ASM (Fig 1).

The INTHAND procedure gains control on return from a mode-setting call (interrupt 10H, AH = 0). It enables the underline mode by writing the desired value (13 is used here) into the underline register. This register is loaded by writing its index (14H) to the EGA controller port, then writing the data value to the port at the next higher address. The base controller port address is available at location 40:63H of the BIOS data area.

Thereafter, any text written in colours 1 or 9 will be underlined. Although the attributes that produce underlining are fixed, the colours that correspond to those attributes are not. Therefore, the underlined colours may be changed by writing appropriate colour values to palette registers 1 and 9. In this example, colours 2 (green) and 3AH (bright green) are used. Blue will no longer be available; instead, green will

```
SCNLIN  EQU     13              ;Scan line for underline.
COLOR1  EQU     0201H           ;Set color 1 to green
COLOR9  EQU     3A09H           ;Set color 9 to brite green
CODESEG SEGMENT PARA PUBLIC 'CODE'
        ASSUME  CS:CODESEG, DS:COSESEG
        ORG     100H

ENTRY:  JMP     LOADER          ;Go to loader routine
OLD10   DD      ?               ;Storage for old INT 10H address
INTHAND PROC    FAR             ;Beginning of INTERRUPT Interceptor
        AND     AH,AH           ;Is it Set Mode function?
        JZ      CALLB           ;If so, arrange to come back from BIOS
        JMP     OLD10           ;Else go to BIOS and do not come back
CALLB:  PUSHF                   ;Push flags to simulate interrupt
        CALL    OLD10           ;Call BIOS and return
        PUSH    AX
        PUSH    DX              ;Save Registers
        PUSH    DS
        MOV     AX,40H          ;Set up addressability to BIOS DATA
        MOV     DS,AX
        MOV     DX,DS:63H       ;Get CRTC base address in DX
        MOV     AL,014H         ;CRT Reg 14 is Underline Register
        OUT     DX,AL           ;Indicate change to Reg 14
        INC     DX              ;Now point DX to CRTC data register
        MOV     AL,SCNLIN       ;Load AL with desired scan line
        OUT     DX,AL           ;Send data to CRT controller
        MOV     AX,1000H        ;Set a palette register
        MOV     BX,COLOR1       ;Set underline, color 1
        INT     10H
        MOV     AX,1000H        ;Set a palette register
        MOV     BX,COLOR9       ;Set brite underline, color 9
        INT     10H
        POP     DS
        POP     DX              ;Restore Registers
        POP     AX
        IRET                    ;Return to original caller
INTHAND ENDP
MESSAGE DB      'UNDERLIN: By Gerald S. Kaplan',0DH,0AH,'$'
LOADER  PROC    NEAR                    ;Loads the INT 10H TSR
        MOV     AL,10H                  ;Get vector for INT 10H
        MOV     AH,35H                  ;DOS function for get vector
        INT     21H
        MOV     WORD PTR OLD10,BX       ;Save the address
        MOV     WORD PTR OLD10+2,ES
        MOV     DX,OFFSET INTHAND       ;Point to new INT 10H handler
        MOV     AH,25H                  ;DOS call to set vector
        MOV     AL,10H                  ;Which interrupt to set
        INT     21H
        MOV     AX,0003H                ;Reset mode to turn on
        INT     10H                     ;     underlining
        MOV     AH,9                    ;DOS Print Message function
        MOV     DX,OFFSET MESSAGE       ;Point DX to message
        INT     21H                     ;Go and print message
        INT     27H                     ;Exit and stay resident
LOADER  ENDP                            ;(DX already points to
CODESEG ENDS                            ;end of resident mode)
        END     ENTRY
```

Fig 1 UNDERLIN.ASM. See 'Underline fix'

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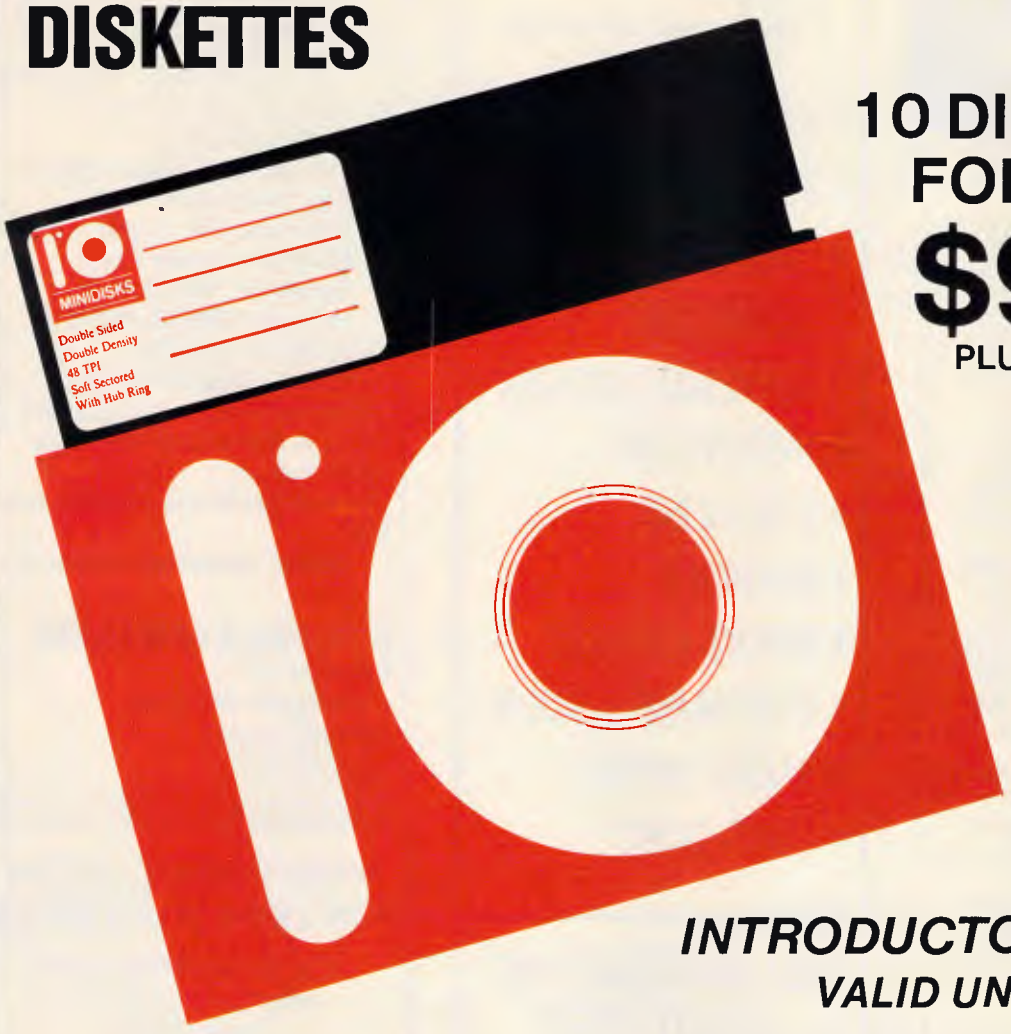

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```
\G          /c~LONG~{contents SPACE,SHORT,@find(@char(32),LONG,1)}/fr
SPACE       REALTY
            ~


SHORT       REALTY          <=== @left(LONG,8)

LONG        REALTY   WK1     6731    9-12-85    1:23a
```

Fig 2 A macro that converts a directory entry into a readable filename

be available in underlined and plain versions. The underline colours are controlled by the values equated to labels COLOR1 and COLOR9. If desired, code may be added to change the background to a colour other than black by writing a nonzero colour value to palette register 0.

G Kaplian

Listings into filenames

A common way to manipulate 1-2-3 files on disk is to redirect the screen output from a directory command to a disk file. Entered at the DOS prompt, a command such as

dir *.wk? > files.prn

creates a disk file called FILES.PRN that contains all 1-2-3 files. You can then use /File Import Text to get this directory into a 1-2-3 worksheet, where you can sort or annotate it.

However, even if you use the 1-2-3 Data Parse command to separate filenames from file size, date, time, etc, there are some things you still can't do with the filename. The macro in Fig 2 demonstrates a technique that converts a line from a file directory into a loadable filename.

An imported directory listing is a column of entries like the one in the last line of the figure. They are long labels. If you put the cursor on one and run the macro with Alt-G, it will load the file of that name.

The macro works by copying the long label to the range named LONG, where the eight leftmost characters are extracted in a cell named SHORT (which contains the formula to its right). Eight characters have to be extracted because filenames can be that long. However, if the name is less than eight characters long, the display in the cell named SHORT will be treated by the load command as having trailing spaces. This is why the macro can't simply put the contents of SHORT into the cell named SPACE and use it as a filename. The trailing spaces make it an illegal filename. The macro transfers SHORT to SPACE, but with a format equal to the actual length of the name. (The number returned by the @find function adds this parameter to the {contents} command.) The /File Retrieve sequence then acts on the contents of SPACE, and the closing tilde completes the command.

D Will

Mr Will submitted this routine as part of a batch file and macro combination that imports a directory and then lets you load the file of your choice. 1-2-3 already lets you do that with the /File Retrieve Name (F3) command. However, the clever conversion with the {contents} command has broader applications — JT.

Determining contents

While writing a database application for SuperCalc 4, I had to find a way to tell if a cell contained a quote mark (") and nothing else. Since SuperCalc has no string functions and the quote is used as a delimiter, there was no obvious way to do it.

The macro in Fig 3 does the job by converting the cell to a textual value with Edit and then comparing it with a known textual value of (""). The test value contains two quote marks since the GETTEXT function in the macro inserts a leading quote. When you run the macro, be sure to give the range names in the cells in the rightmost column to the cells to their right.

On an entirely different subject, I have found that a cell can turn out differently depending on whether it's formatted as an entry or as a column. For example, if you left-justify a whole blank column with the command /FC,LA the cells in the column will stay blank, as you would expect. But if you left-justify blank cells with /FE,LA they will get a text attribute.

This doesn't normally matter, because as soon as you enter a number, if will be justified appropriately. It makes a difference only if you test such a cell with ISBLANK. Where you would expect a value of one (true), you get a value of zero (false). You can avoid this problem by formatting by row or column rather than by entry.

D Carville

You'd expect the results of formatting to be the same, no matter how large or small a block you formatted. And it's not only left-justify that behaves differently; other format choices do, too. As Mr Carville points out, however, it seems to make no difference unless you are testing cells with ISBLANK — JT.

Colouring projections

Recently I was using 1-2-3 to chart historical figures and projections on the same graph. I though it would be effective to present the data so that the

```
\Z      {GETTEXT "Press a printable key, then RETURN.",A1}    Get a key. (GETTEXT also inserts a quote mark.)
        {HOME}                                               Move cursor to home.
        {EDIT}){HOME}{INSERTON}(~                            Try to make it a textual value.
        {IF A1=QUOTE}{BRANCH YES}                            If it now equals ("") the original contents were "".
        {INSERTOFF}{EDIT}{BS}{HOME}{DEL 2}~                  Restore the cell to it's original contents.
        {MESSAGE "Last key pressed was NOT a quote."}        Output message.
        {BRANCH \Z}                                          Enable display and start over.


YES     {INSERTOFF}{EDIT}{BS}{HOME}{DEL}~                    Restore the cell to it's original contents.
        {MESSAGE "Last key pressed was a quote."}            Output message.
        {BRANCH \Z}                                          Enable display and start over.

QUOTE                                                        This cell contains ("") which is a textual value
                                                                  and not visible.
```

Fig 3 A SuperCalc macro that tests cells for the quote mark

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Original Data			New Arrangement		
X Range	A Range		X Range	A Range	B Range
1981	11	Actual	1981	11	0
1982	12		1982	12	0
1983	12.5		1983	12.5	0
1984	13.2		1984	13.2	0
1985	14.2		1985	14.2	0
1986	14.7		1986	14.7	0
1987	15.3	Projected	1987	0	15.3
1988	15.7		1988	0	15.7
1989	16.9		1989	0	16.9
1990	17.9		1990	0	17.9

Fig 4 Graph settings that use colour to distinguish actual data from projections

bars representing projections were a different colour from the bars representing historical data. I hit upon the idea of graphing the data as a stacked bar chart and rearranged the graphing ranges as in Fig 4. Up until 1986, the B range is zero; afterward the A range is zero. Thus, technically speaking, the data is graphed as a stacked bar chart, but the appearance is that of a regular bar chart in which the bars change colour to indicate projections. If your display is set to monochrome, the colours will be the same, but the bar pattern will be different.

J Bowen

Spaced out

Many word processors properly insert two blank spaces at the end of sentences. Curiously, this is one function that WordPerfect does not have. The macro below takes any length of text and ensures there are two blank spaces following punctuation such as fullstops (.), questions marks (?), exclamation marks (!), and colons(:), but only when they occur with a trailing blank space. It checks for words such as Dr., Mrs., Ms., or Mr. and does not insert double blanks after these abbreviations.

The keystrokes required to create the macro are shown below, with each space indicated by a # character.

```
SPACES.MAC
<Home><Home><Up><Alt-F2>N.#<Esc>.##<Esc>
<Home><Home><Up><Alt-F2>N.###<Esc>.##<Esc>
<Home><Home><Up><Alt-F2>N?#<Esc>?##<Esc>
<Home><Home><Up><Alt-F2>N?###<Esc>?##<Esc>
<Home><Home><Up><Alt-F2>N!#<Esc>!##<Esc>
<Home><Home><Up><Alt-F2>N!###<Esc>!##<Esc>
<Home><Home><Up><Alt-F2>N:#<Esc>:##<Esc>
<Home><Home><Up><Alt-F2>N:###<Esc>:##<Esc>
<Home><Home><Up><Alt-F2>NMr.##<Esc>Mr.#<Esc>
<Home><Home><Up><Alt-F2>NMrs.##<Esc>Mrs.#<Esc>
<Home><Home><Up><Alt-F2>NMs.##<Esc>Ms.#<Esc>
<Home><Home><Up><Alt-F2>NDr.##<Esc>Dr.#<Esc>
<Home><Home><Up>
```

The macro first goes to the top of the file and changes all occurrences of fullstop-space to fullstop-space-space. It then changes all fullstop-space-space-space back to fullstop-space-space. This is repeated for the question mark, exclamation mark, and colon. Finally it checks for abbreviations such as Mr. or Mrs. and removes the space-space that follows. Any number of common abbreviations can be accommodated in this way (for example, No., approx., e.g., etc.).

Dr K Lee

Here's a timesaving tip: create Dr Lee's macro in an empty document, so you won't have to wait for all of the Search/Replace events. And if you use it on a long document, wait until the final draft to apply it — NR.

Checking the environment

When developing a custom dBase III Plus application, it's often useful to set up certain functions for testing those that are not needed (or wanted) in the final application. SET HISTORY ON is an example.

I find the GETENV() function perfect for this. I enter SET SYSID=DEVELOP in DOS (from my AUTOEXEC), then have the dBase program enquire for this value in the DOS environment:

```
IF GETENV ("SYSID")="DEVELOP"
* Set up for testing
ELSE
* Run regular program
ENDI
```

When SYSID has not been set, GETENV() simply returns a null string.

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I keep an ASCII file on the root for this same purpose, calling it SYSID.SAV. It holds a different identifying word for each of my computers — BS.

Current events

It's well known that MS-DOS can't get access to the date or time when running batch files. I recently ran across a trick that gets around this problem. My implementation of it requires two batch files besides your AUTOEXEC.BAT. One is made by the others. The other one, which you create, must be called CURRENT.BAT.

Let's assume you want to run a program called ONCEONLY.COM only once a day. Add the following to your AUTOEXEC.BAT:

ECHO : MORE : DATE >> READDATE.BAT

and make

READDATE

the last line in your AUTOEXEC.BAT. Then create a batch file called CURRENT.BAT:

```
ECHO OFF
IF !%TODAY%==!%4 GOTO END
SET TODAY=%4
ONCEONLY
:END
```

You can even arrange that it only runs once a week, say every Friday, by adding a line:

IF NOT %3==Fri GOTO END

after the line SET TODAY=%4. And as a bonus, you wind up with today's date in the environment.

This works by creating a READDATE.BAT, containing the output of DATE:

Current date is Wed 9-30-1987
Enter new date (mm-dd-yy):

DOS tries to run the line beginning with 'Current date is' by looking for an executable file (.COM, .EXE., or .BAT) called CURRENT — and finds the one we created called CURRENT.BAT. DOS then interprets the group of words and numbers following the word 'Current' as parameters for CURRENT.BAT. So it reads 'date' as %1, 'is' as %2, the day of the week as %3, and the actual numerical date as %4.

B Simon

Be sure your environment is large enough to hold the %TODAY% variable.

One special trick that's worth noting is the use of the MORE command in the middle of the ECHO \ MORE \ DATE > READDATE.BAT line. All this does is supply the extra carriage return that the DATE command needs to execute properly. (To make this work, MORE.COM has to be in the same directory or in one that your PATH knows about.) Note also that adding READDATE as the final line in your AUTOEXEC.BAT means that as soon as AUTOEXEC.BAT finishes, DOS will load and execute the READDATE.BAT file.

J Fletcher, who didn't have an internal clock but needed to reboot frequently, suggested an almost identical process. His technique, adapted here, included these lines near the top of his AUTOEXEC.BAT file:

```
ECHO OFF
IF NOT EXIST D.BAT GOTO SETIT
COMMAND /C D
GOTO CONTINUE
:SETIT
DATE
COMMAND /C DATEMAKE
:CONTINUE
```

The COMMAND /C allows one batch file to run another batch file and then jump execution back to the first when the second is done. Users of DOS 3.3 could substitute CALL for COMMAND /C. D.BAT is a short batch file created by DATEMAKE.BAT, containing the lines

Current date is Wed 9-30-1987
Enter new date (mm-dd-yy):

(or whatever the last set date was).

The DATE command below COMMAND /C D conveniently lets you correct the date the first time you run AUTOEXEC.BAT each day.

DATEMAKE.BAT contains one line

ECHO : MORE: DATE > D.BAT

Again, MORE.COM has to be in the current subdirectory or in one your PATH knows about. The only other file you need for this to work is a tiny one called, you guessed it, CURRENT.BAT:

DATE %4

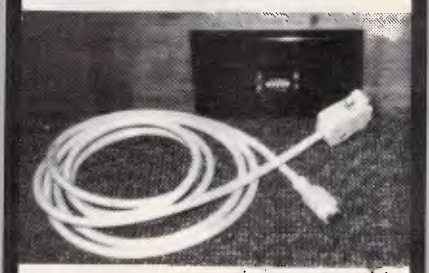
MacWrite

The main window in MacWrite, version 4.5, can't be resized beyond the standard 9in Mac screen when working with a large monitor or a software screen expander. Using ResEdit, however, you can patch MacWrite 4.5 so that the window expands to just under a full page. The patch consists of two parts: the first patches MacWrite's program code to allow for a larger window, while the second part changes the default size of the window.

Using ResEdit, open a copy of MacWrite by double-clicking on the MacWrite line. Then, open the CODE resource with an ID of 9. To do this, first double-click on the CODE line in the MacWrite window, then by double-clicking the line 'CODE ID=9'. The hexadecimal window will open. Choose

VALUE ADS - 1 OF 3

MACINTOSH NETWORK?



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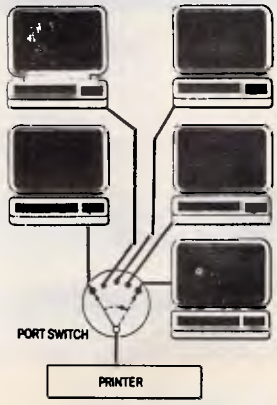

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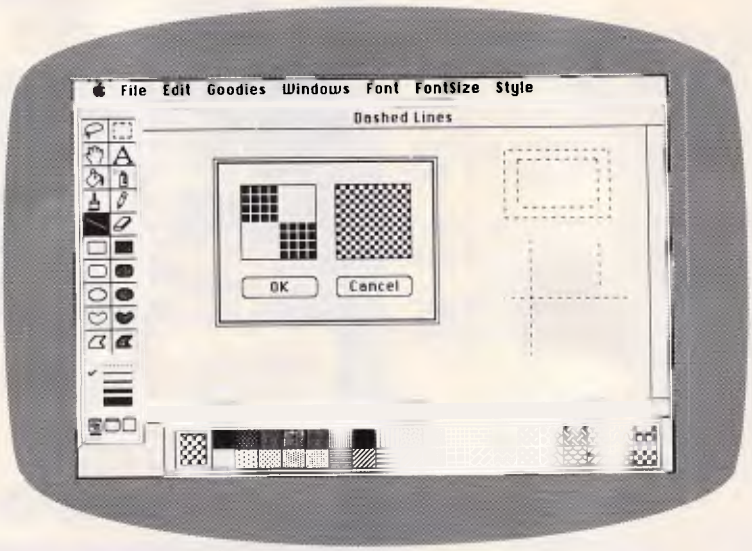

Fig 5 You can use the Option-draw capailities of FullPaint to easily create dashed boxes and dashed horizontal or vertical lines. Create a checkerboard pattern as shown and hold down the Option key while drawing a rectangle or SHIFT/OPTION while drawing a line

FIND HEX from the Search menu. Have ResEdit search and replace the only hexadecimal occurrence of '0136' with '0300'. Finish the first part of the patch by closing all the windows and saving the changes to MacWrite. The MacWrite window can now be resized. It is not necessary to proceed with the second step, unless you want MacWrite to automatically default to the larger window.

Use ResEdit to open the copy of MacWrite. Double-click on the WIND resource line and locate and open, by double-clicking, the line 'WIND ID = 301'. Change the value of 337, found in the third edit box (for boundsRect), to 768. Close all windows, and save the changes to MacWrite. When you now use MacWrite on a large screen, the default window will now open to just under a full page size.

K Harrison

FullPaint

To easily create dashed boxes and dashed horizontal or vertical lines, create a checkerboard pattern of two diagonally opposed 4 x 4 solid boxes. With this pattern selected, hold down the Option key while drawing a square, or Shift-Option while drawing a line. A dashed box or line is drawn. Refer to Fig 5.

G McGath

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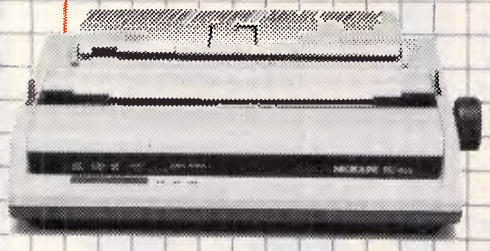

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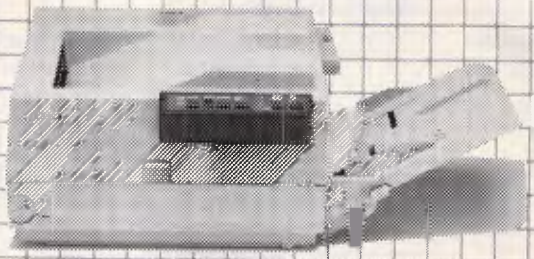

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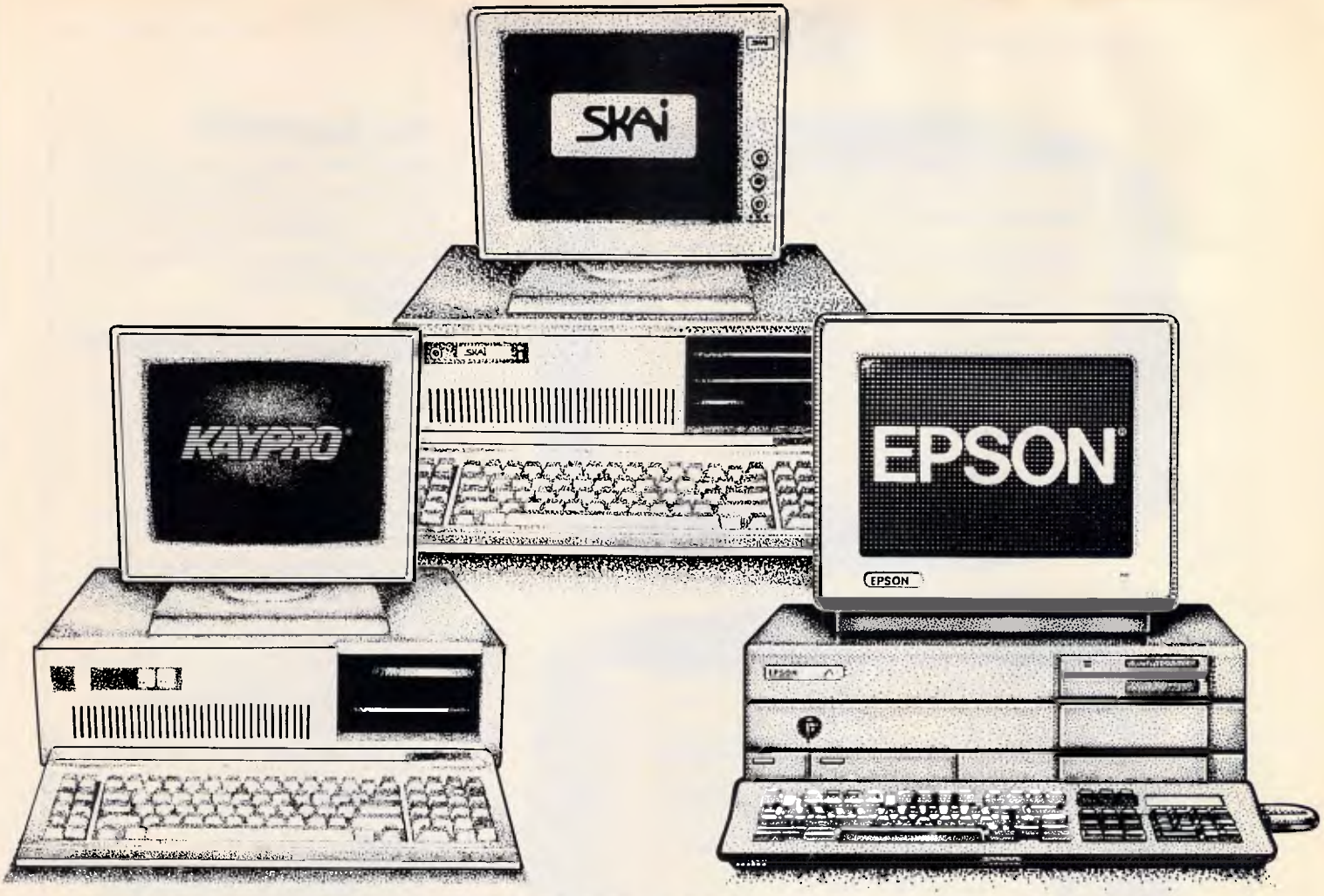

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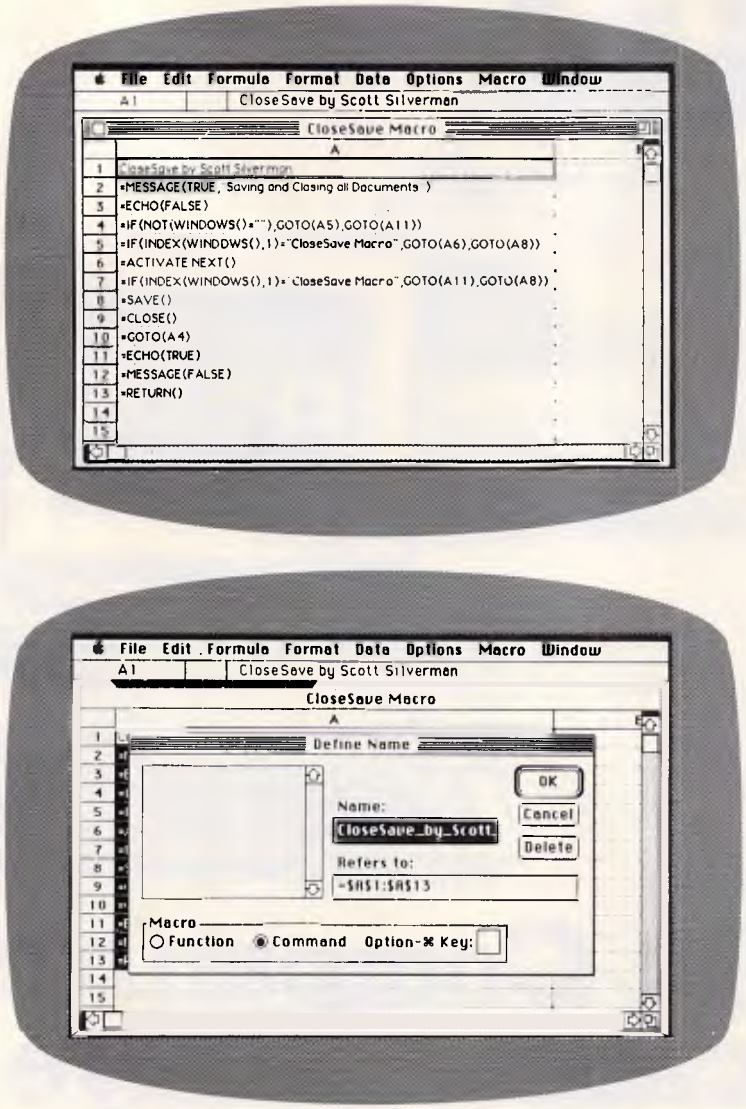

Fig 6 Setting up the macro takes two steps. Start by entering this macro in a blank macro sheet and make sure you save the macro as 'CloseSave Macro' (or it will not function properly). Begin installing the macro be selecting the entire macro (A1:A13) and selecting DEFINE NAME from the Formula menu. Then click in the COMMAND radio button and click OK. Later, whenever you are ready to save all of your open documents, simply choose RUN from the Macro menu and double-click on the line 'CloseSave by . . .'

Mac SuperPaint

While in the Paint layer you can have the marquee tool selected and still be able to use the lasso tool. Just hold down the OPTION key and the cursor becomes a lasso, ready to select any odd-shaped bitmap.

D Condit

Professional Composer

A useful feature in Professional Composer on the Macintosh is that it 'consolidates' rests in parts when PRINT PARTS is chosen from the File menu. However, in all parts other than the first, rehearsal marks are ignored if rests both precede and follow the rehearsal mark. This problem can be fixed if you insert a thick barline from the Barlines palette at the left side of any measure in which you insert a rehearsal mark. In fact, any barline at rehearsal marks other than the standard one will force Professional Composer to break consolidated rests around rehearsal marks in parts where rests both precede and follow the rehearsal mark.

J Greeson

Excel

•The Macintosh Excel macro shown in Fig 6 is designed to save time when closing a set of open Excel documents. Normally, when you specify CLOSE ALL, you are asked if you want to save each and every document. Running this macro automatically saves each open document, except for the macro sheet that this macro is in.

S Silverman

•If you need to show or print all the formulae in a worksheet (rather than the data), just open a new macro sheet, copy the required cells from the worksheet and paste them into the macro sheet.

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Fig 7 Excel normally doesn't allow for the printing of formulae. If you create a worksheet and want to show or print the formulae, copy the cells to a macro sheet. Now all formulae will be shown with their correct reference

the cell references within the macro sheet may be incorrect or missing. Refer to Fig 7.
C Madson

Tops

It's possible to connect your Macs to a Novell network using TOPS. Simply take one of the PCs in your Novell network and connect it to your TOPS network, too. This PC becomes the 'gateway' machine. Using the Novell software, assign the gateway's drive E to the Novell server. Then, using the TOPS menu, publish drive E. Doing this allows all the Macs and PC on the TOPS network to see the Novell server.
D Huag

Cricket Draw

There is a little known trick, not present in MacDraw or SuperPaint, that allows you to gain total control of object placement with the ALIGN OBJECTS command in Cricket Draw. The ordering of objects drawn in Cricket Draw does not depend on their creation order or positioning, but rather in their layering. With this in mind, selecting an object and choosing BRING TO FRONT from the Arrange menu will later make that object the 'point of reference' for future Align commands.

For example, when you have an object that you would like to align other objects with, select the item and choose BRING TO FRONT from the Arrange menu. Then, SHIFT-CLICK the other objects you want aligned and choose ALIGN OBJECTS from the Arrange menu. Regardless of the type of alignment done, the object on the 'top' layer will remain in its original position.
B Bradbury

Error trapping in 1-2-3

The expanded macro language in Release 2 of 1-2-3 has an {onerror} function that lets you write macros that will continue smoothly even if there is an error. It works by causing macro execution to branch to a certain routine when an error occurs. With this technique, you can anticipate particular errors and write routines to deal with them. Error trapping stays in effect until an error occurs, another {onerror} function appears in the macro, or the macro ends.

What happens, however, if the error you anticipated doesn't happen? The macro continues to execute, but error trapping stays in effect. Since the macro language can't distinguish between different kinds of errors, any error that thereafter occurs will cause macro execution to branch back to the original correction routine. If you didn't get the error you originally anticipated, but later get a different one, that correction routine may be wholly inappropriate. Ideally, your macro wont run into unanticipated errors, but if it does, it may make more sense for it to stop dead in its tracks rather than loop back to a correction routine that doesn't make sense.

The macro in Fig 8 illustrates the problem and provides a solution. The routine prompts the user for a filename to combine into the current worksheet. If the user types a filename that doesn't exist, there will be an error. In anticipation of this possible error, the macro contains the statement {onerror NOINFILE}. If the file the user asked for doesn't exist, the error will no longer stop the macro. Instead execution branches to the NOINFILE routine. This routine displays a message to the user telling him the file he wanted wasn't found and asking him to try again.

The macro then starts over again with {branch \C} and sets up the same error-trapping routine. If the user now enters the name of a file that exists, the macro will combine the contents of that file. The trouble is that error trapping is still in effect, and an error — any error — will cause execution to branch to NOINFILE. If you get a surprise error later on in the macro, the NOINFILE routine could be far worse than simply shutting down the macro.

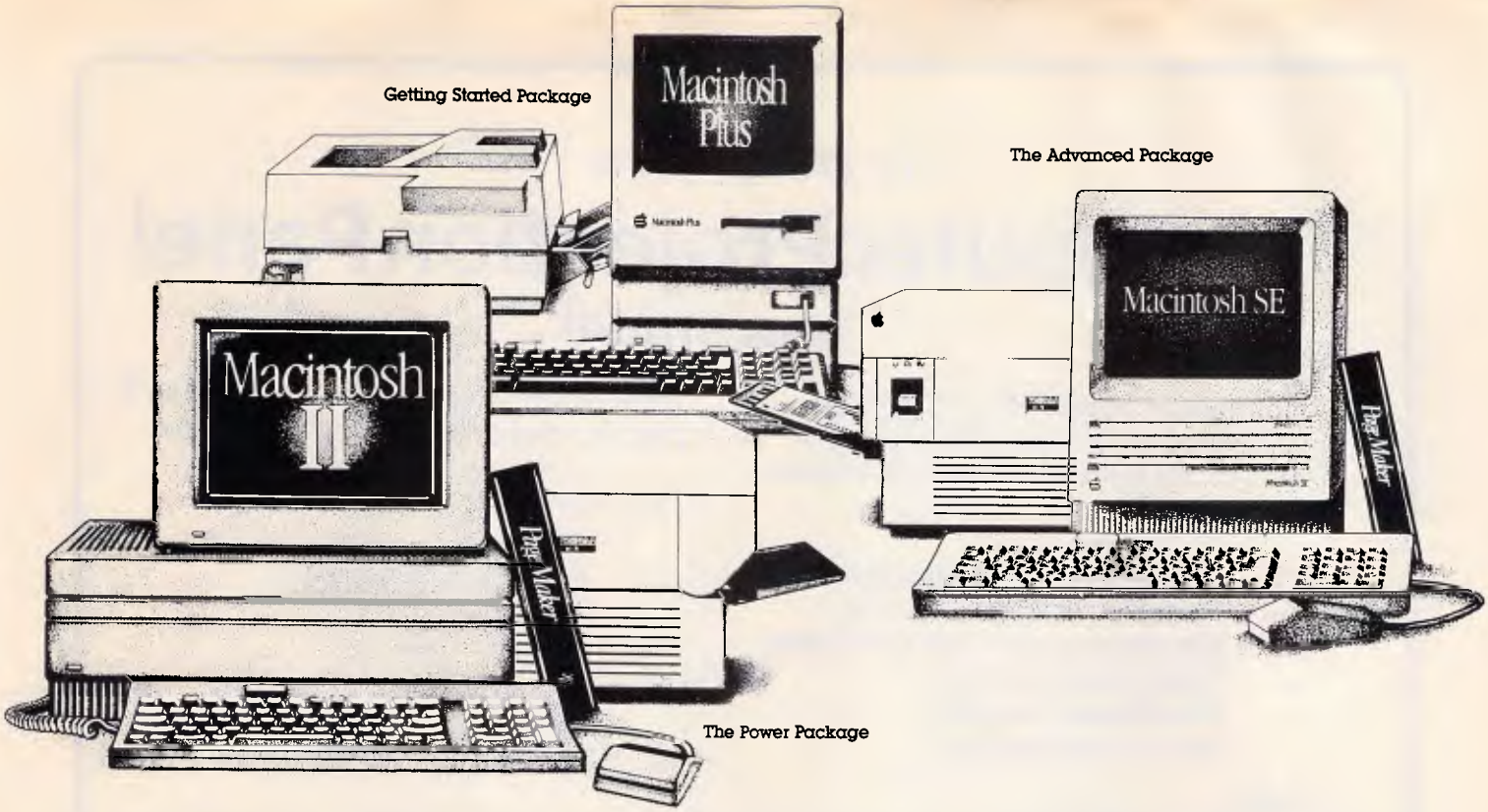
Therefore, the macro shown in Fig 8 contains the {onerror OK} statement

```
\C          {getlabel "Enter filename to read into the worksheet: ",INFILE}
            {onerror NOINFILE}
            {goto}INFIELD~          <--  INFIELD is cell where new file
            /cINFILE~MISSFILE~/fcce                will be combined.
INFILE      budget
            ~{onerror OK}
            {goto}XXXXX~            <-- Deliberate error to cancel
OK          {esc}                                  error trapping.

            . . macro
              continues . .


NOINFILE    {BEEP}FILE              <- One space after "E" in "FILE".
MISSFILE    budget
             NOT FOUND! PRESS [RETURN] AND RETRY! {?}
            {esc}
            {branch \C}
```

Fig 8 A 1-2-3 macro that traps an error and then cancels error trapping if there is no error



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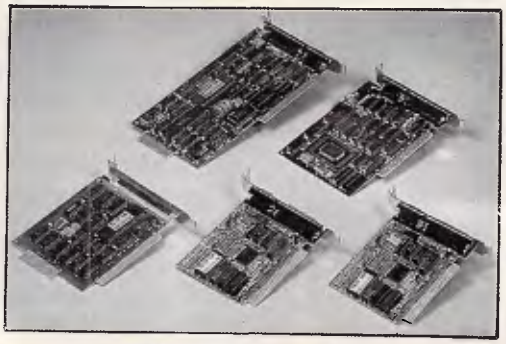

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that cancels the previous error-trapping condition. In the next line of the macro, there is a deliberate error (the range XXXXX doesn't exist) that results in a branch to OK and the cancellation of error trapping. The OK routine is a simple Escape that does nothing and can be though of as an {offerror} routine. The macro can now continue without the danger of branching to the wrong place because of an unanticipated error.

A Forssell

This technique represents an elegant solution to an inelegant problem. Lotus really should have provided an OFFERROR routine to complement ONERROR, and Mr Forssell's macro allows us to correct that oversight — JT.

Word 3.0

Word 3.0 on the Macintosh provides a fast way to return the insertion point to its most recent location. For example, if you are typing and notice an error several words back, correct the error, then type COMMAND-OPTION-Z. The cursor will return to where you were typing. This command actually works for the three most recent insertion point locations.

D Farabee

Command nesting

Since batch files execute one slow line at a time, it's desirable to make them as short as possible. But checking for user inputs usually means a cascade of IF == statements, which can waste space and time. However, I've discovered a shortcut.

Let's say you were running a batch file named RUNIT.BAT that checks its parameters and then runs a program called RUN.COM using the validated parameters. The only valid parameters for RUN.COM are A and B. The usual way to check for parameters would be

```
ECHO OFF
IF %1.==A. GOTO OK
IF %1.==B. GOTO OK
IF %1.==a. GOTO OK
IF %1.==b. GOTO OK
GOTO INVALID
:OK
RUN %1
GOTO END
:INVALID
ECHO INVALID -- USE "A" OR "B"
:END
```

But you can nest the IF statements to speed things up, as shown in Fig 9.

The nested IF command will work with any combinations of EXIST, ER-

```
ECHO OFF
IF NOT %1.==A. IF NOT %1.==B. IF NOT %1.==a. IF NOT %1.==b. GOTO INVALID
RUN %1
GOTO END
:INVALID
ECHO INVALID -- USE "A" OR "B"
 END
```

Fig 9 An example of nesting IF statements to speed up batch file execution

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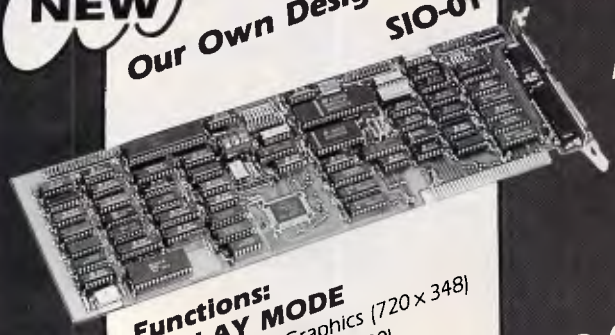

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RORLEVEL, STRING1 == STRING2, and NOT. The only limitation is the command line length of 130 characters.
T Cervenka

This comes in very handy when using IF ERRORLEVEL TESTS. For instance, if you need to figure out which drive you're on, you can use a batch file like DRIVER.BAT:

```
ECHO OFF
DRIVE
IF ERRORLEVEL 0 IF NOT ERRORLEVEL 1 ECHO Drive A
IF ERRORLEVEL 1 IF NOT ERRORLEVEL 2 ECHO Drive B
IF ERRORLEVEL 2 IF NOT ERRORLEVEL 3 ECHO Drive C
IF ERRORLEVEL 3 ECHO Higher than Drive C:
```

To make this work, create a tiny .COM file called DRIVE.COM. Type in the following DEBUG script using a pure ASCII word processor or the DOS COPY CON COMMAND, and call it DRIVE.SCR.

```
N DRIVE.COM
E100 B4 19 CD 21 B4 4C CD 21
RCX
8
W
Q
```

Make sure you hit the Enter key after each line, especially the last one (with the Q). Then type

```
DEBUG < DRIVE.SCR
```

Double dot disaster

It's dangerous for users with rudimentary knowledge of subdirectories to poke around where they're not supposed to be. I recently discovered one who knew what DIR and ERASE did, but hadn't a clue what the . and . . represented in a directory listing. This novice user, who was in a subdirectory one level down from the root, tried to ERASE the mysterious double dot 'file' and, of course, ended up deleting all the files in the root directory.
G Karran

If novice users are going to be fiddling with your system, one simple way to get around this would be to use the DOS ATTRIB.EXE to make all your important files read-only.

And, since DOS responds with an

```
Are you sure (Y/N)?
```

warning when you try to erase an entire subdirectory, you could use DEBUG to patch COMMAND.COM so that it responded with a message like

```
Now hit the N key!!
```

To patch COMMAND.COM with DEBUG, first make a backup copy of COMMAND.COM called COMMAND.BAK so that if you make a mistake you can start over. Then type

```
DEBUG COMMAND.COM
```

Find out how long your COMMAND.COM is by typing RCX and hitting the Enter key twice. You'll see something like

```
CX 62DB
```

Take the four-digit hex number following the CX and type

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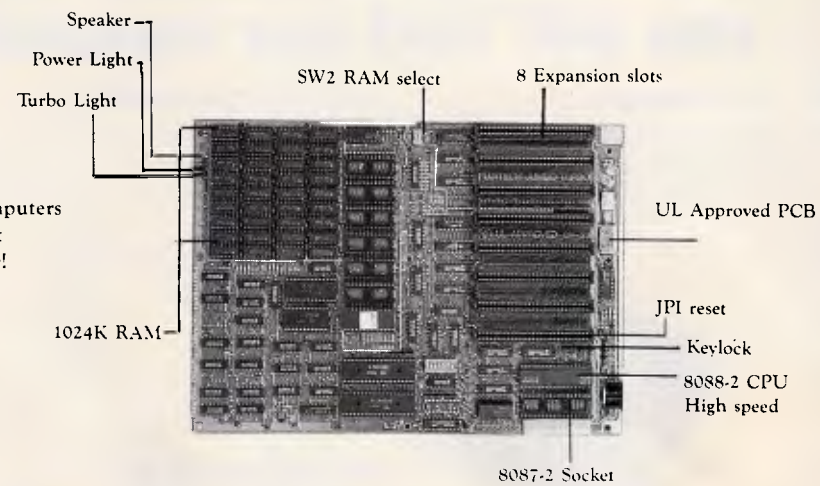

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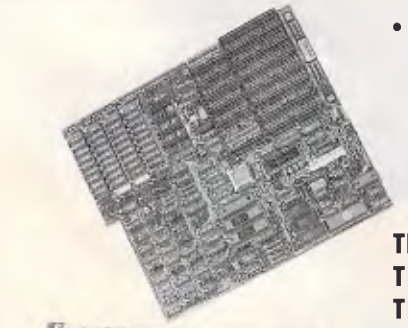

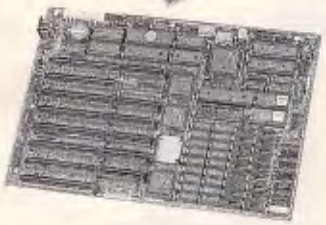

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S 100 L62DB "Are you sure"

(substituting the four-digit hex number if yours is different from 62DB). Hit the Enter key and you should see something like

61B2:5158

Ignore the first four digits (the ones preceding the colon). Take the rightmost four digits and type

E 5158 "Now hit the N key!!"

(substituting the four digit-hex number if yours if different from 5158). Hit the Enter key. Then hit W (and Enter) to write the new version back to disk, and Q (and then Enter) to quit DEBUG. Once you've patched COMMAND.COM, reboot — PS.

Handling run-time errors

The IOResult function in Turbo Pascal on the IBM PC allows you to manage I/O errors nicely, but there is little help for recovery from other errors. Turbo, Version 3.01A, includes information about user-written error handlers that are usually used only to make the exit smoother. If the user does not HALT the program, the regular error routine will force termination.

I enclose a way to manage run-time errors without exiting the program. I have tested this method in Turbo 3.01A, with and without 8087 support. For other versions that support error handlers, it would be necessary to locate the address of the error number (DSeg:$188 in 3.01A and 3.02A) and use this address in the Error-Trap procedure.

Because of the nature of the INLINE code, the variables ErrorExitAddress and OldStackPointer must be declared globally. The procedure OnErrorComeHere must be invoked at the point where we want to return after the error. If it appears more than once, the most recent invocation is active.

```
PROGRAM Error_Trap_Demo;
  {$U+}
VAR
  ErrorExitAddress, OldStackPointer : Integer;
  X, Y                              : Real;

  PROCEDURE ErrorTrap(ErrNo, ErrAddr : Integer);
  BEGIN
    CASE ErrNo OF
      $0001 : BEGIN WriteLn('***User Break'); Halt; END;
      $0110 : WriteLn('   Error in numeric format.');
      $0202 : WriteLn('   Division by zero.');
    ELSE Exit;
    END; {case}
    CBreak := True;                    { Reset Ctrl-Break check flag }
    MemW[DSeg:$0188] := 0;             { Reset error condition flag  }
    INLINE($8B/$26/OldStackPointer/    { MOV SP, OldStackPointer     }
           $FF/$26/ErrorExitAddress); { JMP ErrorExitAddress        }
  END;

  PROCEDURE OnErrorComeHere;
  BEGIN
    INLINE(
      $5D/                        { POP BP                    }
      $5B/                        { POP BX                    }
      $58/                        { POP AX                    }
      $A3/ErrorExitAddress/       { MOV ErrorExitAddress, AX  }
      $89/$26/OldStackPointer/    { MOV OldStackPointer, SP   }
      $50/                        { PUSH AX                   }
      $53/                        { PUSH BX                   }
      $55);                       { PUSH BP                   }
  END;

BEGIN
  ErrorPtr := Ofs(ErrorTrap); { Enable the error handler }
  REPEAT
    OnErrorComeHere;
    Write('Enter X,Y: ');
    ReadLn(X, Y);
    WriteLn(X, ' / ', Y, ' = ', X/Y);
  UNTIL False;
END.
```

Fig 10 A method of trapping run-time errors

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The error type, number, and address are available through the values of ErrNo and ErrAddr, exactly as in the ordinary error handlers. The example program in Fig 10 illustrates the three main exit possibilities: (1) a Ctrl-C (or Ctrl-Break) will terminate by using HALT; (2) a division by zero, or a numeric format error, will display a message and continue execution; or (3) any other run-time error will crash via the normal Turbo error handler. To see these different possibilities, answer the request for X and Y values with (1)Ctrl-C, (2) nonnumeric input or 1 and 0, or (3) 1E20 and 1E-20 (1E300 and 1E-300 if you are using the 8087 version).

The main limitation of the method is that to resume execution, the error return address must be on the stack. To guarantee that, the error must occur after the OnErrorComeHere procedure and in the same block, or in a procedure or function called (directly or indirectly) at such a location.

I have used this method to write a complex program where plenty of arithmetic errors can occur in very different conditions and in such a way that it is very difficult to anticipate them. With this method, I can wait for an error to occur and handle it on the spot. This makes life a lot easier.

J Aguirregabiria

The ErrNo variable in the ErrorTrap procedure contains the type of error in its high byte and the exact error number in its low byte. The three types of error are User Break (0), I/O Error (1), and Run-Time Error (2). Thus, for example, an ErrNo value of $0290 would indicate Run-Time Error number 90, index out of range — NR.

Trapping I/O errors

One nice attribute of Turbo Pascal is its ability to trap fatal I/O errors through the $I compiler directive. It would be convenient to have a similar method for trapping floating point errors without crashing the program. Such a feature would involve considerable modification of the run-time library, but simply ignoring the errors is still useful and much easier to do. The program in Fig 11 contains two procedures: Trapoff and Trapon, which modify and restore the run-time library to selectively ignore floating-point errors. The Trapoff procedure disables checking for floating-point overflow and Sqrt and Ln argument errors. Trapon restores the library to its original condition and should be called before exiting a program that uses Trapoff. The demonstration program illustrates the use of the procedures. Note that after you call Trapoff, there is no indication of a floating-point error. It is up to the user to interpret the validity of any floating-point results. In many situations this is preferable to dumping the program. (I have tested these procedures with Turbo, Version 3.01A.)

```
PROGRAM traptest;
VAR dummy : Char;

  PROCEDURE trapoff;
  BEGIN
    MemW[CSeg:$19B3] := $9090; {Floating point overflow}
    MemW[CSeg:$1C5C] := $9090; {Ln argument error}
    MemW[CSeg:$1C61] := $05EB;
    MemW[CSeg:$1B5E] := $E680; {Sqrt argument error}
    Mem[CSeg:$1B60] := $7F;
    MemW[CSeg:$1B61] := $9090;
    WriteLn('Floating point error trapping is OFF');
  END;

  PROCEDURE trapon;
  BEGIN
    MemW[CSeg:$19B3] := $0772; {Floating point overflow}
    MemW[CSeg:$1C5C] := $0574; {Ln argument error}
    MemW[CSeg:$1C61] := $0574;
    MemW[CSeg:$1B5E] := $C6F6; {Sqrt argument error}
    Mem[CSeg:$1B60] := $80;
    MemW[CSeg:$1B61] := $4375;
    WriteLn('Floating point error trapping is ON');
  END;

BEGIN
  IF MemW[CSeg:$101] <> $2C79 THEN
    BEGIN WriteLn(#7,'You need Turbo version 3.01A!'); Halt; END;
  ClrScr;
  trapoff;
  WriteLn('R = ', 1e20, '          R*R = ', 1e20*1e20);
  WriteLn('R = ', 0.0, '           Ln(R) = ', Ln(0.0));
  WriteLn('R = ', -49.0, '         Sqrt(R) = ', Sqrt(-49.0));
  WriteLn; WriteLn('Hit any key');
  Read(Kbd, dummy);
  trapon;
  WriteLn;
  WriteLn('R = ', -49.0, '         Sqrt(R) = ', Sqrt(-49.0));
END.
```

Fig 11 The Traptest program demonstrates how to disable some of Turbo's error trapping

D Markovitch

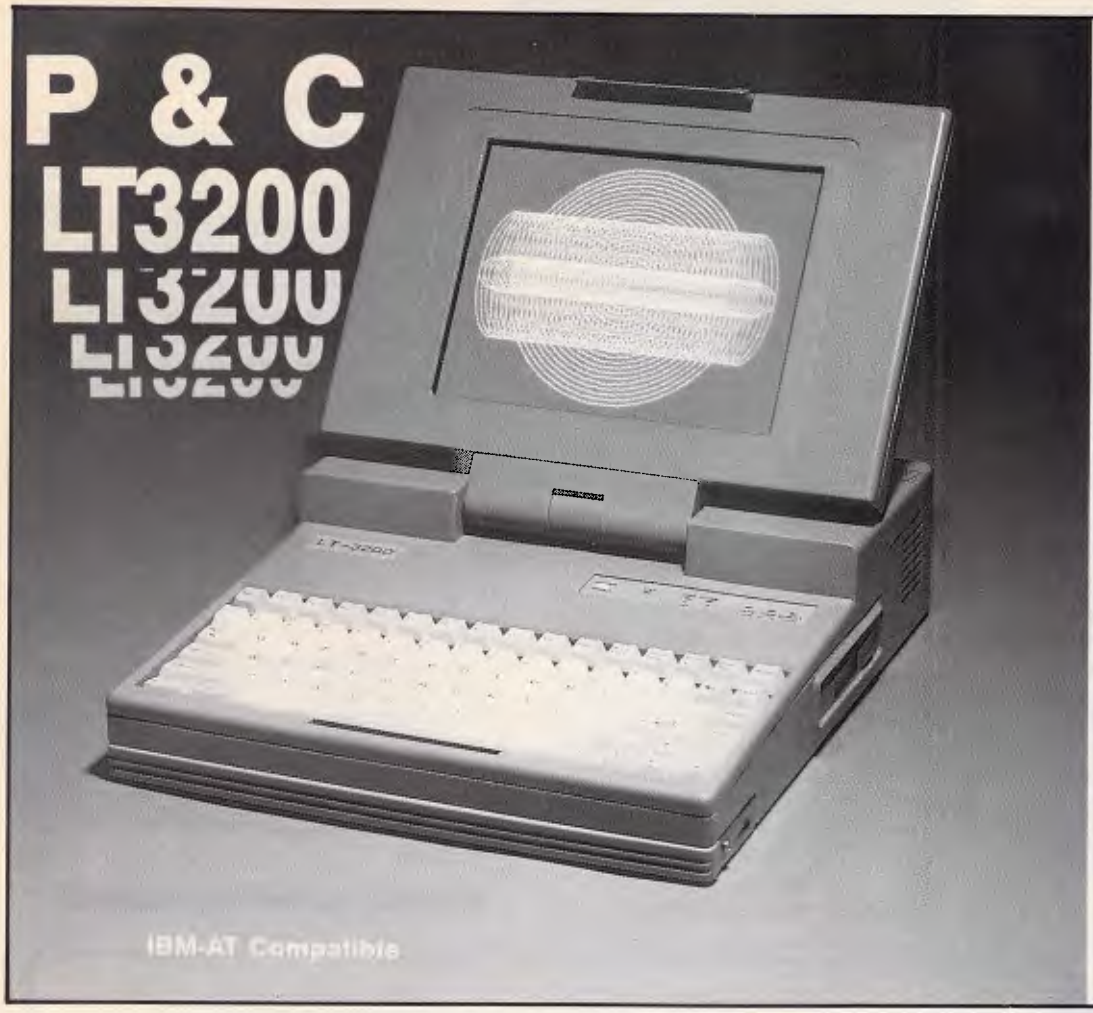
A program that self-patches the run-time library will usually only work under one specific version of Turbo Pascal. If you are just distributing the compiled program, this is not a problem. You know which version of the compiler you are using. However, if you distribute the source code, you may want to include a check for the correct version. A compiled Turbo program does not specifically include the version number, but it always begins with a JMP past the run-time library. The value of this jump has been different for every version of Turbo Pascal, so I use it to test for the correct version. Fig 12 is a list of the integer values found at location CSeg:$101 for all versions of Turbo Pascal — NR.

Apple IIGS crash control

When one of those new super-hi-res-graphics programs for the GS crashes,

version	value	version	value
1.00A	$222C	3.01A	$2C79
2.00B	$2725	3.01A w/ 8087	$272C
2.00B w/ 8087	$22FA	3.01A w/ BCD	$2B87
3.00B	$2BB3	3.02A	$2C4A
3.00B w/ 8087	$2666	3.02A w/ 8087	$26FD
3.00B w/ BCD	$2AC1	3.02A w/ BCD	$2B5A

Fig 12 Values found at MEMW[CSeg:$101] for different versions of Turbo Pascal



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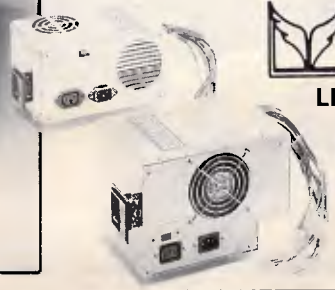

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```
10 SA = 768:N = 19
20  FOR Q = 0 TO N-1: READ DA$
30 A$ = LEFT$ (DA$,1): B$ = RIGHT$ (DA$,1)
40  IF A$ > "A" AND A$ <= "F" THEN A = ASC(A$)-55: GOTO 60
50 A = VAL (A$)
60  IF B$ > "A" AND B$ <= "F" THEN B = ASC(B$)-55: GOTO 80
70 B = VAL (B$)
80 VA = A * 16 + B
90 POKE SA + Q,VA
100  NEXT Q
110  RETURN
1000 DATA A9,FF,85,06,AD,30,C0,A2
1010 DATA 20,C6,06,F0,05,CA,D0,F9
1020 DATA F0,F2,60
```

Fig 13 The hex POKE program

type Control-T and press Return. Doing so causes the 80-column screen to be displayed. You will see the address of the crash, the last instruction executed, and the contents of all the 65816 microprocessor's registers. The developer of the program will be interested in this information because it makes it a bit easier to track down the source of the bug that caused the crash.

T Swihart

The Control-T command forces the screen display to text page 1, regardless of current soft-switch settings (which may select a graphics mode or text page 2). The command is not available on the IIe or IIc. For information on all the new system-monitor commands on the GS, see Apple IIGS Firmware Reference *(Addison-Wesley, 1987) or* Apple IIGs Technical Refrence *(Osborne/McGraw-Hill, 1987) by Michael Fischer — GL.*

A subroutine for a better way to POKE

Are you a programmer who often POKEs machine-language code into memory from inside an Applesoft program? If so, you probably convert the machine-language bytes to decimal form (from hexadecimal) before putting them into DATA statements. You can use the more convenient hexadecimal form if you take advantage of the techniques illustrated in the subroutine in Fig 13.

It reads the hexadecimal data entries as strings rather than numbers and then converts the strings to decimal numbers before it POKEs them into memory.

To use the subroutine, set SA equal to the starting address of the machine-language code and set N equal to the number of bytes to be POKEd. Each data element must be exactly two characters long and you must not type a $ in front of a data element.

R Evers

END

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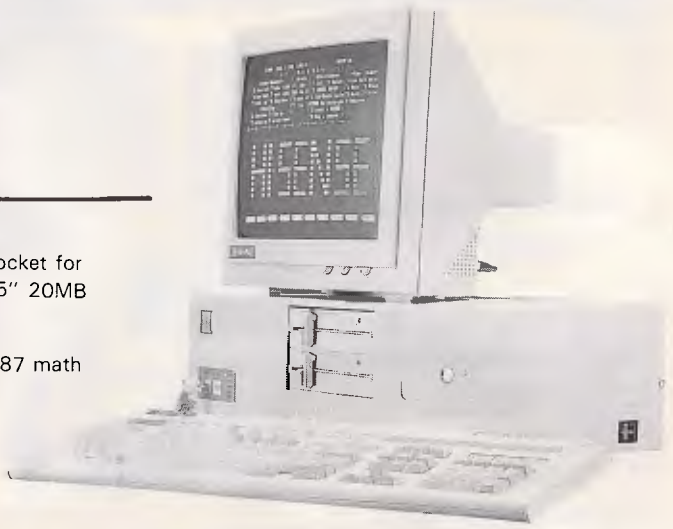

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NUMBERS

Mike Mudge delves into the factorisation and other properties of Fermat Numbers, with mathematical requirements being kept to the minimum.

Definition 'Fermat Numbers' are defined by $F_n = 2^{2^n} + 1$. Thus, $F_1 = 5$, $F_2 = 17$, $F_3 = 257$, $F_4 = 65537$.

It can be readily verified that these first four Fermat Numbers are prime; indeed, Pierre De Fermat (1601-1665) conjectured that *all* F_n were prime. However, such are the dangers of generalisation based upon empirical evidence, and in 1732 Leonhard Euler found that:

$F_5 = 2^{2^5} + 1 = 2^{32} + 1 = 4294967297$
$= 641 \times 6700417$

In 1880 F Landry proved that:
$F_6 = 2^{2^6} = 2^{64} + 1 = 274177$
$\times 67280421310721$

No prime Fermat Number has been found beyond F_4, so that Fermat's conjecture has not proved to be a very happy one. It is perhaps more probable that although the number of prime F_n is finite, there are others waiting to be discovered (reference the probabilistic argument given as a footnote in *An Introduction to the Theory of Numbers* by GH Hardy and EM Wright).

The existence of prime F_n has an interesting geometrical connection, since Karl Friedrich Gauss proved that a regular polygon having F_n-sides could be inscribed in a circle by Euclidean methods if F_n is prime. (A 65537-sided regular polygon inscribed in a given circle could provide an interesting challenge in computer graphics, particularly if an attempt was made to simulate the Euclidean methods mentioned above!)

Theorem 1 No two Fermat Numbers have a common divisor other than 1.

Theorem 2 If F_n is prime, then the number:

$$Z_n = 3^{2^{2^n - 1}+1}$$

is divisible by F_n.

For example, $F_2 = 17$ is prime, hence we know that $3^{2^3} + 1 = 3^8 = 65\,61 + 1$ is divisible by 17. In fact, 6562 = 17 x 386.

Note the converse of theorem 2 is also true: that is, if F_n is *not* prime, then Z_n is *not* divisible by F_n.

Theorem 3 Any factor of F_n has the form $k \times 2^m + 1$ where $m \geq n + 2$ and k is an odd integer.

For example, the factor 274177 of F_6 cited above is given by 256 x 1071 + 1, while the factor 6700417 of F_5 is given by 52347 x 128 + 1.

This month's project is to search for factors of Fermat Numbers; it is suggested that Theorem 3 be used, hence two different ways of organising the search are possible.

The description which follows is due to Professor Wilfrid Keller of the University of Hamburg, who has conducted extensive research in this area using both a Telefunken TR 440 computer in TAS assembly language and a Siemens 7.755 with built-in extended precision floating point arithmetic.

How far can *APC* readers get with this work?

Approach 1 — Trial division For fixed n, look for all k less than some search limit L_n to see if $k \times 2^{n+2} + 1$ divides some F_r, $r \leq n$.

Approach 2 — Tabulation of primes For fixed k, list all primes of the form $k \times 2^m + 1$ for m up to some limit M_k. Then, for each prime, look to see if it divides some F_n where $n \leq m - 2$.

Readers are invited to send their thoughts, together with attempts at this project, to Mike Mudge, C/- *APC*, 124 Castlereagh Street, Sydney 2000, to arrive by 15 November 1987.

It would be appreciated if such submissions contained a brief summary of results obtained, in a form suitable for publication in *APC*. These submissions will be judged using subjective criteria, and a prize will be awarded by *APC* to the 'best' contribution received by the closing date.

Please note that submissions can only be returned if a stamped addressed envelope is provided.

Belated review: October 1986

Regular readers of Numbers Count will be aware that the prize award associated with this problem was deferred (*APC*, April) due to a lack of response. Interesting correspondence has since been generated, resulting in a very worthy prizewinner, Fred Hartley. Fred used a BBC Model B and relied very much upon a set of long integer arithmetic routines written in assembler which cope with integers up to 256 bytes in length. The computing went hand in hand with a careful theoretical analysis, and Fred's third communication concludes: 'I suspect that s(k)/k increases without limit as the number of factors increases, but I have not proved this.' Can any mathematicians help?

Review: April 1987

This problem was, as expected, extremely popular. It was prompted by the following results quoted in LE Dickson, *History of the Theory of Numbers, Volume 2.*

'Fermat noted that if in (205769, 190281, 78320) we add the area to the square of the sum of the legs, we get a square.'

'Frenicle stated that in (17, 144, 145) the sum of the area and the hypotenuse is a square, while the first three right triangles in which the sum of the area and smaller leg is a square, are (3, 4, 5); (16, 30, 34) & (105, 208, 233).'

' "Calculator" found three right triangles of equal perimeter and areas in arithmetical progression (18601944, 13951458, 23252430); (18559223, 13999464, 23247145) & (18515584, 14048388, 23241860)'.

While AH Beiler, *Recreations in the Theory of Numbers*, reports:

'Four primitive Pythagorean triangles having a common perimeter have also been found. Only seven such quadruples exist for a perimeter less than 1000000 so they are quite rare. The smallest of these perimeters is 317460 and the triangles are (153868, 9435, 154157); (99660, 86099, 131701); (43660, 133419, 140381) and (13260, 151811, 152389). Can the reader find the other six?'

Unfortunately, the italics in part (v) of the problem together with the lack of the adjective 'primitive' generated a great deal of computer output — at least one complete answer to that part!

After much consideration, this month's prizewinner is Peter Hicks of Rye, Victoria.

END

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.

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LAZING AROUND

END ZONE

Brianteasers courtesy of JJ Clessa

Quickie
A puzzle submitted by a reader, so don't blame me for the idea. What time period does the number 14600926 represent? Clue — try converting it to hex.

Prize puzzle
This shouldn't be too difficult for those of you with micro power.
You can add or subtract 20 from a certain perfect square, and in either case the result is also a perfect square. What is the original perfect square? (Lateral thinking needed here.)

Answers on postcards please, or backs of envelopes only, to reach *APC,* Lazing Around October, 124 Castlereagh Street, Sydney 2000, no later than 30 October 1987.

July prize puzzle winner
I'm afraid there was a slight ambiguity about this month's question, which said that: '. . . the three missing digits from both telephone numbers are the same as the last three digits of my safe combination . . .' In other words, the three digits need not necessarily be in the same order.

One solution was:
Safe No 79 648
Tel — 1 90 486 17 Common factor 19
Tel — 2 491 864 4

This was not what I intended, but I included the entrants who submitted this type of solution with the others who interpreted the rules as I intended, into the draw. The winner is Mr Peter Guides of Seven Hills, NSW.

Mr Guides' solution was the one I expected:
Common factor 547
Missing digits 862

To all the entrants, keep trying — it could be your turn next.

END

DIARY DATA

Readers are strongly advised to check details with organisers before making travel arrangements to avoid wasted journeys due to cancellations, printers' errors, etc.

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Contact: Sara Mulvihill (02) 922 5532

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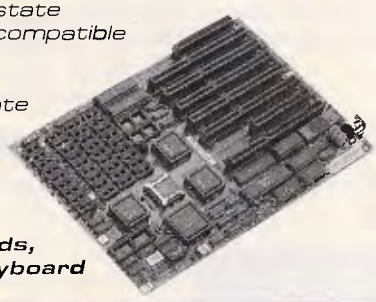

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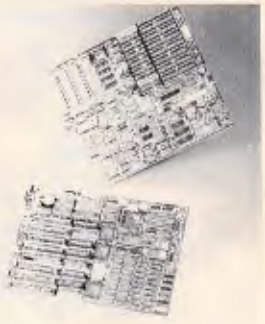

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