DECEMBER 1986 • Volume 9 • Issue 12

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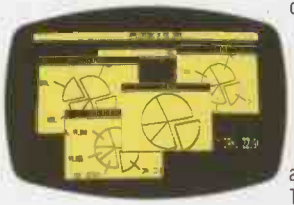

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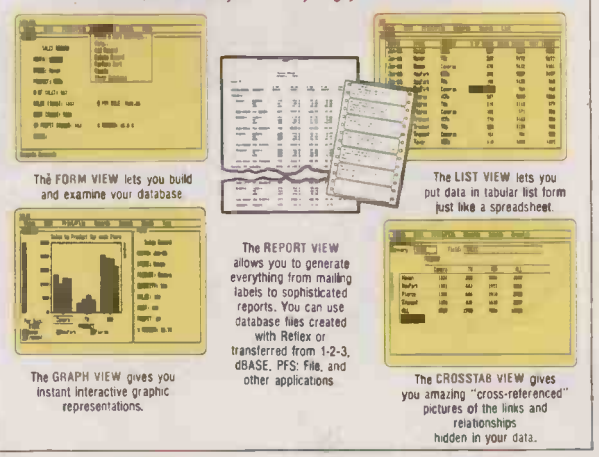

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COVER FEATURE

HOT 100

1986 has probably seen more happening in the business micro market than ever before. In this end-of-the-year round-up we look at the most significant recent developments on both the hardware and software fronts. As we chart the birth of new trends and the death of old ones, we pick out the top machines and programs. We also look forward to 1987, which promises to be just as exciting as this year. The top 50 software packages begin on page 86, and the top 50 machines and add-ons on page 92 85

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Kuma K-Max Taming the Transputer — page 44.

PRACTICAL COMPUTING

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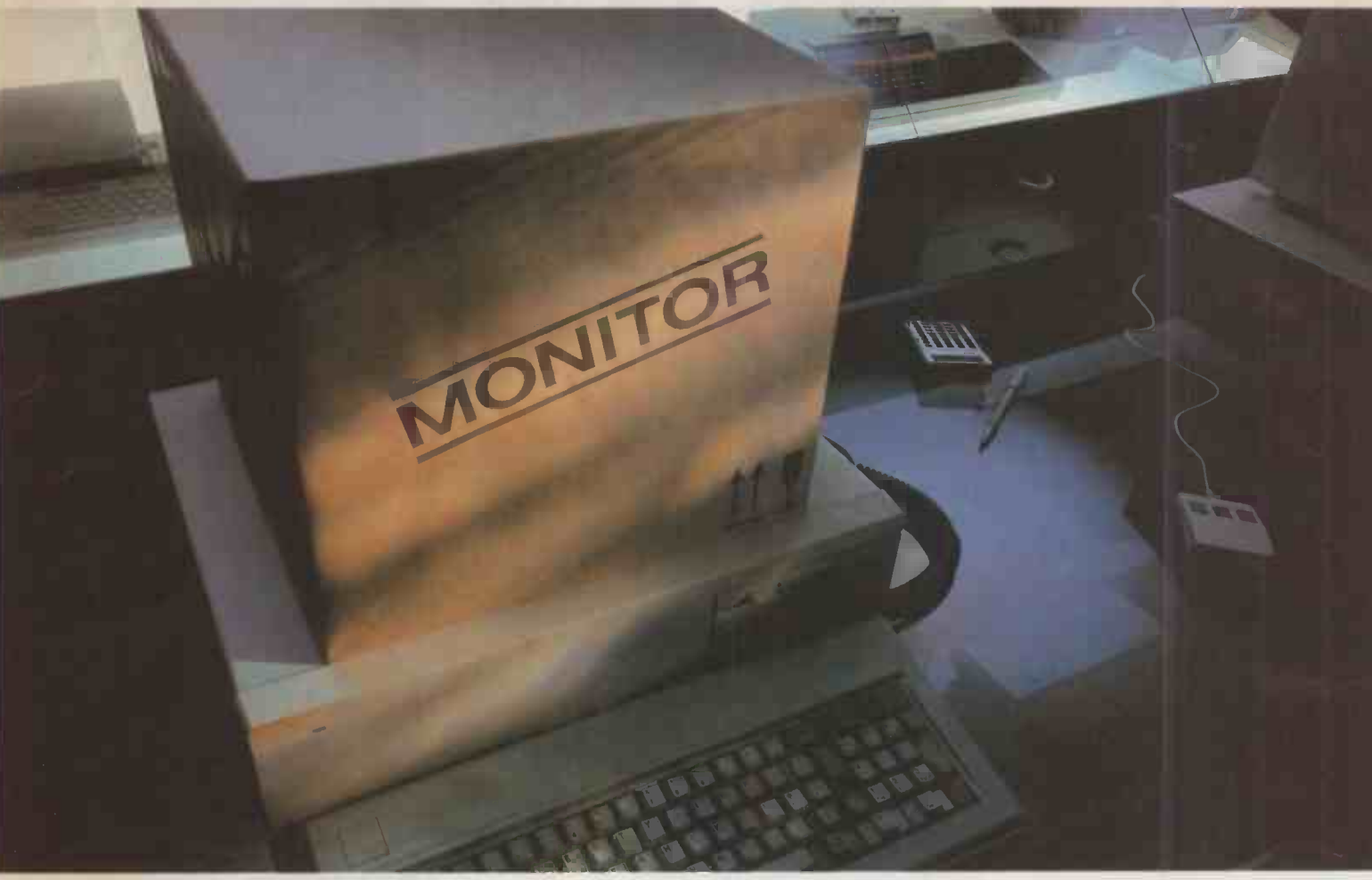

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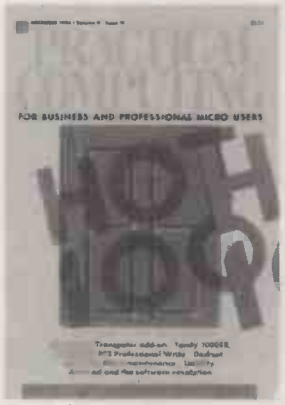

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SOFTWARE SHUTDOWN

Here in the U.K. we have the makings of a full-blown software crisis on our hands. A market report from the electronics consultancy XMT claims that over 3,000 U.K. software firms will go under in the next five years. Although this figure was arrived at through simple extrapolation rather than any deep analysis, its basic message is clear enough.

The XMT study is a timely reminder of what the government's Advisory Council for Applied Research and Development (ACARD) warned of earlier in the year. At first there was a flurry of excitement, followed by lots of soothing noises from ministers; then the industry returned to its complacent slumbers. The newsworthiness may have diminished, but the problem has not.

The situation at present is that the U.K. represents some five percent of the world software market, yet U.K. suppliers only provide around two to three percent of that. Worse, the ACARD report predicts that at the current rate this country will have a trade deficit of £2 billion in 1990 on software alone.

The U.K. has long been resigned to almost total domination by foreign manufacturers in the area of hardware, but it has prided itself on software skills. In a kind of IT snobbery, hardware has come to be thought of as a cloth-cap metal-bashing activity, whereas software is the province of sophisticated professionalism.

It is true that there are a number of U.K. companies which derive very healthy livelihoods from writing software. But this has largely been in the area of labour-intensive, high-margin bespoke packages where foreign software houses are least able to compete. Many projects have been defence-related and so subject to a further protectionist barrier. In the all-important packaged software market, U.K. firms are being left nowhere.

The rise of the software package, as opposed to the custom program, is intimately related to the rise of the micro. The large user bases it has generated have meant that high research and development costs can be recouped by very high volumes. Unfortunately, to reap those benefits requires the kind of entrepreneurial risk-taking this country is notoriously bad at. The U.S., on the other hand, has at the heart of its self-image precisely this kind of activity. Hence the rise of Lotus, Microsoft and the rest.

The cosy parochialism of the U.K. software industry fails to recognise that over the next few years there will be a huge shift away from purely bespoke packages. Not because they are inherently less suitable than off-the-shelf programs, but simply because they cannot be supported. Increasingly, it is taking DP departments all their limited resources to update present installations, never mind cope with new software for new applications. The only way out of this impasse is the use of easily configured software, possibly of the type generally and vaguely called "fourth generation".

Whether software houses die by attrition or are swallowed up by overseas manufacturers, the end result will be the same. The U.K. will be left defenceless in what is probably the key strategic industry of the next century. After all, software drives everything. The folly of depending on American goodwill is clearly demonstrated in the risible restrictions which it has attempted to apply to the use of one of the latest supercomputers.

To avert this dire prospect, the ACARD report makes a number of suggestions. Inevitably some of them involve setting up yet more schemes and projects with names like Starting, Typssea and Bassmatt which are so beloved of bureaucrats. More useful is the recommendation that technical training be provided on a regular basis to those in the software industry in order to increase their skills and productivity. The report also mentions an approach adopted by the successful French programme, which gives tax incentives for research and development in the form of accelerated write-offs.

But much more needs to be done. The government must stop tinkering about with IT: it must treat it not only as a way of making valuable improvements to efficiency, but as absolutely central to the transformation of this country into a post-industrial service economy. Industry must learn that it is only through large-scale investments — above all in software and people — that it will claw its way out of the slough of ineptitude it has been wallowing in for decades. And everyone in business has got to start choosing the right software for the right reasons, and start using it properly.

5 YEARS AGO...

The Government has rejected the idea of an independent data-protection authority, but is to publish a White Paper setting out its proposals on the subject. This was made clear by Home Office Minister of State Timothy Raison at a recent conference held at the British Medical Association, London.

The conference included among its speakers Sir Norman Lindop, who reported on data protection in December 1978 and has argued consistently that any data-protection authority must be independent if it is to have any teeth.

However, Raison, giving the Government's proposals, rejected the independent approach and suggested that "The form of independent authority proposed by Sir Norman's committee is fundamentally objectionable".

FEEDBACK

Our Feedback columns offer readers the opportunity of bringing their computing experience and problems to the attention of others, as well as to seek our advice or to make suggestions, which we are always happy to receive. Make sure you use Feedback — it is your chance to keep in touch.

WRITE TO:

Feedback, Practical Computing, Quadrant House,
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AMSTRAD COMMS

I AM writing in response to Glyn Moody's article in the September issue which contained a review of the communications package Comm Plus. Easylink distributes a customised version of the program, which I understand was supplied to you along with the raw version you reviewed.

The article gave quite the wrong impression with regard to the use of the Amstrad for communication purposes, and presented a view of Comm Plus which contrasts sharply with the feedback that we get from our subscribers who use the program. As supplied by Easylink, Comm Plus is almost completely menu-driven apart from the editor. All the user is required to do is to press the correct keys; he doesn't even need to know what the files are called, since Comm Plus will automatically send files with a particular internal file name. It must also be pointed out that the writing of the Job Control File (JCF) that you showed can hardly have been an enormous effort since it is cribbed from the Comm Plus manual.

Mr Moody also said that the use of single-letter commands from the menu is "very unhelpful". First, I have already shown that most users would never have to touch the "guts" of Comm Plus. Secondly, what is unhelpful about using F to initiate sending a file, P to toggle on a printer, and H to set the level of help?

It made me wonder what Mr Moody would make of Crosstalk, which has a similar means of working, in that to get the best from it you need to write script files. Neither Microstuf nor its distributors provide these for any service and users are thrown in at the deep end. This has not prevented it becoming the most popular communications package available so far.

Thus, in conclusion, Comm Plus would not have proved "inappropriate to the ordinary user" had the versions supplied to you been used. Comm Plus would have emerged as the package which is "taming a hostile area" and illustrated that the Amstrad is an ideal, low-cost terminal for email and telex applications.

I P NORTHWOOD,
Easylink Ltd,
Brentford,
Middlesex.

THE EDITOR REPLIES: Mr Northwood spends most of his time defending the customised version of Comm Plus, against which I have no complaints. I did not look at it or any other specific customised version of the package since the whole tenor of the review was comms packages which could be used generally — that is, without modification.

As Mr Northwood notes, the Job Control File in the review was provided in the manual; the enormous effort was finding it, not writing it. Crosstalk may well be a runaway success, despite its use of similarly opaque instructions. But as I was at pains to point out, the review was written from the viewpoint of the general user, accustomed to neat rather than knotty solutions.

Reader panels

PRACTICAL COMPUTING would like to thank those who responded to our invitation to take part in reader panels. Their replies are now being processed. After this has been done, readers will be contacted in rotation, so you may not hear from us immediately.

Canon lasers

CANON has pointed out that we were incorrect in stating on page 100 of our August issue that the drum in its LBP-CX laser-printer engine is made from selenium. The disadvantage of selenium is that it is toxic, creating a disposal problem when the drum is finished with. Canon in fact uses a safe organic photo-conductor (OPC) drum, as do most other makers of laser printers and photocopiers designed for the office. PC

NEXT MONTH

SPECIAL SECTION

DESK-TOP PUBLISHING

From nowhere, desk-top publishing has grown into one of the hottest areas around. It seems that everyone is launching a program. In this special section we look at the two main groups of personal-publishing packages: those for the Apple Macintosh and those for the IBM PC.

HARDWARE

Multi-user systems are becoming increasingly popular solutions for automating the office. As more powerful chips come through, the attractiveness of a single processor becomes greater. We review the Comart Quad and the Bromcom QC, two four-user systems which are cheaper than you think.

SOFTWARE

Earlier in the year we reviewed VP-Planner, the low-cost 1-2-3 clone from Adam Osborne's Paperback Software. Now there is VP-Info modelled on dBase III. We also try out some of the word processors specifically designed for the Amstrad PC.

FEATURES

Whatever happened to Worms? We investigate the latest generation of write once, read many times optical discs. We also profile Zenith, a company most famous for its knack of beating IBM to the U.S. government's big contracts.

TOP 10 SURVEY

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Serial Adapter	£59.00	AT 360k Disk	£145.00
AT Parallel/Serial	£99.00	PC DOS 3.2	£70.00

COMPAQ

Portables

Portable I (256k RAM 2x360k Disks)	£1377.00
Portable II (640k RAM 360k + 20Mb Disks)	£2637.00
Portable 286 (640k RAM 1.2Mb + 20Mb Disks + 10Mb Tape Backup)	£3127.00

Deskpros

Model 2 (256k RAM 2x360k Disks)	£1307.00
Model 3 (640k RAM 360k + 20Mb Disks)	£1797.00
Model 20 (640k RAM 1.2Mb +20Mb Disks)	£2357.00
Model 2 (640k 1.2Mb + 30Mb Disks)	£2707.00
Model 3 (As Model 2 + 40Mb Tape Backup)	£3157.00
Model 4 (640k RAM 1.2Mb + 70Mb Disks + 40Mb Tape Backup)	£4247.00

All prices include Keyboard, Dual-Mode Monitor & DOS.

SOFTWARE

Multimate Advantage (Word Processor)	£299.00
Framework II (Integrated)	£349.00
Lotus 1-2-3 (Spreadsheet)	£259.00
Symphony (Integrated)	£359.00
dBase II Plus (Database)	£399.00
MS Windows & MS Mouse	£195.00

PRINTERS

Dot Matrix

NEC P6 (180cps, 72cps NLQ, 80col)	£Call
NEC P7 (180cps, 72cps NLQ, 136col)	£Call
NEC P5 XL (264cps, 88cps LQ, 136col)	£Call

Letter Quality

NEC Spinwriter 8850 (55cps)	£Call
IBM Quietwriter Model 2 (45cps)	£1075.00
HP LaserJet (8ppm)	£1999.00

All prices include cable.

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	Mono	Colour
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M24SP (640k RAM 360k + 20Mb Disks)	£2032.00	£2268.00
NEW MODEL		
M28 (512k RAM 1.2Mb + 40Mb Disks)	£3131.00	£3367.00

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System illustrated is XEN-xi 10 with optional XEN-TEL and high resolution colour monitor.

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Two clone makers drop prices

BOTH Compaq and Olivetti, the leading sellers of IBM clones in the U.K., have cut their prices. Olivetti prices are falling by about 20 percent across the range. The M-28 AT clone comes down from £3,288 to £2,767 for a system fitted with a 20Mbyte Winchester disc.

Compaq prices are falling less dramatically, but the changes still average more than 10 percent on the Deskpro range. An 80286-based Deskpro with one floppy-disc drive drops from £2,981 to £2,181. The equivalent system with a 20Mbyte hard disc costs £2,881; this is a newly introduced model, so there is no old price to compare it with.

British Olivetti is at Olivetti House, PO Box 89, 86-88 Upper Richmond Road, London SW15 2UR. Telephone: 01-785 6666. For information on Compaq contact Compaq Computer, Ambassador House, Paradise Road, Richmond, Surrey TW9 1SQ. Telephone: 01-940 8860.

WANG'S LAP PORTABLE

DESPITE flagging interest in the IBM-compatible lap-portable market, Wang is to introduce its own £2,535 offering at the start of next year. The 14lb. Wang Laptop is a battery-powered machine, making it a true portable.

It has a full-size LCD screen, a hard disc and a printer installed as standard. The processor is the 8086-compatible NEC V-30 CMOS chip.

The company seems to be placing its faith in improved technology, which allows a battery-powered machine to get closer in performance to a desk-top system. A key improvement is to the screen. Wang uses the new super-twist LCD technology, which is claimed to give better contrast and therefore readability.

The standard Wang Laptop does not have a built-in floppy drive, only the 10Mbyte hard disc. Wang is offering two separate external floppy units as options: a mains-powered 5.25in. drive and a 3.5in. drive which will run off mains or batteries. The built-in printer is a full-width 24-element thermal-transfer unit made by Epson. It uses thermal ribbon, enabling it to print on to ordinary paper at 18 characters a second.

Battery life on the Wang Laptop depends on how much use you make of the printer. Wang quoted us four hours continous use between recharges, but also said this could drop to between two and three hours with heavy use.

There is little doubt that the poor showing of the IBM PC Convertible in the U.S. checked the expected growth of sales of portables. But the requirements for desk-top power in a portable system is still there. Wang's main rivals in this market are likely to be Toshiba, Zenith, Data General and possibly Grid.

Contact Wang U.K., 661 London Road, Isleworth, Middlesex TW7 4EH. Telephone: 01-560 4151.

HARDWARE SHORTS

- Logimouse C7 is a £125 mouse aimed at IBM users. It has a resolution of 200 dots to the inch, and plugs straight into an RS-232 serial port. Software to drive Lotus 1-2-3 is included in the price. Both Hercules and EGA cards are supported. Contact Silicon Express on (0533) 374917.
- U-Microcomputers has a low-cost system based around the 68000 processor which is aimed at satisfying number-crunching and multi-user requirements. Prices start at £1,299 for a single-user system with 1Mbyte of main memory; an eight-user system comes in at around £5,000 plus the cost of the terminals. Telephone (0925) 54117.
- The Infoscribe Model 1400 18-pin dot-matrix printer has a 400cps top speed for DP use, with two slower multi-pass modes available for higher-quality correspondence work. The printer comes with IBM, Epson and Diablo printer emulation. Contact Infoscribe on (0273) 25992.
- Alpha Micro has launched a low-cost hard-disc backup device which works in conjunction with a domestic video-cassette recorder. The £365 unit lets you store up to 80Mbyte of data on a standard two-hour video tape. Details from Alpha Micro on (0753) 821922.
- Omnichrom 2000 lets you add colour to laser-printed paper or transparencies. The £995 unit heat-bonds special film on to the laser output. Details from ABM on (04895) 2457.
- Tyepro of Cambridge calims to be able to link any brand of computer and printer together. The company makes its own range of interface converters, switches and cables, which it will customise if necessary. For information phone (0223) 322394.

Rush to market new lasers

LASER PRINTERS continue to flood on to the market, in many cases from new suppliers. This month the emphasis is on compact size as well as price and speed.

Oki's Laserline 6 is priced very competitively at £1,899. The specification of six pages per minute with fairly limited graphics suggests that it is mainly intended for straightforward office word-processing use. Its main claim to fame is that it is exceptionally small, with a 16in. square footprint, and at 33lb. it is about half the weight of its competitors.

Oki is a major manufacturer of matrix and daisywheel printers, but this is the company's first laser. It is built around a mechanism from Ricoh. Oki is also believed to be working on a much faster upmarket printer which will use a light-emitting diode array rather than a laser.

C. Itoh is also launching its first office-level printer, the LIPS-10. It has a £3,200 price tag and a top speed of 10 pages a minute. The laser engine is made by Konica/Ubix, and has not shown up before in the U.K.

Kyocera is launching the F-1010, a £2,995 10 page a minute laser model. The laser engine for this machine is Kyocera's own, and is already on the market here inside printers made by Mannesmann-Tally and Sperry.

Xitan has hitherto distributed laser printers from other manufacturers but is now launching its own machine, the Turbolaser, to sell for around £4,250. Its principal feature is the control electronics, which are designed to be fast.

The Turbolaser is also quick at graphics. Driver software to make the Turbolaser work with Autocad and Robocad drawing packages is included in the price.

Meanwhile the very competitively priced 15 page a minute Omnilaser 2015 from Texas Instruments is beginning to arrive in the U.K. As well as speed it provides exceptionally good paper handling. Costing only £4,295, it looks like the laser bargain of the moment for users with a heavier than average print volume to deal with.

C. Itoh is at Beacon House, 26-28 Worple Road, London SW19 4EE. Telephone: 01-946 4960. For information on Kyocera machines contact Mekom Computer Products, Enfield Hall, Enfield Road, Edgbaston, Birmingham B15 1QA. Telephone: 021-454 2288. For Oki contact X-Data, 750-751 Deal Avenue, Slough Trading Estate, Slough, Berkshire SL1 4SH. Telephone: (0753) 31292. For Texas Instruments contact RTS Technology, St. Pancras Commercial Centre, Pratt Street, London NW1 0BY. Telephone: 01-267 7541. Xitan is at Xitan House, 27 Salisbury Road, Totton, Southampton SO4 3HX. Telephone: (0703) 871211.

Publishing system from Xerox

XEROX has launched Documenter, an £8,200 desk-top publishing system based around its own hardware. At the same time it is preparing to launch Ventura Publisher, a bought-in program aimed at IBM PC/AT users.

Documenter is based on the Xerox 6085PC. The base Documenter configuration has a 6085 with a 15in. bit-mapped screen and a 10Mbyte hard disc: you also get Xerox's own Viewpoint 1.1 desk-top publishing software and the 4045 laser printer.

Options include a co-processor board to let you run IBM PC software. The system is designed for use on its own or for connection to an Ethernet local area network.

Rank Xerox (U.K.) is at Bridge House, Oxford Road, Uxbridge, Middlesex UB8 1HS. Telephone: (0800) 444180. PC

Lotus targets technical users

TWO PRODUCTS aimed at engineering and scientific users have been announced by Lotus. Manuscript is a technical word processor, while Measure is an add-on package to Lotus 1-2-3 which allows the direct transfer of instrument data into a worksheet. Both packages should be on sale by the end of the year, priced at £395.

Manuscript has many special features for the technical WP user, including the ability to mix text and graphics and to support Greek and mathematical symbols. The package also supports footnoting and indexing, and can generate a table of contents. A clever zoom facility lets you preview you printer output on-screen even if you have a poor-quality display card.

Manuscript will work with most matrix or laser printers. You can even output directly to certain typesetting machines, as Manuscript can turn documents into Postscript files.

Lotus Measure is aimed at users who handle quantities of data from measuring instruments. The package allows such data to be passed directly into 1-2-3 spreadsheets without rekeying. The package works with IEEE-488 and RS-232 comms ports, and with special add-on data-acquisition boards such as the Metrabyte Dash-16.

Manuscript and Measure are designed to run on hard-disc systems with a minimum of 512K of memory. For more information contact Lotus Development (U.K.), Consort House, Victoria Street, Windsor, Berkshire SL4 1EX. Telephone: (0753) 840281.

HUMAN FACE FOR 1-2-3

AMONG the flurry of new products from Lotus the one of greatest general interest is HAL, the Human Access Language for 1-2-3. HAL is a memory-resident program which is used alongside 1-2-3 to give it a new user interface.

HAL lets you enter 1-2-3 commands as ordinary words or phrases. You type things like:

Graph January to March
or
Make revenue = sales – costs

Other useful features include a Find and Replace command, an improved ability to link spreadsheets together and an Undo command to let you correct mistakes.

HAL costs £120 and runs on IBM or compatible machines with at least 512K of memory. More details from Lotus Development (U.K.), Consort House, Victoria Street, Windsor, Berkshire SL4 1EX. Telephone: (0753) 840281.

Aldus Pagemaker now to run on IBM

THE AVALANCHE of desk-top publishing products continues. Aldus has announced the IBM PC version of Pagemaker, which is brand leader on the Mac. Pagemaker PC runs under Microsoft Windows and should be available in the U.K. by the end of the year. The price will be around £600.

PC Pagemaker can import text files from word-processing programs like Word Perfect, Microsoft Word and WordStar, and graphics from 1-2-3, Inavision and PC Paint. Output can go to a range of different devices, including laser printers from Hewlett-Packard and Apple, and Postscript-compatible typesetting machines.

Xerox has finally announced some plans for Ventura Publisher, an IBM desk-top publishing package to which it acquired the rights earlier this year. In the U.S. it will cost $875; U.K. pricing and distribution arrangements have not been finalised. It is reportedly a strong candidate for leadership in the IBM desk-top publishing market. But with competitors arriving all the time, Xerox could miss the boat if it delays too long.

On the Macintosh, currently the leading machine for desk-top publishing, new software includes an offering from Letraset. Letrapage, priced at £595, is intended to compete with Pagemaker on the Mac. It is a heavily rewritten version of an existing product, Mac Publisher, to which Letraset has acquired the rights.

Aldus Pagemaker PC is available from McQueen, Elliott House, 8-10 Hillside Crescent, Edinburgh EH7 5EA. Telephone: 031-558 3333. For information about Ventura contact Rank Xerox, 338 Euston Road, London NW1 3BH. Telephone: 01-300 8000. Letrapage is distributed by Page and Print, 3 Bedford Street, London WC2E 9HD. Telephone: (0483) 277702.

SOFTWARE SHORTS

• Borland is now shipping a new version of Turbo Prolog, its AI language for IBM machines. The new version compiles more quickly, uses less space in memory and can handle larger applications. The tutorial disc also has many more examples. The price remains £70; currently registered users will get the upgrade free. Contact Altor on 041-226 4211, First Software on (0256) 463344, P&P on (0706) 217744, or Softsel on 01-568 8866.

• Quickbasic 2.0 is a cleaned up, debugged and enhanced version of Microsoft's Basic compiler for MS-DOS computers. You can use it to compile and therefore speed up your existing Basica or GWBasic programs, or you can type new code directly into Quickbasic's multi-windowed full-screen editor. New features include EGA support. Quickbasic 2.0 costs £85 from Microsoft on (0734) 500741.

• Interchange HS lets you transfer any kind of MS-DOS file from a 5.25in. IBM-compatible machine to one with 3.5in. discs. For £95 you get software to run on both machines plus a cable which links their RS-232 ports. Contact Belmondo Research on (0272) 276143.

• A utility called 1-dir gives MS-DOS a more friendly front end, replacing the bald DOS prompt with a command screen that shows a directory along with statistics on disc and memory usage. It costs £59 from Qubie on 01-871 2855.

Pertmaster's baby brother.

Bargain basement software

CHEAP software continues to come on to the market, prompted by the arrival of the Amstrad PC-1512. Most of it is existing software that has been repackaged for the low-end market, but in some cases features have been altered. The programs will also run on other cheap IBM clones.

Personal Cardbox Plus is a simplified version of the well-known database. It costs £150, while the standard IBM PC product, which now has some additional features, remains at £300. For information contact Business Simulations on (0892) 86315.

Trustwriter is a WP program that resembles WordStar. It sells for £49.95 inclusive of VAT through Tandy's High Street retail stores. Tandy is introducing a range of low-cost software to go with its own 1000EX IBM compatible, which we review on page 42 of this issue. The excellent VP-Planner spreadsheet with database facilities costs £87.

Twin is another worthwhile 1-2-3 clone, this time with outstanding graphics. It is coming down in price to £99. Contact Future Management on (0908) 615274.

Vuman is bringing out a £49 version of its scientific word processor, Vuwriter. More information on 061-226 8311.

In Control is a new £49.50 project-management package from Abtex. It is simpler than the company's existing Pertmaster project manager, but you can move data files up into the more powerful package if necessary. Contact Abtex Software on (0274) 734838. PC

BEST PROGRAMS AND HARDWARE OF 1986

ONCE more *Practical Computing* has got together with an international group of leading micro magazines to elect the Software and Computer of the Year under the aegis of the German magazine *Chip*.

The system of choosing winners has changed slightly. Before, we had one vote apiece. This year we had 100 points to distribute as we wished in each of the categories. The final winners are shown in the table below.

One problem with this pan-global approach is that machines are launched at different times in different countries; in some they never appear at all. It is therefore quite difficult to make choices which are valid for all participating countries. For comparison *Practical Computing's* nominations are shown alongside the winners.

Our thanks to the publishers of *Chip* for organising this year's awards.

	WINNER	PC NOMINATION
Commercial software	Javelin, followed fairly closely by Paradox and Supercalc 4	Javelin, followed by Paradox
Technical-scientific software	Autocad the clear winner, followed by What's Best	Autocad and What's Best
Software tools	Turbo Pascal, with Turbo Prolog number 2 — both from Borland	Turbo Prolog
Personal computer	IBM PC/AT, with a host of more interesting machines bringing up the rear	Amstrad PCW-8256
Portable computer	Toshiba T-3100	Compaq Portable II
Hand-held computer	Toshiba 1100, closely followed by Zenith Z-171	Kaypro 2000

SHORTS

Amstrad has announced a turnover for 1985/86 of £304 million. This compares with £136 million for the same period last year. The profit on this year's turnover was £75 million, as against £20 million last year.

Telecom Gold claims to have 53,000 active members and to be expanding at 100 percent per annum.

Ansa Software, the author of Paradox, has announced revenues of over $1 million for both April and May of this year.

BETA, the Business Equipment Trade Association, has completed a survey to assess the size of its industry. It estimates that the U.K. turnover of the computer, DP, WP and comms industry is £7.77 billion, and that exports in this area are £2.2 billion.

Telecom Gold adds new-tech service

TELECOM GOLD has added another database to its portfolio of on-line services. Fintech Gold is an on-line version of the Fintech range of twice-monthly publications covering the business aspects of new technology. The six Fintech publications cover telecomm markets, the electronic office, personal-computer markets, the automated factory, software markets and updates on computer products.

In addition to the usual Telecom Gold costs, there is a charge of 80p per minute; for current Fintech subscribers the charge is 15p. More information can be obtained from Telecom Gold, 60-68 St. Thomas Street SE1 3QU. Telephone: 01-403 6777.

It is also now possible to send messages to Telecom Gold subscribers from Prestel. There will be a charge for this service, including evening use. There are no plans at present for a service from Telecom Gold to Prestel. Details from Prestel Headquarters, Telephone House, Temple Avenue, London EC4Y 0HL. Telephone: 01-822 1056.

Dial a floppy disc

THE Dial'n'File DF-23 stores up to 20 3.5in. floppies. It has a control at the front of the box which allows you to see each label and so select any disc in turn.

The DF-23 costs £11.95, discounted to £9.85 for orders of five or more. Details from Action Computer Supplies, Abercorn Trading Estate, Manor Farm Road, Wembley, Middlesex HA0 1WL. Telephone: (0800) 333333.

Magazine index

FIND-IT is a computerised index of computing magazines that is being published on IBM-format discs. It is being issued monthly at £20 per disc. A year's quarterly subscription costs £60, and 12 monthly subscriptions cost £120.

Information is indexed by name of product, name of manufacturer and by topic. Six publications are covered, including *Practical Computing, PC User* and *Which Computer?* More details from Orkney Computing, 60 Albert Street, Kirkwall, Orkney KW15 1HQ. Telephone: (0856) 86268.

Addresses on CD

SOMEONE has found another use for the CD-ROM at last. The Post Office has brought out a system based around hardware from Hitachi which compresses all 23.5 million private and business addresses in the U.K. on to a single disc.

The Post Office claims that any U.K. address can be found from partial information in less than two seconds. Apart from internal use, other applications could include validation of credit cards.

For external purposes the Post Office is selling the disc for £2,500. The Hitachi drive costs £945 for either a stand-alone or built-in model. For further information contact Anne Wine, Room 380, Post Office Headquarters, 33 Grosvenor Place, London SW1X 1PX. Telephone: 01-245 7951.

Pirate in court case

A SOFTWARE PIRATE has been charged with offences under the 1981 Forgery Act. The case was brought against an accountant accused of copying accounting software from Pegasus. He admitted to four offences relating to the unauthorised use of floppy discs. He was bound over for a year and ordered to pay £250 costs.

The Key Tronic KB 5151: A Superior Keyboard For The IBM* PC or XT.*

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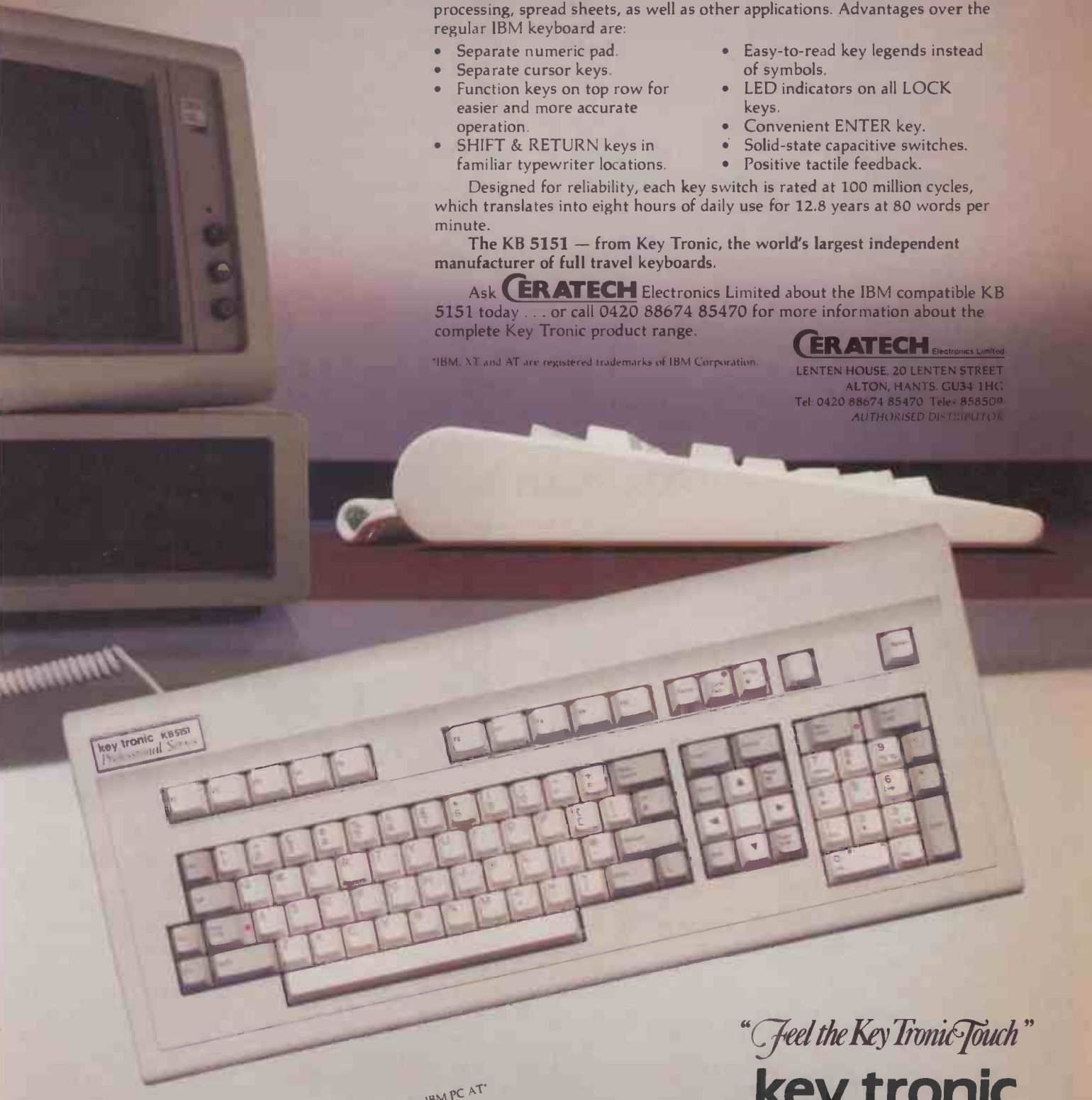

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BY MIKE LEWIS

FITTING WORDS

Having your text on file means you can manipulate it in a number of useful ways.

Even people who use word processing a lot sometimes lose sight of some of its benefits. After all, the goal is usually to get words on to paper; holding them on disc is merely a step towards that end. Yet once you have your text nicely set up in a file, it is a pity not to put it to work in other ways.

An obvious example of this is word counting. Anybody who submits copy for publication needs to know how many words it contains. Editors use word counts to help work out how much space the printed text will occupy. Authors count words because this is often the basis on which they are paid. But counting words by hand is laborious and prone to errors.

COUNTING PROGRAMS

However, once the text is on disc, it is an easy matter for a program to do the counting. There are plenty of programs available for this, many of them in the public domain. If you cannot find one, it is not too difficult to write one in Basic. You will find an example of a word-counting program on page 31 of the August 1985 issue of *Practical Computing*.

However, defining what constitutes a word can be tricky. I usually consider a word to be any string of characters made up entirely of letters, digits, hyphens and apostrophes. This definition is adequate but not ideal. It means that a phone number in the form 123-4567 is counted as one word, while a date, such as 31/12/86, counts as three. But this is no worse than the variations that often arise when words are counted by people rather than by machine.

Of course, word counts are not always an end in themselves. Once an editor has determined the number of words in the copy, he or she must still go through a lengthy process to work out the physical size of the text on the final printed page. This process is called copy fitting, and most people who are called upon to do it find it a tedious business.

Writing a program for copy fitting is harder to do than writing a program for word counting because there are extra factors to take into account. As well as the size of the text you have to think of the size of the characters, in terms of both their height and their width. Height is measured in points. There are about 72 points per inch and on this basis one point is 0.35278mm. Roughly speaking, the point size of a piece of text is the physical height of its characters, including ascenders and descenders — that is from the bottom of a *y* to the top of a *d* set in the same line.

LEADING

When type was set in metal, printers used to increase the spacing between lines by inserting strips of lead between the type. The term "leading" has been retained as measure of the spacing between lines, and it too is expressed in points. The total vertical space occupied by a line of text is its point size plus its leading.

Measuring type horizontally is not so simple. Different characters have different widths, although you can usually get away with applying an average. Unfortunately, this average is not directly related to point size. Thus, a capital E in Times New Roman is 20 percent wider than the same letter in the same point size of Helvetica Medium. Other letters in these two typefaces vary by different amounts.

CHARACTER WIDTHS

You can overcome this problem by using a look-up table showing the average character width for a given combination of typeface and point size. Such tables are easy to come by; many printers and typesetting firms publish them for their own range of typefaces.

Given the typeface, point size and leading, you can copy fit a text file. Two other parameters are useful: the extra leading, if any, between paragraphs, and the amount by which the first line of each paragraph is indented. The program would be too long to print here, but if you want to write one yourself, the information in the box on the following page should start you off. Bear in mind that the results will not be exact; they cannot, for example, take account of different systems of hyphenation.

There are plenty of other ways of using text files. For example, there are a number of programs on the market which claim to analyse your writing, looking for weaknesses in style and grammar. They can flag redundant words, like "why" in "reason why", or "of" in "all of this", and they can highlight instances of the same word being used many times in one sentence.

I have never tried any of these programs, so I cannot say how useful they are. But in *The Word Processing Book* Peter McWilliams describes how he used one, called Grammatick, on some of his writing. He expected to pick up

(continued on next page)

SYLLABLE COUNTER

```
1000    DEF FNISVOWEL(J$) = INSTR("AEIOUY",J$)>0
                          'Function to test a letter; returns true if it
                           is a vowel


2000    'Subroutine to count the syllables in a word. The word is held
         in WORD$, which is assumed to be in caps, with no punctuation or
         digits. Result is returned in COUNT%.

2010    TEMP$="X"+WORD$                          'Put extra consonant in front of word
2020    IF RIGHT$(TEMP$,1)="E" THEN
              TEMP$=LEFT$(TEMP$,LEN(TEMP$)-1)
                                                 'If there is a final E, remove it
2030    COUNT%=0                                 'Initialise the count
2040    FOR I%=1 TO LEN(TEMP$)-1:
              THIS$=MID$(TEMP$,I%,1):
              NXT$=MID$(TEMP$,I%+1,1)  'Extract each letter in turn, and
                                        the one following it
2050          IF (NOT FNISVOWEL(THIS$)) AND FNISVOWEL(NXT$) THEN
                    COUNT%=COUNT%+1
                                                 'If it is a consonant followed by a
                                                  vowel, count it
2060    NEXT I%
2070    RETURN
```

(continued from previous page)

one or two mistakes; the actual results he describes as "vicious." *The Word Processing Book* is published by Dorling Kindersley at £5.95.

A less exacting way of analysing your prose is to use a readability scorer. This is based on a technique sometimes used by newspaper and magazine editors. You start by going through the text, counting the words, the sentences, and the long words — that is any word of three or more syllables. You then calculate the average number of words per sentence; then the number of long words as a percentage of the total number of words. You add these two figures together, multiply by 0.4, and add 5.

The result is the readability score, which is expressed as a reading age. The lower the score, the easier it will be to read the text. Popular newspapers have a reading age betwen 12 and 14, while learned journals often exceed 20. Most of the articles in *Practical Computing* are between 15 and 18.

If you want to write a readability scoring program there are a few points to bear in mind. Semicolons should be treated as full stops. Hyphenated words should be considered as two distinct words. Short numbers ought ideally to be spelled out in full, while long ones should be disregarded. This last rule will be tricky to program.

You will also need an algorithm for counting the syllables in a word. The listing on the previous page shows one method of doing this. It produces correct results in 95 percent of cases and the remaining discrepancies tend to cancel each other out.

When writing a program that manipulates a text file it is worth remembering that different word processors store text in different ways. With WordStar, you will have to watch out for high-order bits in certain characters — the example word counter mentioned previously shows how to deal with them. Other systems present problems of their own. Inevitably, very little is published on this, so you will just have to work things out for yourself. PC

HOW TO WRITE A COPY-FITTING PROGRAM

A program that copy fits a text file would need the following parameters:

P — point size
L — extra leading between lines, in points
G — extra leading between paragraphs, in points
C — width of a column of the text, in millimetres
I — amount by which the first line of a paragraph is indented, in millimetres
W — average width, in millimetres, of a character for the typeface and point size, obtained from a look-up table.

The program must scan the text file, obtaining the following figures:

T — number of printable characters
R — number of paragraphs.

At this stage, the program must ignore line endings and disregard control characters used by the word processor. These include extra spaces which the word processor might insert in the text to make the right margin even. The count of printable characters should include one space between each pair of words.

The program can then apply the following formulae. The number of characters per line, A, is given by:

$$A = C/W$$

The number of characters in the text, T, is adjusted to reflect paragraph indentation, giving:

$$J = T + (R \times I/W)$$

The number of lines, K, is basically the adjusted character count divided by the number of characters per line. To this is added half the number of paragraphs, on the assumption that on average half a line is wasted at the end of each paragraph.

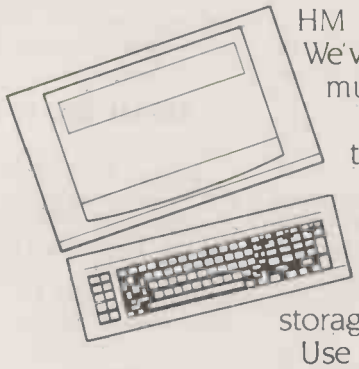
$$K = (J/A) + (0.5 \times R)$$

The total point size of the text is then:

$$K \times (P + L) + (R \times G)$$

This can be converted to column-millimetres by multiplying by 0.35278.

Minstrel PC networks. The alternative to not-quite-works.



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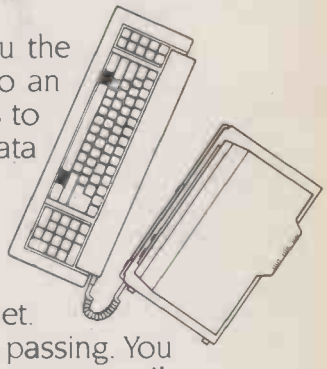

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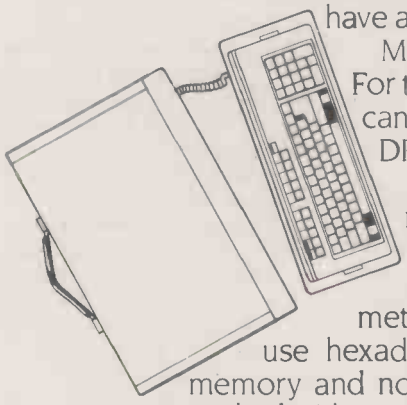
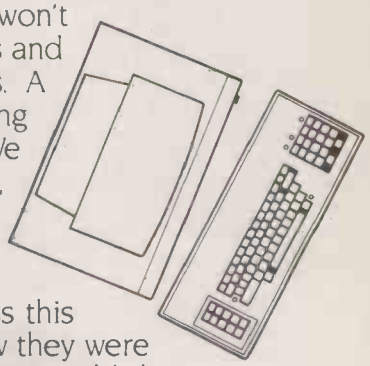
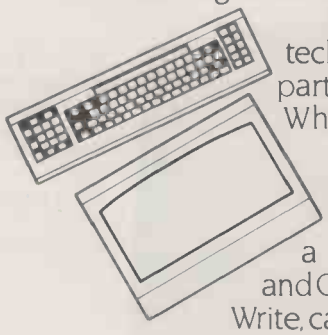


Minstrel PC Network cards use ARCnet. For the technical, that's 2.5 MBit/Sec, token passing. You can network PCs in a star or ring or tree, using Novell, DR–Net, TurboDOS/PC and other leading systems.

The clever part is that you won't need to make software changes and you can use standard drivers. A unique RAM buffer accessing method improves performance. We use hexadecimal rotary switches for I/O, memory and node number settings. The card is supplied with timer IC and a socket for a PROM, allowing for diskless workstations.



But nobody needs a PhD to access this technology. Most users would not know they were part of a sophisticated network unless you told them. Which is the way it should be.



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BY BEN KNOX

HOTLINE

British Telecom has launched a new on-line service specialising in business information.

British Telecom's Value-Added Systems and Services division has launched a new on-line business information service called Hotline. According to BT the service covers all aspects of the business world, from company and market information to key business news.

Hotline covers European markets and companies in particular detail. This area has been rather neglected by the U.S. information services, which up until now have had the market for on-line information more or less to themselves.

To gain access to the Hotline service you need to purchase a subscription. A single-user ID and password costs £1,000. This includes 10 hours of search time at £60 per hour. However, a number of the databases which you can search cost more than £60 per hour, so if you use them, you will get less than 10 hours search time for your fee.

Organisations requiring more than one ID can purchase in bulk. Three IDs cost £3,000, including 40 hours of search time.

A software package for IBM compatibles or Apricot micros is also included in the price of the subscription. It will handle automatically all the calling and logging on to Hotline as long as you have a Hayes-compatible modem.

Once you are on-line you have access to 19 databases which cover news, company and market information, plus telecommunications and information technology. Wall Street Journal covers finance, company, economic and other business news. Information is updated on a daily basis within 72 hours of publication. Marketing Week covers the latest events in the marketing and media world. The Daily Telegraph contains articles from the newspaper's business section. China Express covers business developments in China, including a comprehensive listing of trade fairs and exhibitions plus details of opportunities for trade in China.

Inter Company Comparisons is a comprehensive source of British company information, containing details of some 1.8 million companies. Gas: Company Risk Monitor is a daily service which tracks the strategic developments of more than 100 top international companies and analyses the impact of economic and politcal change on their operations.

Euromonitor On-line comprises three separate databases. Eurofacts contains comparative statistics on 16 countries, Eurofile is a database for marketing and strategic planning, and Market Direction offers over 300 reports on French, Italian, West German and U.K. consumer markets. China Express Contracts is a companion to China Express, containing a list of project opportunities in China. Peat Marwick Grants is a guide to finance for new projects in the U.K. Saatchi & Saatchi Media Facts gives details of major media developments and trends. Gas: Country Risk Analysis, Statistics and Rating Monitor, and Daily Risk Monitor are three databases which look at the economic effects of news events throughout the world.

INTERNATIONAL

Cambridge Database was created by British Telecom and provides information and news on international trends in the telecomms and information-technology fields. Inspec covers the technical aspects of information technology, software, computers, electronics, electrical engineering and physics. Cable & Satellite provides the text from the monthly magazine *Cable and Satellite Europe*.

Perhaps the most revolutionary feature of Hotline is the way it uses windows to present information. When you log on to the service you are asked whether you want to use the Linefeed version or the window version. If you choose the former, the database works in the same way that most other text-based systems do: text is written at the bottom of the screen, and as more lines of text are received, those written earliest scrool off the top of the screen.

The window feature makes the display much clearer and very easy to follow. The screen is split into three windows. The bottom window is two lines deep and is the command window, where you enter commands to carry out your searches. The command window also contains a small box which tells you which database you are currently working in. The next window up is the history window, which contains details of your previous five searches. Finally, in the top window, the help menu is displayed when requested.

The search commands are based on natural language and are fairly straightforward. For example, to search for all occurrences of the word "modem" in a database, you simply enter

FIND MODEM

or

F MODEM

for short.

You can combine searches using the information in the history window. If the first search you did was for "modem", the history window would tell you

S=1 <317> FIND MODEM

The number tells you how many articles in the database contain the word you have searched for.

To search for items which also contain "IBM" you enter

FIND S=1 AND IBM

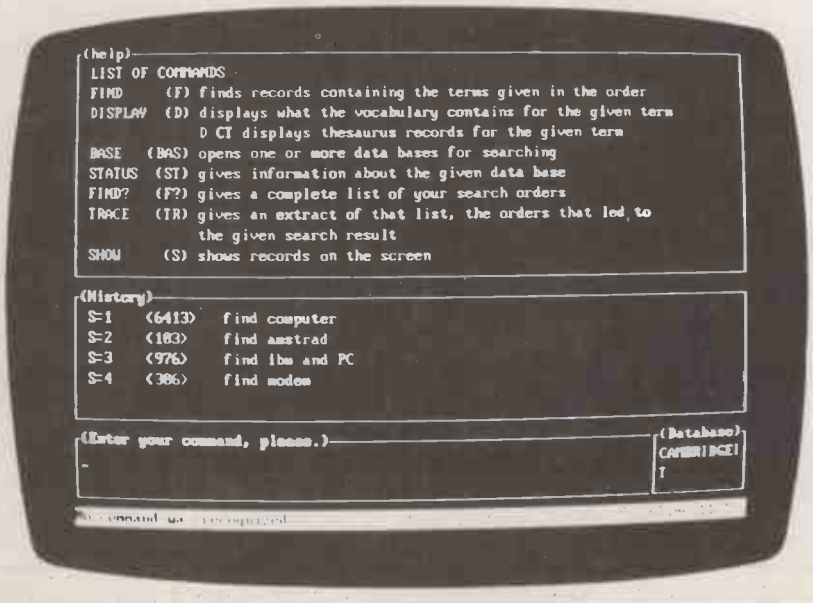
Once you have whittled your search down to a manageable number of articles, you use the Show command to display the full text. The search language is very simple to use, and BT claims that it will only take five to 10 minutes for a typical user to learn.

Other features enable you to jump from database to database using just one command, to focus in on the paragraph in an article which contains the search word, to save your searches until you next log on and to search for publication dates.

SMALL BUSINESS

It is difficult to see who Hotline is aimed at. At first sight it seems that it could be invaluable to small business users. But I doubt whether many small businesses could afford the extremely high subscription charge. I know of no other database which demands that the user pays in advance for searching time.

As a public database service Hotline does not offer a particularly large number of databases, although it does link into the Dow Jones News/Retrieval service in the U.S. Dialog and Newsnet, two of the main U.S. systems, both offer hundreds more files, and many for less than the £60-plus per hour charged by Hotline. But Hotline is a new system and in time it may well expand to a more useful size. The system will be linked into Telecom Gold and possibly Prestel in the future. For further information contact Hotline, Wellington House, Upper St. Martin's Lane, London WC2H 9DL. Tel: 01-379 7709.



Help and History windows separated from the command sequence make Hotline especially easy to use. The name of the current database is also displayed.

New The Tandy 102

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For years now the Tandy 100 portable computer has been dragging terrified writers and travelling executives kicking and screaming into the computer age. Here was a computer for those people who thought they couldn't use and didn't need one. Even hardened note-pad scribblers found the injection of technology a painless step forward

Now, for the enlightened believers out there who've come this far with us, there's more good news. Those people who once thought that a well-sharpened HB was the pinnacle of office automation started to complain that they wanted a built-in modem in their portables (well, it was such a chore having a separate box cluttering up the desk....). So much for being blinded by science.

So it was back to the drawing board in the land of the rising sun. In typical Japanese fashion they ended up giving us even more than we asked for. Whilst building in our extra features they managed at the same time to reduce the size of the 102, thus proving that the maxim that small is beautiful still rings true in Japan.

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Each modem is thoroughly tested, then switched on and off continuously for at least eight hours before it leaves the factory.

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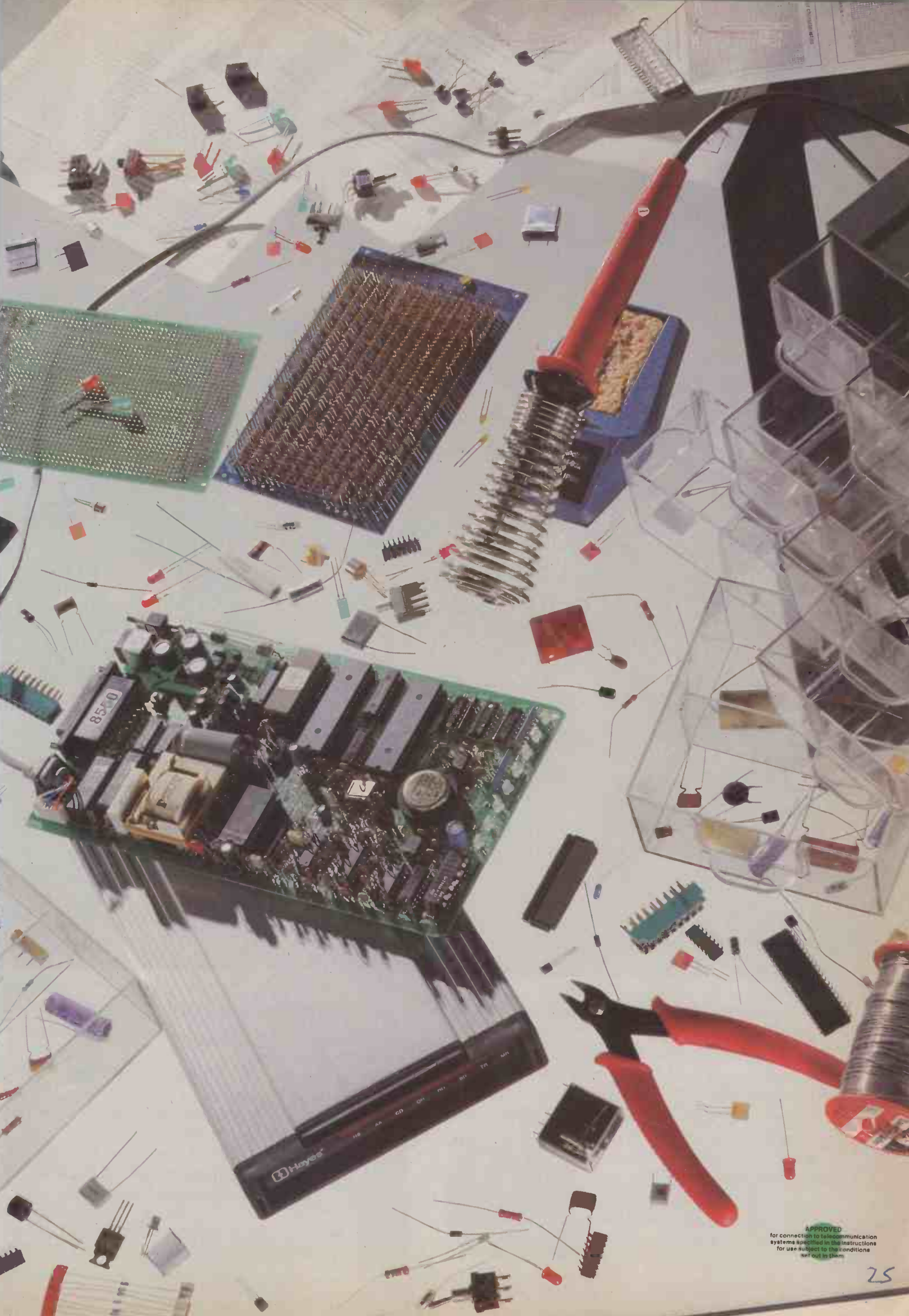

APPROVED
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While other computers are still
starters orders, you're off and ru

The Amstrad 6128 has a built-in advantage over most other home computers.

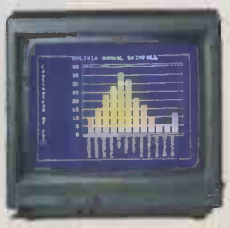
Its fast loading disc drive unit.

An ordinary cassette driven computer can take as long as 15 minutes to load.

Whereas the 6128's built-in disc drive will load the same programme in seconds.

Which means you don't waste valuable playing time loading.

And it also means you can quickly get into more sophisticated programmes, using more of the 6128's big 128K memory.



Loads more business programmes

There are hundreds of games to play on the 6128, but it also has its serious side.

It can handle spreadsheets, database and account management programmes.

It can file and index, produce standard letters and compile reports.

And it will even keep track of rates, mortgage and H.P. payments for you if you want it to.

The 6128 comes complete with green screen or full colour monitor, as well as keyboard with

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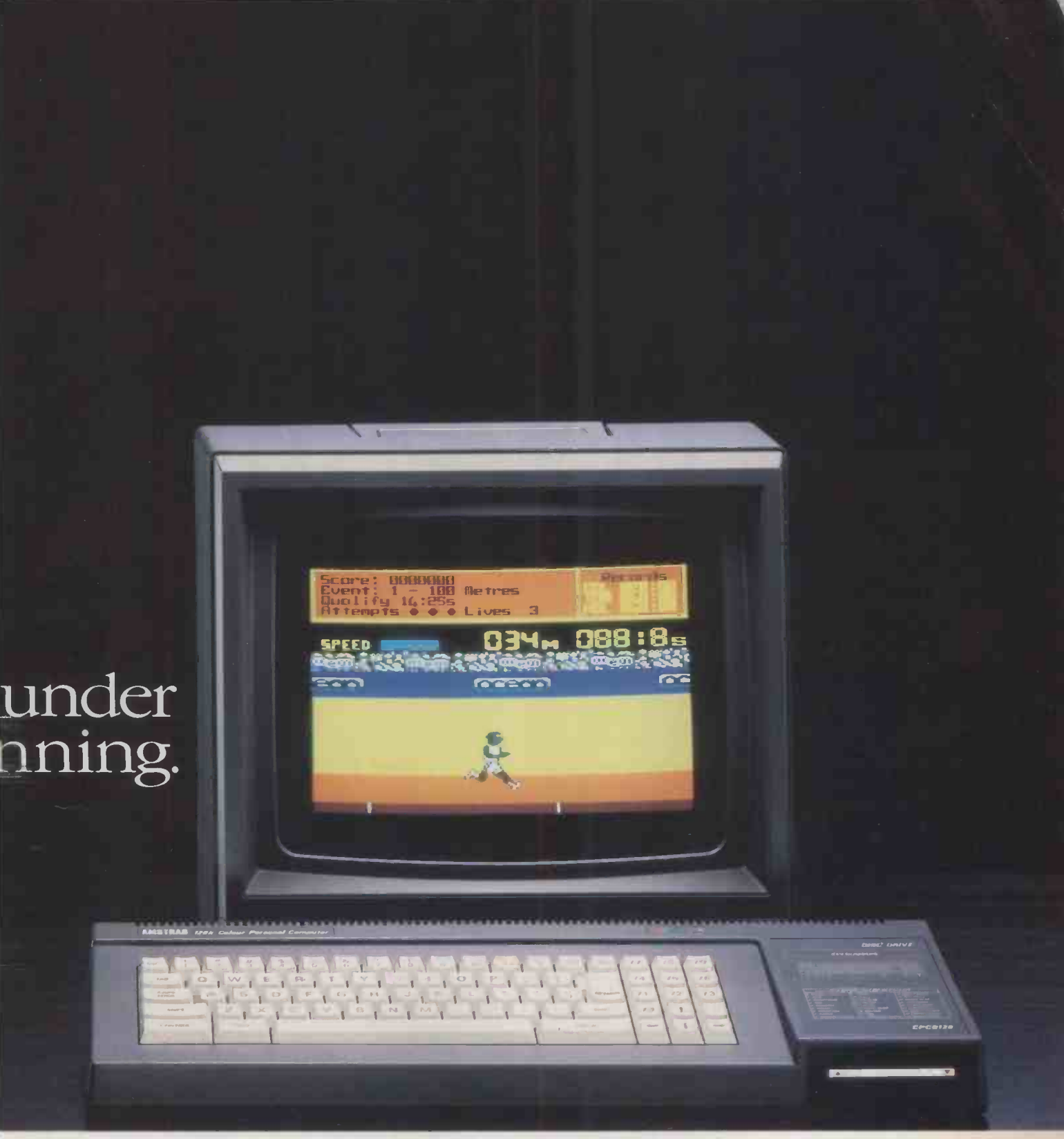

under
nning.

built-in disc drive.

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BY RAY COLES

LEGLESS CHIPS

The mass-production costs of microelectronic equipment are due to take another tumble thanks to a new type of component package.

Contrary to what the headline might suggest, this article is not a description of a trip home from the pub on a Saturday night. In fact legless chips — or more properly leadless chips — are part of a fundamental change in semiconductor packaging which is revolutionising the manufacture of electronic equipment. The revolution is at least as important as that which saw the demise of the wired metal chassis in favour of the copper-clad printed-circuit board in the 1950s, and it is taking place for very similar reasons.

The introduction of printed-circuit boards deskilled the whole manufacturing process. It allowed complex systems to be mass produced — generally in Japan and Hong Kong — at such low prices that even unemployed British wireless builders could afford them. That's progress, of course, and there is another dollop heading our way thanks to the introduction of leadless chips.

The trouble with printed-circuit boards is the plethora of holes that are necessary to accommodate the little legs of resistors, capacitors, transistors and integrated circuits. During assembly, the board is clamped in a frame, and with help from a pre-programmed light beam and a rotating component dispenser the PCB operative stuffs the components into the appropriate holes. The frame is then inverted with the components held in position, and all the legs are cut to a uniform size. Finally the board is passed on to a flow-solder machine which makes all the soldered joints at one go.

ROBOT INSERTERS

This process works fairly well, but despite all the assistance the poor old human is still apt to make mistakes, especially on Monday mornings and Friday afternoons. Robots do the job faster and with fewer mistakes, so any circuit board that is required in quantities of more than a few thousand per year is made with the help of an automatic component insertion machine. Resistors and capacitors are loaded into the machines on bandoliers like machine-gun bullets; integrated circuits are loaded in tubes like Sten-gun magazines. At the touch of a button the whole contrivance whirrs into action, putting hundreds of Japanese assembly operatives out of work.

Unfortunately, the pretty multi-coloured components with their funny shapes and bendy legs are a robot designer's nightmare. To cope with their variety and variability, a fiendishly complex and expensive machine is needed. But even the best machine still manages to get its bandoliers in a twist when a fickle IC leg fails to engage its appointed hole in the intended manner. It is small consolation to know that robots make mistakes, just like the rest of us.

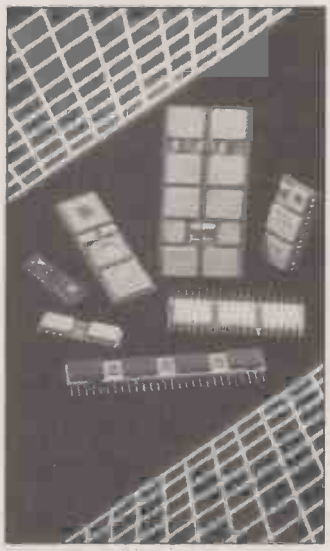
To get these expensive machines to work reliably it is also necessary to design the circuit board layout very carefully. This usually means wasting space, and adapting them to work on new circuit boards with different quantities and positions of components can be something of a nightmare.

UNIFORM SHAPE

But in their endless quest for world domination, the robot designers were not going to stand idly by while humans sniggered at their immortal creations. As a result they have prevailed upon the electronic components industry to design a completely new packaging system which robots can handle with ease. There are no pretty colours, no bendy legs, and the components have a uniformity of size and shape which would bring tears to the eyes of a sergeant major.

The generic title for the new components is surface mounted devices, or SMDs for short. Resistors, capacitors, transistors, diodes and all integrated circuits are now becoming available in this format. Robots love them. They do not need bandoliers or Sten-gun magazines; you could load them with a shovel if they were not so expensive. Best of all, with no legs, leads or pins to go astray, they do not need circuit boards with holes in them.

All SMD components look like tombstones with connections made via pads around their periphery. Any robot worth its oil can quickly orientate and position any one of them on to the surface of a PCB which has been pre-printed with a solder paste. When all the components have been positioned the whole assembly is heated until the solder flows, and the job is done.



EDI's leadless modules are pin-compatible with ordinary chips

The robot required is potentially cheaper, and the job of reprogramming it is much simpler, so how boards manufactured in quantities of just a few hundred can be made this way. You do not even have to be a mainstream PC manufacturer to appreciate the benefits of SMDs. Quite apart from their suitability for robot assembly, they offer performance advantages which make them attractive in their own right.

With the cost of labour less important the U.K. could be back in business in a big way. The snag is that we have already lost our chip production capability. As Alan Sugar reminds us, it is still not cost effective to manufacture here because we have to pay duty on all the chips we import.

HIGH TOLERANCE

The ceramic leadless chip carrier (LCC) is still the most popular surface mounting package for ICs. It was first used by the designers of military equipment because of its high tolerance of extremes of temperature, shock and vibration, and because of its very small size compared with a conventional dual in-line (DIL) package. Today almost all logic, memory and microprocessor devices are available in this package style. Prices are higher than for the DIL equivalent, which is why most PCs do not use them yet, but they are already falling fast. Cheaper plastic versions of the LCC are now available, so the position will change rapidly over the next few years.

One interesting use of the LCC package is in the manufacture of very dense memory and microprocessor modules such as those produced by Electronic Designs Inc. (EDI). The memory modules are produced so that they are physically and electrically compatible with today's DIL memory packages. The difference is that they provide much more memory than is available with the current generation of monolithic devices. They do this by using several LCC packages mounted on a co-fired ceramic substrate which also provides the necessary interconnections.

The EDH-8832C, for example, is a 28-pin DIL RAM module. It is pin-compatible with the 1Mbit CMOS static RAM devices which will one day be available as monolithic chips. The substrate carries four 32K × 8 RAM chips in LCC packages, together with a separate address decoding chip and an SMD decoupling capaciror.

It is just the thing when space is at premium, or when designers want to test and evaluate a system before the required monolithic devices are available. Similar modules are available with a mixture of static RAM and EPROM. You can also get groups of 256K dynamic RAM chips in LCC packages mounted on single-in-line substrates for ultra-high-density memory systems.

Perhaps the neatest example of how the combination of LCC-packaged parts and co-fired ceramic substrates can revolutionise system design is the amazing 80C86 module from EDI. This jumbo-sized DIL package carries a complete CMOS 8086 subsystem, including processor, floating-point maths unit, interrupt controller, communications chips, decode logic, RAM and EPROM — a total of more than 20 LCC packages in all. It can replace a conventional circuit board more than 10 times its own size.

At the moment this module is produced primarily for military applications, so the price is high. Yet in principle the same LCC components could be mounted directly on to a printed-circuit board for everday applications. This would still give you all the LCC's advantages of lower assembly costs and greatly reduced size compared with an equivalent that uses DIL packages. PC

Q When first I fitted a hard disc to my PC I was delighted with the performance as disc accesses were about 10 times faster from the hard disc than from floppies. Now my hard disc seems slow, and disc access from floppies is faster than from the hard disc. The hard disc has 10Mbyte capacity and is about one-quarter to one-third full, with about 200 files. Can the disc wear out, or does it need servicing?

K ANDREWS

A Hard discs do not wear out and go slowly like old motor cars, and no routine servicing is required. The factor that affects disc performance more than anything else is the number of file entries in a single directory or sub-directory.

It sounds as if you have used the hard disc as a very large floppy and have not created any sub-directories. Thus you have stored 200 files in the root directory. If this is so, then the reason for the loss of performance is that you have too many files in a single directory.

When a directory grows too large to fit into the cache — that part of memory reserved by DOS to hold the directory — then searching for a file takes quite a long time. This is because the cache is examined, then the disc is read and the cache contents are replaced by more of the directory, which is then examined . . . and so on.

A quick solution is to increase the size of the cache by changing the setting of the Buffers parameter. A buffer is simply an area of memory that holds data when you are writing to or reading from a disc. Normally on a twin-floppy machine the buffers are set by a statement in the Config.Sys file such as

BUFFERS=2

Hard-disc systems often have Buffers set to 3.

Each buffer can hold 16 directory entries, so with Buffers set to 15 the cache will hold up to 240 entries in the directory, which should cover your present position. The maximum value of Buffers is 99, which would hold 1,584 directory entries.

Increasing the size of the cache only provides a partial solution to the problem since MS-DOS uses a sequential search. Even with large buffers it takes a long time to read through a very long list of file names. Remember also that MS-DOS needs buffers for other purposes, such as opening and reading files. Certain programs like Basica and databases that use random read and write are speeded up enormously by increasing Buffers to 10 or even 20. Plainly if you use all the buffer space for the directory you will degrade the speed of other functions.

A much better solution is to split your file store into a number of sub-directories, and to try and limit the number of entries in each to 100, or at the most to 150. Once you have created a very large directory or sub-directory it will not go away even if you delete some of the files. The only way to get rid of it is to create several new sub-directories, copy the files from the large directory and distribute them into several of the new sub-directories, and finally delete the large directory altogether.

If you have produced an oversized root directory the only way out of it is to back up all the files you want to keep on to floppy discs or a tape streamer, and reformat the whole of the hard disc. You can then create several sub-directories and copy the files back from floppies into various sub-directories on the hard disc.

In the end, it is all a matter of good housekeeping. It is a great pity that this is not explained in the introductory pages of computer manuals.

FILE TRANSFER TO MS-DOS

Q I own an Osborne 1 with two single-sided double-density 40-track disc drives, running under CP/M 2.2. Recently I purchased an Osborne PC IBM compatible which has two double-sided double-density 40-track drives running under MS-DOS 2.11. I would like to use copies of the various command files, databases and format files from the Osborne 1 and boilerplate text from the old discs on the new machine with the corresponding IBM versions of WordStar and dBase II.

How can I copy these files from my CP/M-discs on to new discs in a format that will be compatible with the new machine and MS-DOS. I have seen firms advertising this service. Is there a utility program that will allow me to do it myself at home?

TREVOR MITCHELL

A There are several ways you could tackle this problem. First, you could obtain Kermit for both machines, and this would allow you to transfer files in either direction simply by wiring the serial ports on both machines together. Read the two articles in *Practical Computing* in the May and June 1986 issues for some details of what Kermit aims to do, where you can get it and how you use it. If you go for this solution, you can almost certainly get the CP/M version of Kermit from the Osborne Users library. Write to Mike Bruce, 8 Sole Farm Avenue, Great Bookham, Leatherhead, Surrey KT23 3DE.

Alternatively you could try one of the commercially available utilities running on PC compatibles that can read data from a wide variety of foreign formats from one disc drive and write it in IBM format on the other disc drive. Plainly the process can work in the other direction as well. One that I have used in called Mediamaster. It is simple to use, and is available from Control Alt Deli, 44 Brownbaker Court, Milton Keynes MK14 6JH; telephone (0908) 662759. The Mediamaster program will read over 60 different formats.

There are a number of firms that will copy a disc from one format to another. For example, Grey Matter can copy to and from over 400 disc formats for £10 per disc plus the cost of a new disc. Grey Matter is at 4 Prigg Meadow, Ashburton, Devon TQ13 7DF; telephone (0364) 53499.

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Q I need to be able to read and possibly write to hard-sectored 5.25in. floppy discs. I feel sure that this is possible with an industry-standard drive, as externally the hard-sectored and soft-sectored floppies look the same. I doubt if the WD-1793 disc-controller chip in my TRS-80 controller could decode the data. I wonder if there is a software solution to the problem, or whether there is any special controller chip designed for hard-sectored discs.

S P JARMAN

A Floppy discs for machines like the IBM PC, Apple, BBC Micro and so on are soft sectored. They contain information stored on concentric tracks, usually 35 or 40 but sometimes 80 tracks on one side of a disc. Near the centre of the disc is a small timing hole, which is used to detect the beginning of each track. Each track of information is divided into a number of sectors, and to read or write data to a disc both the track and the sector on that track must be specified. A stepper motor moves the read/write head to the correct track; the drive then looks for the timing hole, and software reads each sector until the specified sector is reached.

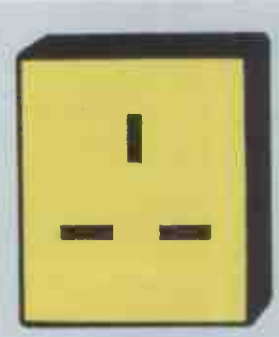
A number of machines use hard-sectored floppy discs. For example, the North Star uses hard-sectored discs with 10 sectors per disc. They are the same size as the IBM discs, but in addition to the timing hole near the centre there are 10 smaller holes equally spaced which indicate where each sector begins.

In general machines are designed to use either soft-sectored floppy discs or one particular arrangement of hard sectoring, not both.

If you can get access to a machine that can read your hard-sectored discs you could then transfer the data to your favourite machine by mounting Kermit or some other communications program on both machines and transferring the files from one machine to another. Commercially available transfer programs such as Moveit, BStam or Ascom do the same thing. Kermit is available free. We described it fully in two articles in the May and June issues of *Practical Computing*.

If you cannot get access to a machine that can read the disc, you could try a firm like Grey Matter, which claims to be able to read over 400 disc formats and write a new disc in some other format. Grey Matter charges £10 plus the cost of a disc for doing this, and can be contacted at 4 Prigg Meadow, Ashburton, Devon TQ13 7DF; telephone (0364) 53499. PC

In "Ask PC" **John and Timothy Lee** answer questions on any area of microcomputing. If you have a nagging problem, write to us, marking ASK PC clearly on the top left-hand corner of the envelope. Letters should contain one question only. We cannot guarantee a personal reply, but to be considered your letter must include your name and address, together with a stamped addressed envelope. The most representative questions of general interest will be answered and published.



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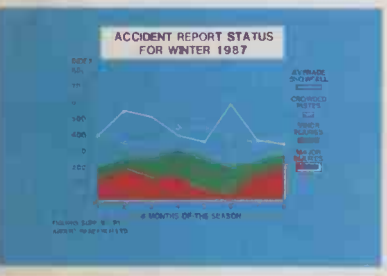
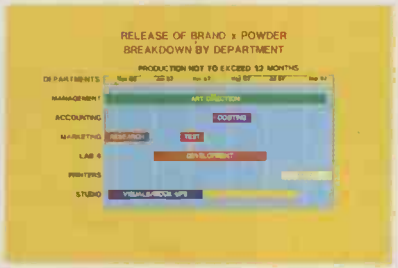
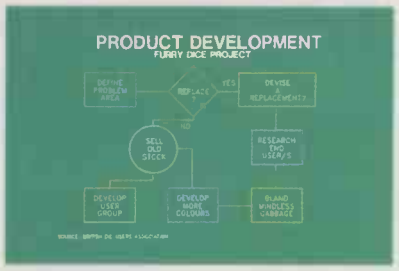
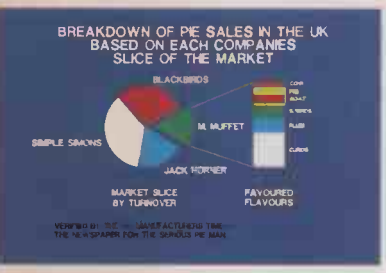
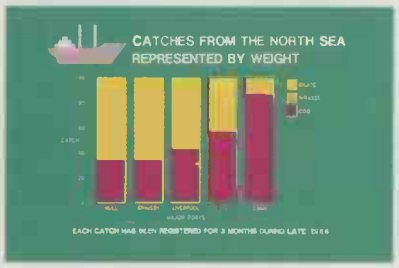
GRAPHWRITER, FREELANCE, OR BOTH?

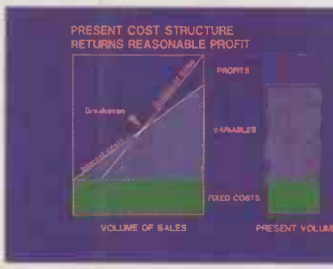


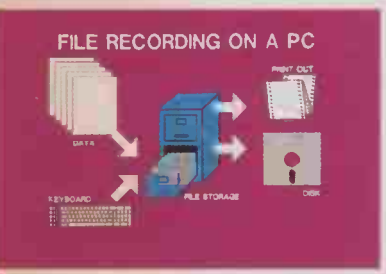


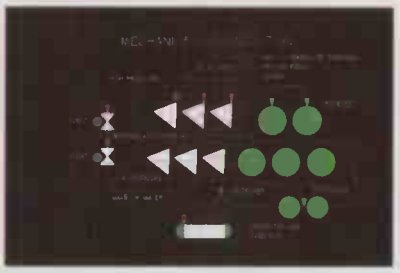


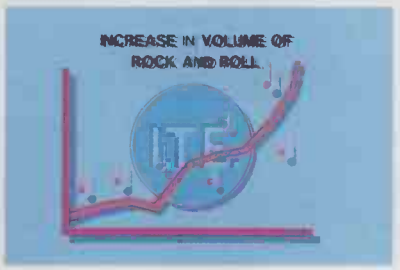












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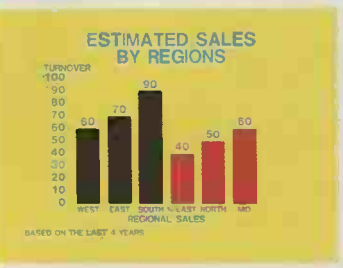

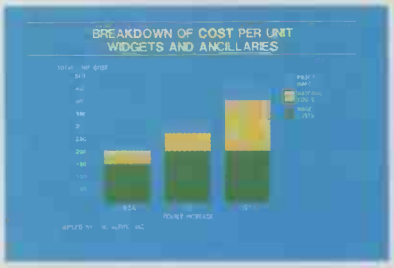

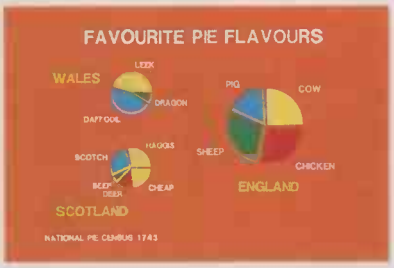

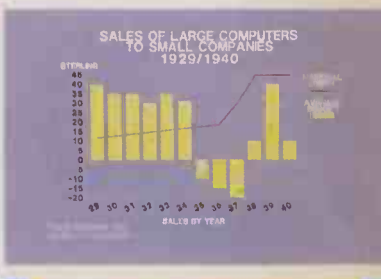

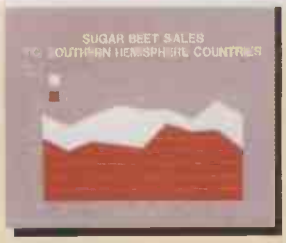

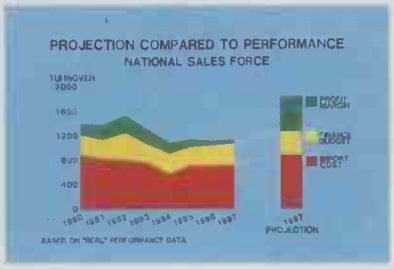

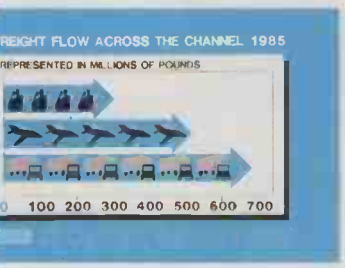

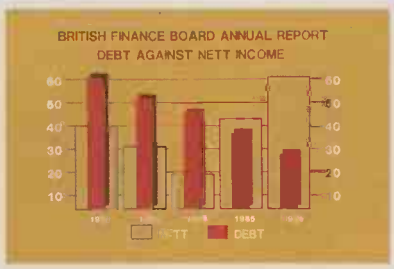

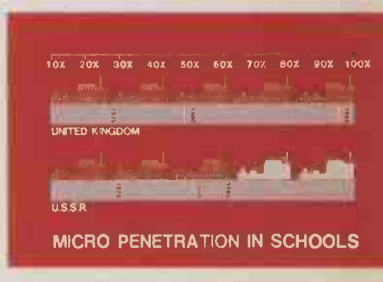

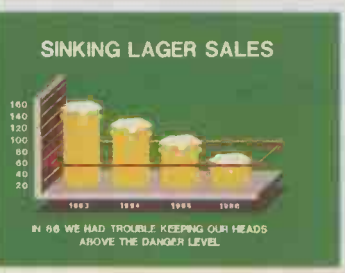

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Like our XT-compatible, it is full-featured and fully expandable. Serial and parallel ports and battery-backed clock calendar are standard, as are the high-performance 80286 CPU and fast 120ns RAM. The case will accommodate up to 5 half-height drives of various types and there are 8 expansion slots.

If you need outstanding performance at a reasonable price, this is the machine for you.

System shown with optional EGA monitor and optional Microsoft Mouse. Fascia on production version is somewhat different.

£999

If you are a "power user", forced to wait while your XT slowly grinds its way through a large spreadsheet or engineering calculation, this is the machine for you. The Bristol Micro 286 is an 80286-based computer, compatible with the IBM PC/AT, but running at 10 MHZ instead of the 6 MHZ and 8 MHZ of IBM's AT models. As a result, on the widely used Norton SI rating of system performance, the Micro 286 scores over 10, vs. the 1.00 score of the PC/XT.

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The Micro 286 offers exceptional perfc
mance and exceptional savings as the fi
server in a low-cost network. The system c
be configured with fast Seagate or Toshil
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as a turnkey system. This includes a Mic
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stations. This network can be as cheap as
multi-user system, has the same advantage
But instead of a terminal, each user has h
own computer, which can be expanded wi
hard drive, printer, etc.; and which is mo
reliable, since it can be run completely i
dependently of the Micro 286.
If a multi-user system breaks down, everyo
stops working. If a station in a netwo
breaks down, some people are inconvenien
ed. It's a world of difference.

Computer-aided design

CAD is another area where a high performance system is essential. The Micro 286 can be configured as an ideal CAD workstation, with high resolution colour graphics, a maths coprocessor, mouse, and high-speed hard disk drive — all for roughly the same price as an IBM PC/XT with 10-15% of the Micro 286's performance!

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ed. This permits large graphic images to be manipulated in memory, providing yet another big performance boost, if an appropriate operating system such as UNIX is used.

Unix

Recently, a full port of UNIX System V has

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Send your order to Bristol Micro Traders, Systems Group, Maggs House, 78 Queens Road, Bristol BS8 1QX.

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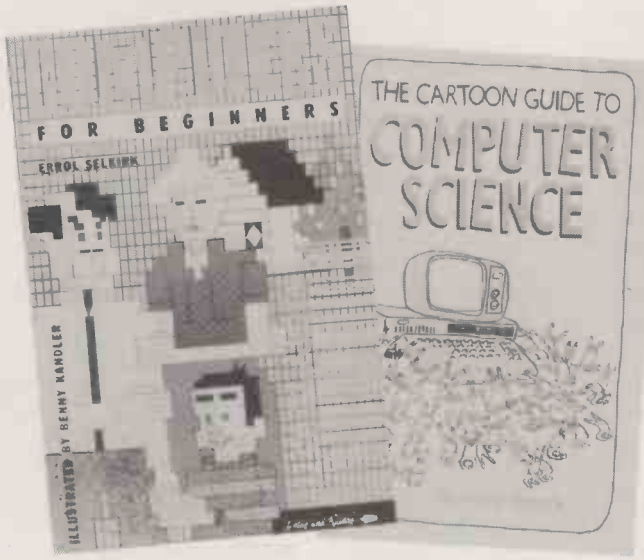
A NOVEL APPROACH

Glyn Moody digests some off-beat introductions to computing.



MOST of the books providing general introductions to micros have one thing in common: they are very dull. Now that the first flood of publications has subsided, a second generation is beginning to come though which offers more than the standard potboilers knocked out in a few weeks on a word processor. Some even credit the reader with critical faculties and provide reading with real intellectual fibre.

A case in point is *Computers for Beginners*. This forms part of the well-known series *Marx for Beginners, Einstein for Beginners* and so on. Apart from their clear political slant — for *Guardian* readers only — they are notable for their use of striking visual images, and the fact that they often wryly funny.

The first chapter sets the scene as well as the tone. It points out that the information processing offered by computers is not neutral: knowledge is power, and power always implies politics. Having got its social message off its chest, the book continues with a history of computers, starting with numbers. Along the way there are numerous interesting facts which will doubtless stand you in good stead for playing Trivial Pursuit. Did you know that although the abacus was invented by the Babylonians, the word is Phoenician and means a flat slab covered with sand on which figures are drawn?

The jog thereafter is through familiar landscapes: Babbage's analytical engine, the tragic Ada Lovelace, Hollerith and his census punched cards, Alan Turing and so on. What distinguishes *Computers for Beginners* is the excellent picture research which has evidently gone into it, and the way captions amusingly subvert the images.

The book then turns to how the things work, and once more potentially dull subjects are brought to life by neat analogues. However it does fall down in its rather skimpy treatment of peripherals. A short chapter on applications expains what all this high-tech can be used for.

With its duty done, *Computers for Beginners* then gets down to the nitty-gritty: are computers worth it? To quote the Zen aphorism which heads the chapter. "The bigger the front, the bigger the back." In particular it spends some time spelling out the uses and abuses to which computers can be put to by the state. Unfortunately, most of the data and examples cited here refer to the U.S.

The following chapter on artificial intelligence is a bit of a letdown after all this heady sedition. Only the last chapter, headed "Final Siliconsiderations" gets back into the swing of things with a grand crescendo of doubt about the wisdom of it all. It worries that perhaps, as Issac Asimov once said: "The human species was simply the most efficient way that nature could find to build the silicon chip." If this thought troubles you too, buy the book. Even if it doesn't, buy it anyway.

The Carton Guide to Computer Science is also one of a series, but it differs from *Computers for Beginners* in that the text and the drawings were produced by one person, Larry Gonick. This leads to a unity which *Computers for Beginners* lacks. Some people may finds its Doonesbury-type American humour slightly trying.

Like *Computers for Beginners*, it offers the usual scurry along the horizons of information technology. It takes in the history of numbers, Babbage, Ada Lovelace and the rest. This century's developments are centred around the U.S., with no mention of Turing's Colossus or Bletchley Park.

The second part of the book explains how a computer works. It goes into some particulars with treatments of Nand and Or gates in full, gory detail. For anyone determined to understand this level of operation, Gonick's guide probably provides the most painless approach around.

The Cartoon Guide's concluding chapter offers a few cautionary remarks on computers, and ends with the following quotation from Norbert Wiener on the dangers of thinking that, at the worst, you can always turn the damn thing off: "To turn a machine off effectively, we must be in possession of information as to whether the danger point has come. The mere fact that we have made the machine does not guarantee that we shall have the proper information to do this . . . The very speed of modern digital machines stands in the way of our ability to perceive and think through the indications of danger."

No such worries will have ever troubled the designer of the pop-up guide *Inside the Computer*. In six spreads you are presented with pop-up delights such as keyboards,

(continued on next page)

A pop-up spread from *Inside the Computer*.

BOOK REVIEWS

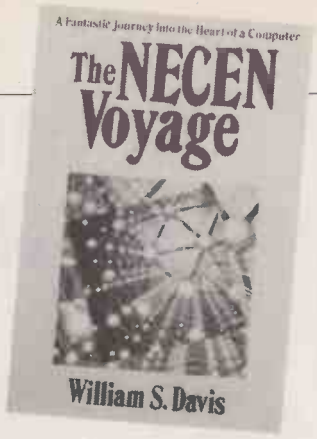
(continued from previous page)

disc drives, electron beams and printers. Pop-up books of the human body show how complicated the many connections and dispositions of organs are. But computers are fundamentally very simple in construction; it would be as sensible to produce a scratch 'n' sniff guide to computers as it would a pop-up book. I am also not clear who this book is aimed at. An adult would find it of little real use, and a child would get bored in five minutes with its limited range of things to pull and push.

Another alternative approach to explaining computers is offered by *The NECEN Voyage*. This is cast in the form of a science-fiction novel in which a band of intrepid heroes are miniaturised and enter the very circuits of a computer to outwit a malicious hacker. The dreaded Harlequin — for like all such hackers, he has a romantic nom de guerre — has gained control of the North East Central Computer (NECEN). This gives him power over New York traffic lights, the banking system and air traffic control. In other words, he can bring the U.S. to its knees in a matter of seconds — and part of the book's message is that we should not become totally dependent on computers, wonderful things though they be. All he requires is $1 billion to stop him from taking over.

Up to this point, the story is predictable, but then Professor Corbin is called in to deal with this threat, and enters the computer to debug it from the inside. You are taken on a journey not of fourth-rate sci-fi, but a genuinely revealing voyage of discovery through the workings of the hardware and software, even down to the bootstrap routines. For anyone interested in parity bits, operating systems and the rest, but unwilling to plunge into books about as exciting as a bus timetable, *The NECEN Voyage* could be the perfect Christmas present.

Finally, a book which is not



strictly in the same category as the others reviewed here, but which has enough similarities to warrant inclusion. *Xorandor* is a fully fledged novel. The difference is that its central character is a silicon-based life form called Xorandor. The story is told by two young twins Jip and Zab, who discover the life form by sitting on it, since to all intents and purposes it is a rock. The language they use to describe their experiences is a curious melange of computerspeak and adolescent nothings. It reads as if it were written by Anthony Burgess gone techie.

Like most of the other titles reviewed here, *Xorador* is a book with a social conscience. It is concerned with nuclear waste and nuclear weapons: Xorandor lives off the one and hates the other. The plot is slight, apart from one mildly exciting episode, but along the way there is a feast of material which raises questions about consciousness, evolution, the arms race and Shakespeare. It is hardly easy-going, but well worth the effort if you want to read something which will undo some of the damage wrought on your brain by too much turkey and Christmas pudding. PC

A NOVEL APPROACH

Computers for Beginners by Errol Selkirk, illustrated by Benny Kandler. Published by Unwin Paperbacks, £3.95. ISBN 0 04 001011 2

The Cartoon Guide to Computer Science by Larry Gonick. Published by Harper & Row, £4.25. ISBN 0 06 460417 9

Inside the Personal Computer by Sharon Gallagher. Published by Penguin, £7.95. ISBN 0 670 80114 3

The NECEN Voyage by William Davis. Published by Addison-Wesley, £9.60. ISBN 0 201 11979 X

Xorandor by Christine Brooke-Rose. Published by Carcanet, £8.95. ISBN 0 85635 655 7

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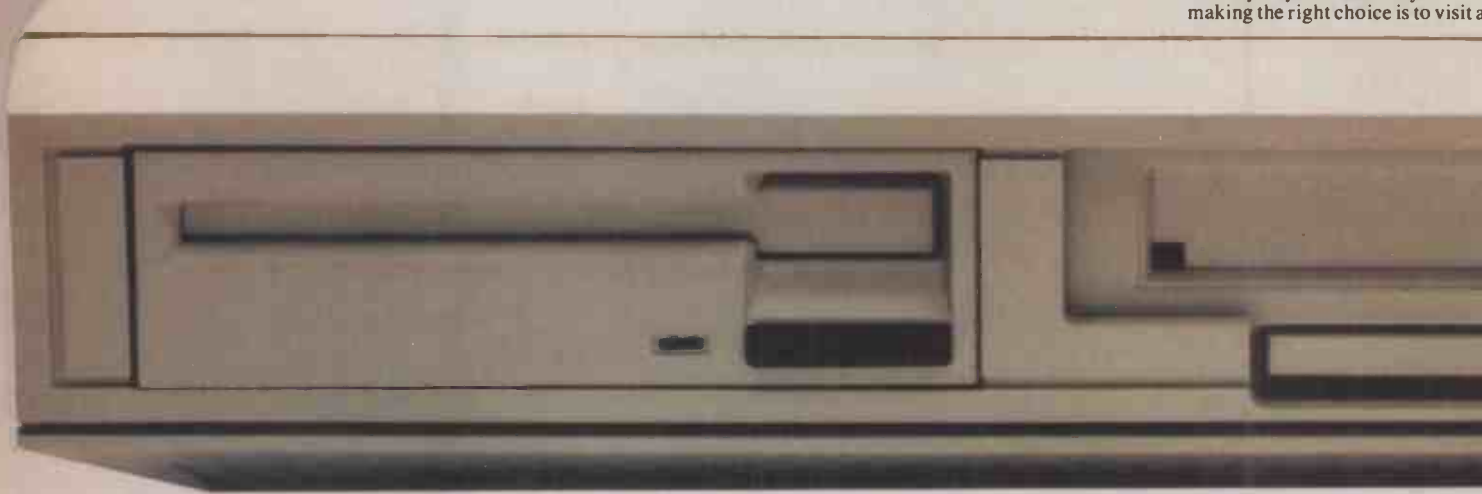

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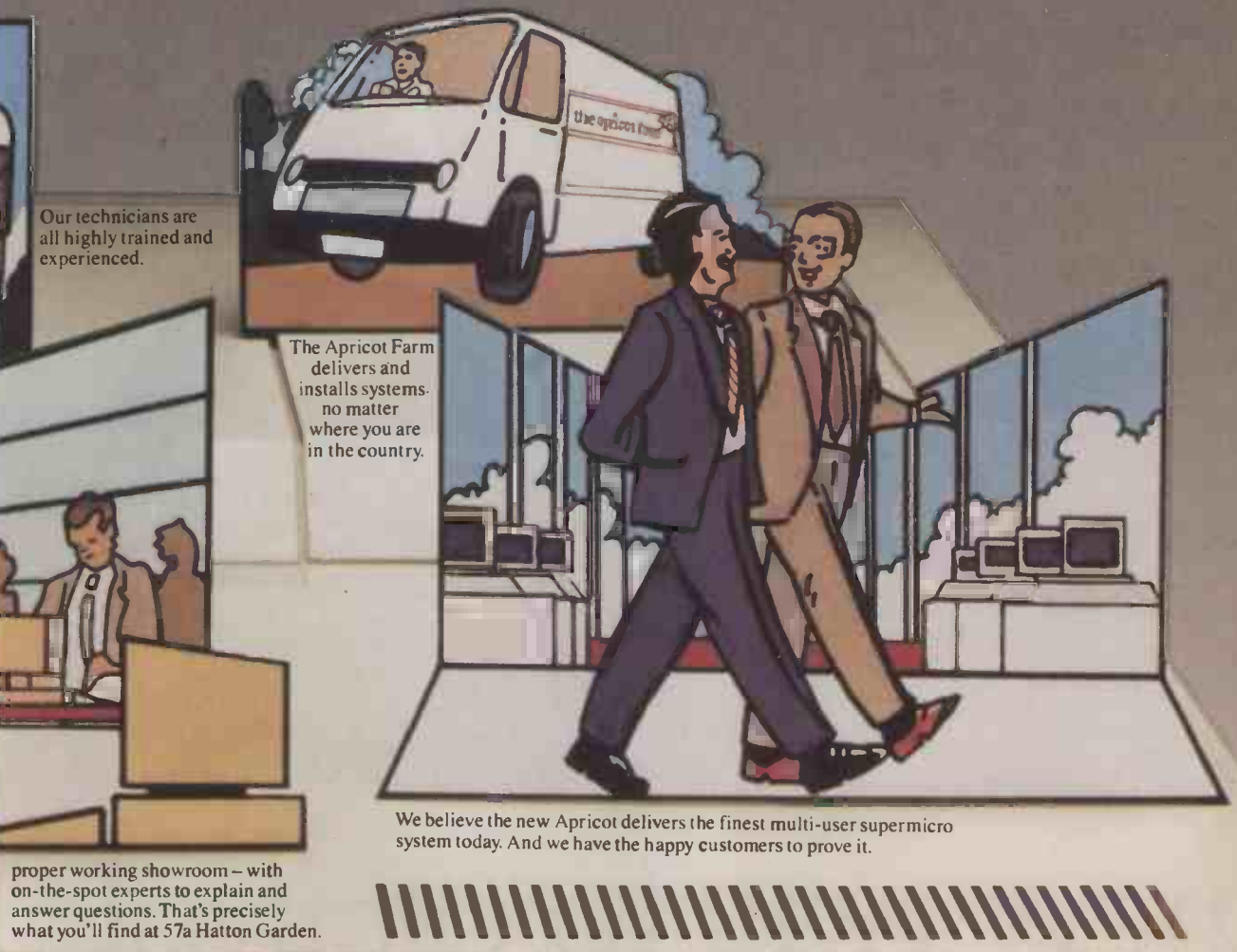

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REVIEW

TANDY 1000EX
A PALPABLE MISS

By Glyn Moody

Tandy is pitching its new micro in direct competition with the Amstrad PC.

Tandy U.K. must be cursing Alan Sugar. If the Amstrad PC-1512 had not been launched, the Tandy 1000EX would doubtless have aroused great interest as a very low-cost PC clone from a reputable manufacturer. But measured against the Amstrad, the 1000EX has several serious flaws.

The basic model comes with one floppy disc, 256K of RAM and mono screen, but with built-in colour circuitry. The cost is £459. This compares with £399 for the Amstrad PC which has 512K RAM, though the Tandy comes bundled with an integrated package called Personal Deskmate. The system reviewed here had a colour monitor and costs £549.

The reason for the Tandy's shortcomings are clear from its design. Unlike most business computers, the 1000EX has its keyboard built into the systems box. This is reminiscent of the Apple II and the home computers which followed it — not surprisingly, since the Tandy 1000EX has been designed first and foremost with the U.S. home market in mind. In Britain the home market is less able to sustain the equivalent price level, so the new Tandy is being targeted here at entry-level business and education.

One consequence of the all-in-one design and the original end market is that there are no standard IBM expansion slots. This renders the machine well-nigh useless for business purposes, where add-on cards are increasingly vital as a way of beefing up the ageing IBM-standard hardware. Instead, Tandy is offering the possibility of proprietary cards, though few of these are available at the moment.

It is also not possible to upgrade to a hard-disc system at the moment, though an external drive may be available later. Tandy answers these criticisms by pointing out that the next model in the range, the Tandy 3000HL, comes with a built-in hard disc and expansion slots. Such segmenting of the market with non-upgradable machines went out years ago; to revert to the practice is a regrettable piece of backsliding on Tandy's part.

The main unit is quite slim but rather space-consuming. The single 5.25in. disc drive is placed on the right-hand side towards the back. This positioning is awkward at best, and well-nigh unreachable for those who are left-handed.

The keyboard is also idiosyncratic, and the changes it makes to the basic IBM PC layout are not improvements. The function keys are placed along the top, and there are 12 instead of the usual 10. There is no Scroll Lock key, which causes problems with some programs, and the Control, Alt and Delete keys have been shifted in such a way that doing a warm boot requires some acrobatics. The + sign associated with the numeric keypad is at the top rather than at the side, and is not well positioned. Tandy has always been wilful when it comes to keyboards; with the 1000EX it has not only ignored all pleas to move in the direction of the standard, but has moved even further away. On the plus side, the feel is good, and the quality of construction is probably better than that of the Amstrad PC.

The machine's home-computer origin is further evidenced by joystick ports and an earphone socket. At the back of the machine there is a parallel printer port and a socket for connecting a second disc drive, which can be 5.25in. or 3.5in.

TANDY 1000EX

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	■	□	□	□
Ease of use	■	□	□	□
Documentation	□	□	■	□
Value for money	□	■	□	□

□ For once British is better: get an Amstrad PC instead.

Despite the broad footprint of the machine, there is little provision for standing a monitor safely on the system box. The colour monitor in particular balances very precariously on top. I found the colour display unacceptable in terms of definition: the characters are very difficult to read, and for word processing it would be very tiring.

As befits a machine designed for the uninitiated, it is hard to get inside the casing. There is, however, a small expansion compartment which can accept up to three small boards.

The machine comes with a version of MS-DOS 2.11 that has been extended to handle 3.5in. discs. Also bundled are GWBasic and Personal Deskmate. The 8088 chip can be run at either 4.77MHz or 7.18MHz. The change is effected during the boot process by pressing f4, or by entering Mode Fast or Mode Slow. One very curious feature on the review machine was that there appeared to be only 240K of RAM. Tandy was at a loss to explain this.

Running the standard Basic Benchmarks produced an average time of 17.7 seconds at the faster speed and 20.7 seconds at the standard 4.77MHz. These are unimpressive results: the ancient IBM PC manages 16.8 seconds and the Amstrad a swift 6.9 seconds. The Bagshaw Disc Benchmark timings were more respectable: 217 seconds against the IBM's appalling 742 seconds and the Amstrad's 284 seconds. Since the IBM PC/XTs hard disc could only manage 254 seconds, the Tandy's performance is rather creditable.

The Tandy 1000EX ran Lotus 1-2-3, Flight Simulator and Sidekick. The non-standard keyboard gave rise to difficulties with some of Sidekick's functions.

Clearly the Tandy 1000EX has little to offer in terms of hardware or performance, especially in comparison with the Amstrad. Where it does score is with the Personal Deskmate package. This is a very substantial rewrite of the Deskmate program bundled with the Tandy 1000, which *Practical Computing* reviewed in April 1985. It offers all the main applications of word processor, spreadsheet, database, telecomms and calendar.

SPECIFICATION

CPU: 8088 running at 4.77MHz and 7.16MHz
RAM: 256K, expandable to 640K
ROM: bootstrap and diagnostics
Mass storage: 5.25in. 360K floppy-disc drive built-in; second disc can be added externally
Keyboard: non-standard QWERTY layout with 12-key numeric pad
Display: 320 by 200 pixels, eight colours from possible 16
Expansion options: memory board, mouse, RS-232 port
Software in price: MS-DOS 2.11, GWBasic, Personal Deskmate
Prices: monochrome system £459, colour system £549
Manufacturer: Tandy U.K., Leamore Lane, Bloxwich, Walsall, West Midlands WS2 7PS. Telephone: (0922) 477778
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The main difference in the new version is a completely rewritten front end that gives it a Mac-like appearance, complete with pull-down menus. To derive the full benefit from it you need a mouse. Tandy will be offering its own proprietary model as an optional extra, though the Microsoft mouse will work if you add a serial port. In use I found Personal Deskmate rather confusing without a mouse. It is also very tedious to keep swapping between the three discs on which the program's constituent parts are stored, especially with the inconveniently placed drive. The manuals, as elsewhere, are quite good.

Tandy has also announced a range of low-cost software for the machine, to be sold through its chain of stores. It includes products like VP-Planner, Delta 4 and a £49.95 WordStar-like word processor called Trust Writer.

The Tandy 1000EX emerges as rather a sad example of cultural imperialism: it is a U.S. niche-market machine that is simply inappropriate for this country. This is particularly regrettable as Tandy's last few machines have shown a steady improvement culminating in the Tandy 3000 — still about the best low-priced AT clone around.

Both keyboard and disc drive are built into the system box.

There are few reasons for anyone in the U.K. — especially in the corporate sector — to buy the new Tandy. If you are after a cheap clone the Amstrad PC is far better value. Apart from the bundled software, which may be of interest to those starting out and who want a complete solution, the main advantage the 1000EX has at the moment is availability. If, as Tandy claims, these machines are to be had right now, they might sell to frustrated would-be Amstrad owners for that reason alone.

CONCLUSIONS

- The Tandy 1000EX is a low-cost IBM PC compatible.
- It is seriously flawed by its badly designed keyboard, illegible display and lack of expansion capabilities.
- Some may find the bundled integrated software attractive, but for business users the Amstrad PC is worth waiting for. PC

KUMA K-MAX
TAMING THE TRANSPUTER

By Steve Malone

The fearsome processing power of the Transputer can now be tapped through an add-on package for Atari ST.

Just over a year ago Inmos launched the Transputer. This revolutionary 32-bit processor chip opened up the prospect of genuine parallel processing for microcomputers. Since then the device has made slow but steady progress in the fiercely competitive microprocessor market. Inmos claims that it has taken five percent of the world 32-bit market, which is not bad for a company less than 10 years old.

Most uses for the Transputer have so far been confined to high-performance number crunching. But even with Transputers now costing around £500 each, cheaper development systems are beginning to appear, one of them being the K-Max add-on system for the Atari ST series.

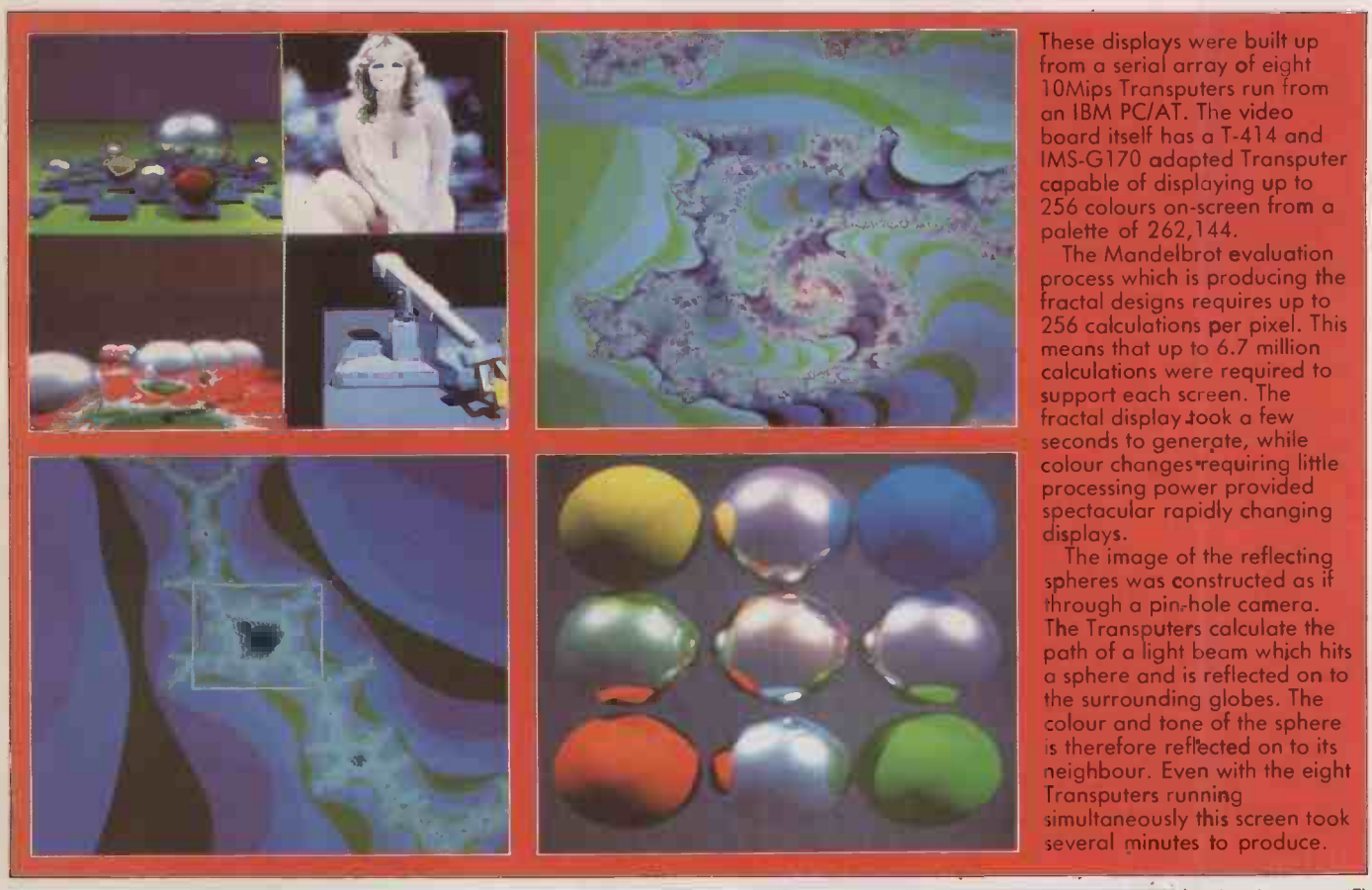
Billed as a "computer on a chip", the T-414 Transputer is a 32-bit CPU with 2K of RAM on board. When operating as a straightforward 32-bit device it has the memory and data-addressing capabilities of the 68020 and 80386: thus it has a 4Gbyte address space and 32-bit internal architecture.

The real secret of the Transputer is the four fast serial links associated with each chip. Their throughput rate is 10Mbaud. Data received on one of these links is processed by the Transputer using the programs and data stored either in the on-board memory or supplied via the external data bus. Once the processing is complete, the output can be sent via one of the links to another Transputer for further processing. This assembly-line approach to processing means that a number of tasks can be carried out simultaneously.

The effects are dramatic. The base-level Transputer has been benchmarked at 7.5 million instructions per second (7.5Mips). At optimum efficiency, daisy-chaining two Transputers together could produce a combined processing power of 15Mips. Inmos currently has a 10Mips device on sale, and faster Transputers are planned. The Transputer's fast serial links are bi-directional and capable of receiving both input and output.

The four links also mean that the Transputers can be arranged in a matrix fashion, with perhaps all four links connected to other Transputers and all exchanging information. While this is an unusual problem for the design engineer, it is a completely alien world to most software developers. Most of them are new to the problem of achieving maximum efficiency from parallel processors.

In order to make the most of the parallelism available, Inmos has developed a parallel-processing language known as Occam. At the coding level the language bears a resemblance to C and Pascal. Where it differs from the others is in its size and the way it supports the Transputer's architecture. The current generation of Occam compilers occupy around 256K of RAM, though Inmos says you need about 1Mbyte to hold associated files.

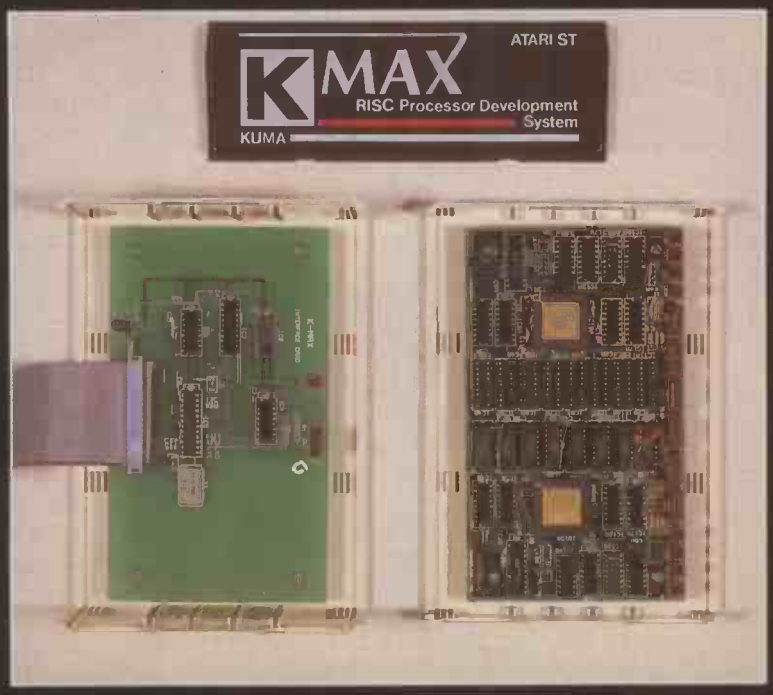


These displays were built up from a serial array of eight 10Mips Transputers run from an IBM PC/AT. The video board itself has a T-414 and IMS-G170 adapted Transputer capable of displaying up to 256 colours on-screen from a palette of 262,144.

The Mandelbrot evaluation process which is producing the fractal designs requires up to 256 calculations per pixel. This means that up to 6.7 million calculations were required to support each screen. The fractal display took a few seconds to generate, while colour changes requiring little processing power provided spectacular rapidly changing displays.

The image of the reflecting spheres was constructed as if through a pin-hole camera. The Transputers calculate the path of a light beam which hits a sphere and is reflected on to the surrounding globes. The colour and tone of the sphere is therefore reflected on to its neighbour. Even with the eight Transputers running simultaneously this screen took several minutes to produce.

(continued on page 47)



The K-Max twin-Transputer system allows for true parallel-processing programs. It includes I/O facilities to service the Transputer board and link it to the ROM port of an Atari ST.

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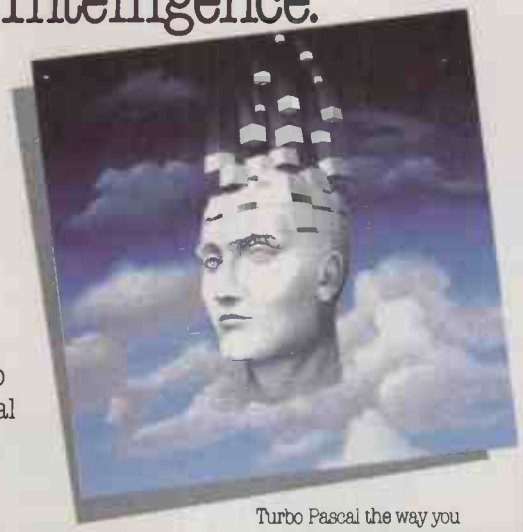

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Turbo Prolog 1.0 Technical Specifications

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(continued from page 45)

Although Occam is not the easiest of languages to pick up, it is not as difficult as some would have you believe once you have understood the background to the Transputer. The main problem is that programmers are entering uncharted territory, without any of the familiar techniques which they may have been using previously. A second drawback is price: the Inmos Occam development kit, consisting of a Transputer, 2Mbyte of memory and an Occam compiler, will set you back £4,500.

Many establishments and potential users — computer-science students in particular — will find that the Inmos system is simply too expensive. This gap in the market has been perceived by Kuma Computers, which has put together its Transputer development package for the Atari ST at a fraction of the cost of the equivalent Inmos system.

The Kuma K-Max is housed in a box measuring 75mm. by 147mm. by 206mm. which plugs into the ST's ROM port. It contains two circuit boards, one with a 7.5Mips T-414 processor and 256K of RAM, the other with the circuitry needed to interface the system to the host computer. Kuma has also provided circuitry to fit a second Transputer as an optional upgrade along with its associated 256K of RAM. Thus the device allows for true parallel-processing programs.

In the two-Transputer system the processors are connected via one of the four links. To pass information to and from the ST another of the links on the first Transputer is linked to the K-Max I/O board via the Inmos validated transmission protocols. These are similar to the Transputer-to-Transputer links, but have particular checksum passing routines built-in.

Other connections from the I/O board to the Transputer go under the collective name of "system services". They perform the basic hardware maintenance necessary to keep the system running. This includes such things as provision of the 5V power supply, the clock, error signalling and hardware event flagging.

MEMORY MANAGEMENT

Transputers can handle almost all the tasks associated with more traditional 32-bit processors. The major exception is virtual-memory management, for which they have no hardware facilities. Inmos says that this was a conscious decision, as the company feels that virtual-memory management is becoming increasingly unnecessary and would have reduced performance. But it means you cannot run a conventional operating system like Unix through Transputer hardware — although of course it is possible to perform software emulation of virtual-memory management.

The favoured solution to this problem is to use the Transputer architecture as a co-processor to a standard processor. This is the kind of thing which has already been achieved, not only with up-market research systems but increasingly with some of the more widely available machines, especially those based around the Motorola 68000 series that holds a large proportion of the current Unix market.

SPECIFICATION

Description: Transputer development system and assembler
Hardware required: Atari 520ST or 1040ST
Dimensions: 75mm.(3.0in.) x 147mm. (5.8in.) x 206mm.(8.1in.)
CPU: Inmos T-414 32-bit Transputer running at 15MHz
RAM: 256K
Manufacturer: Kuma Computers, 12 Horseshoe Park, Pangbourne, Berkshire RG8 7JW. Telephone: (07357) 4335
Price: £1,450 for single-Transputer system, £2,450 for twin-Transputer layout
Available: now

Serial Transputer output is interfaced to the parallel 68000 universe by means of an Inmos link adaptor. This is essentially a multiplexer which receives the serial data from one of the Transputer links and converts it into bytes which can be placed on the host computer's data bus. The adaptor also handles the duplexing which allows the Transputer to run at a different clock rate from the host.

The central part of the K-Max I/O board is the C-002 multiplexer which turns the Transputer's serial signals into 16-bit parallel data able to be read by the ST's 68000 CPU. It is here that the bottleneck occurs that prevents the user gaining access to the full power of the Transputer. The ST add-on is unable to perform the virtuoso displays of the Inmos graphics systems which are based around the Transputer-derived IMS B-007 board.

Kuma has had to perform a certain amount of operating-system tweaking to get the system to work at all. The major problem facing the developers was that the ROM port used as the interface between the ST and the K-Max is intended for read-only devices. Luckily the port does not have any diodes installed which prevent it becoming bi-directional, and so Kuma has been able to read and write to it via software. The other problem involved in interfacing the 8MHz 68000 chip and the 15MHz T-414 is the difference in speeds. This is taken care of by the C-002, which contains asynchronous duplex circuitry enabling it to adapt to the clock speed of the host computer.

In order to make use of the Transputer, Kuma has provided its own K-XPA assembler, which occupies a mere 20K of RAM. It has all the features that programmers expect in a modern development system, including a full-screen editor, assembler, disassembler, debugger and monitor. Although source code can be written on any word processor which is capable of producing files in an ASCII format, Kuma recommends that you use the K-Max editor.

The editor has a split-screen feature. At the top is the standard full-screen editor, which allows you to move and edit the source code at will. At the bottom is the command line which allows you to exit, load, save or assemble the source code. The editor also contains a Block Move facility which enables you to reproduce code elsewhere in the program. This feature can become especially important when handling parallel processes.

The assembler itself is in the usual two-pass format. Code is checked for syntax errors and then compiled. Kuma says that the code is entirely relocatable and compiles at the rate of 50,000 instructions per minute. It is written in 68000 assembly language. During compilation the source code is translated by the processor into Transputer mnemonics and is loaded into the Transputer's own RAM via addresses at the ROM port. Once the code has been assembled into RAM it can be executed by the Transputer.

OCCAM PREFERRED

To begin with, Inmos was not best pleased with Kuma, as it is trying to get everyone to program in Occam rather than assembler. This is not simply to sell more Occam licences; it also means that Inmos can change the microcode of the Transputer. As long as any relevant changes are implemented within the Occam compiler, all Occam programs can be recompiled and run on a new layout. This would leave Inmos with a free hand to change the architecture of future Transputers without having to support dead wood left over from earlier designs.

Next year Inmos is hoping to introduce the T-800 Transputer. This chip will be able to handle floating-point calculations via hardware rather than software emulaton as at present. As a comparison, Inmos says that current versions of the T-414 are able to generate 0.1 million floating-point calculations per second (0.1Mflops). The new device is able to manage 1Mflop. Several of these Transputers linked together will be able to challenge supercomputers like the Cray for the title of the world's fastest number-crunching machine.

Now that a lot of ROM-based code has been written for specific Transputers Inmos feels that it cannot alter the T-414. Future versions of the Transputer like the T-800 will be upwardly compatible under Occam, even though they will not be compatible as far as assembly code is concerned.

CONCLUSIONS

- One year on and the Transputer is still ahead of its time in terms of both its speed and its parallel-processing capabilites.
- The K-Max add-on system for Atari STs is a good entry point for investigating parallel processing on the Transputer.
- Though it does not display the stunning demonstrations that Inmos's own eight-Transputer system is capable of the K-Max is still impressive. Its main handicap is the bottleneck caused by the host computer's relatively limited capabilities.
- With falling component prices the K-Max is only the beginning. Kuma hope to reduce the price of the system in the near future. PC

TOSHIBA T-3100
80286 TRANSPORTABLE

By Steve Malone

Such has been the pace of technical development that the power of an XT-286 is now available in a package the size and weight of a briefcase.

Transportable computers have come a long way since the days of the Osborne 1. Improvements in CMOS technology and the development of light, low-powered displays mean you no longer have to be built like Geoff Capes to carry one around. Weight has been reduced to such an extent that many transportables are all but indistinguishable from lap-portable computers. The only feature separating the two categories is whether or not they can be run on batteries.

It is tempting to refer to the Toshiba T-3100 as an AT clone. The machine is based around the Intel 80286 processor and is fitted with a 10Mbyte hard disc. It is also compatible with IBM software. However, the comparison ends there, and it is more accurate to view the Toshiba machine as a portable version of IBM's new PC/XT-286.

Packed away for carrying, the T-3100 is briefcase sized, measuring roughly 12in. by 3in. by 14in. It weighs 15lb. The carrying handle fitted behind the peripheral ports at the back allows the machine to swing on two pivots. This makes it less of an effort to carry, and means that the handle can double as a stand, raising the back of the machine to place the keyboard at a natural typing angle.

The T-3100 has a fold-down screen. It is held down by a clip on the front which, when released, allows the screen to spring up; it can then be lifted back to a suitable viewing angle. The keyboard is recessed, with the full-sized keys raised just above the surrounding casing. They are arranged in a QWERTY layout. The feel of the keys is excellent and although the space between them is understandably a little cramped, touch-typists will have no trouble adapting to the machine.

One of the problems with building a full-function IBM-compatible portable is squeezing the great expanse of the IBM keyboard into a manageable space without too much doubling-up of key functions. The two biggest headaches for the keyboard designers are the function keys and the numeric keypad. Toshiba has placed the 10 function keys in a row across the top and has moved the Escape key alongside. To the right of the function keys are the Num Lock, Scroll Lock, Prt Scr and Sys Req keys. Along the far right-hand side are other cursor-control functions like Home and Pg Dn.

A block of alphanumeric keys on the right-hand side of the keyboard double as number keys. While this may be a way round the space problem, it really is nothing like as easy to use as a separate keypad. I found the numbers at the top of the keyboard easier to locate.

Toshiba has managed to find room on the keyboard for separate cursor functions. This is practically essential, as word processors frequently use the cursor keys for full-screen editing; switching the alphanumeric keys back and forth between normal and cursor modes would be unacceptably laborious.

The T-3100 is an up-market version of the earlier T-2100; the main difference is that it has a 10Mbyte hard disc as standard rather than simply as an option. The single 3.5in. 720K floppy-disc drive is fitted flush with the casing on the side of the machine. Its red eject button is illuminated by an LED and doubles as a drive activity light. This may seem like a neat idea, but in practice it does not work very well. The LED is faint, and as the button is recessed into the side of the machine you have to peer round to see it. More easily visible disc-drive activity lights are placed underneath the screen, along with indicators for power, Scroll Lock, Caps Lock and Num Lock.

The most striking feature of the T-3100 is the built-in plasma display. Measuring 9.5in. diagonally, it supports a full 80- by 25-character display. The individual characters are bright orange, displayed against a deep brown background. They are large enough to be perfectly legible even under strong background lighting. The pixel resolution can be switched to one of three formats. The 320-by-200 resolution supports a basic 40-column mode, while 640-by-200 matches standard IBM colour graphics. Extra-high resolution is provided by a 640-by-400 format.

The plasma screen is able to support most of the attributes associated with the standard IBM monochrome display, but cannot represent bold. The T-3100 gets around this by thickening the characters. Shade is supplied by simply turning off some of the columns in the block graphics. Unless the application software demands it most users will prefer to keep the screen in double-pixel, high-resolution 640-by-400 format, as it produces a much clearer display.

At the rear of the machine the usual peripheral ports and power unit are fitted into two banks. At the top is the power unit with the normal three-pin a.c. input and switch, along with a switch to allow the machine to be used with different mains voltages. The lower tier, which is shielded by the carrying handle when it is not being used as a stand, carries the peripheral ports.

On the far right is a standard IBM RGB connector which enables the T-3100 to use a CRT monitor if it is available. Next to that is a bank of six DIP switches. The display fount is switchable from single to double dots; the printer port, the size of system memory and the fount itself can also be set from the DIP switches.

Next to the DIP switches is a parallel

TOSHIBA T-3100

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	☐	■
Ease of use	☐	☐	■	☐
Documentation	☐	☐	■	☐
Value for money	☐	☐	■	☐

☐ A high-performance lightweight transportable.

SPECIFICATION

CPU: Intel 80286, switchable between 4.77MHz and 8MHz
RAM: 640K
ROM: 64K
Dimensions: 311mm. (12.2in.) x 80mm. (3.1in.) x 350mm. (13.8in.)
Weight: 6.6kg. (15lb.)
Display: plasma display; 80 by 25 characters or maximum resolution of 640 by 400 pixels; RGB colour socket
Keyboard: QWERTY with 10 function keys; numeric keypad mapped on to alphanumeric keys, separate cursor-control keys
Mass storage: 720K 3.5in. floppy-disc drive and a 10Mbyte hard disc
Interfaces: expansion bus, RS-232C port, parallel printer/floppy-disc interface
Software in price: MS-DOS 2.11
Expansion options: modem, pending approval for use on BT network; expansion box containing five PC/XT-compatible slots

The T-3100 includes an 80286 CPU, 640K of RAM and a 10Mbyte hard disc as standard. With the plasma screen folded down it forms a portable briefcase-sized package.

printer port and beyond that the RS-232 serial interface. On the far right is the Toshiba expansion bus, hidden behind a metal plate. It looks like a miniature version of an IBM expansion board, except that the Toshiba bus has pins. A Toshiba modem that plugs into the bus is currently awaiting approval for use on the BT network.

The Toshiba bus is compatible with the PC/XT expansion specification, although not with that of the PC/AT. This could turn out to be rather a limitation, particularly now that certain AT cards like the Above Board PS/AT memory-expansion card are becoming accepted add-ons for 80286 machines.

The printer port doubles as an interface for a 5.25in. disc drive.

Price: £3,200
Manufacturer: Toshiba (U.K.) Ltd, International House, Windmill Road, Sunbury, Middlesex TW16 7HR. Telephone: (0932) 78566
Available: now

Apart from the modem, Toshiba is offering a £695 expansion box for the computer which will allow up to five full-length PC cards to be fitted. Since display circuitry, disc controllers and serial and parallel ports are fitted as standard on the T-3100 expansion cards will only be required for the less usual applications.

The parallel printer port can double as an interface for an external floppy-disc drive. Although it is theoretically possible to use this port for any type of drive it is intended especially for use with a 5.25in. unit. Even with the advent of the IBM Convertible, the 3.5in. format is still something of a novelty in the IBM universe, with 3.5in. IBM software even more so. Access to a 5.25in. drive is therefore important if users are to have a reasonable choice of software.

Anyone thinking of buying a T-3100 should seriously consider spending an extra £395 for the 5.25in. drive to go with it, but even that is not the end of the problem. If the software is copy-protected you will not get it across to the 3.5in. format. Many software houses have removed copy protection from their discs but there are exceptions, notably Lotus. A version of 1-2-3 is, however, available on 3.5in. format for Toshiba users.

To configure the parallel port for use as a disc drive or printer interface you use a switch on the left-hand side of the T-3100. This switch has three settings: Printer, Drive A and Drive B. The two drive settings are important if the external drive is to be used to its full capabilities. Some copy-protected programs like Lotus 1-2-3 insist on being booted on drive A, while at other times you may prefer to boot off the 3.5in. disc and keep the external drive as drive B to store data that you intend to transfer back to a system with 5.25in. drives. You can even change the interface designations while the machine is running. Thus it is possible to load an application from 5.25in. disc and then switch the port over to printer mode so that data from the application can be dumped as hard copy.

Problems arise when you have data on 5.25in. format which is read into buffers before being sent to the printer. In this case you will have to copy it to the hard disc or 3.5in. floppies before you send it to the printer.

The installation of the 3.5in. drives provided us with something of a surprise. The version of MS-DOS which was supplied with the machine was 2.11, although Microsoft has said that only version 3.2 supports 3.5in. drives. It appears that Toshiba has tweaked MS-DOS 2.11 to use the 3.5in. format. All the application packages we tried ran on the machine, including graphics-intensive products like the Microsoft Flight Simulator.

The Bagshaw Disc Benchmarks came in at 143 seconds for the hard disc, 291 seconds for the 5.25in. floppy and 361 seconds for the 3.5in. floppy. The hard disc is particularly slow: it is only twice the speed of the 5.25in. floppy, and way behind the 60 seconds of the IBM PC/AT's 20 Mbyte Winchester. At least part of the reason for this is that it has a mechanism that automatically parks the disc head after seven seconds of inactivity. This allows the machine to be carried around without any fear of damaging the Winchester mechanism. The difference between the floppy-disc times probably reflects some of the patching that was necessary to get the drives to work under MS-DOS 2.11. The Basic Benchmarks gave an average timing of 4.3 seconds, which is comparable with the Compaq Deskpro 286.

Alert readers will remember that last month we said that we would be reviewing the Sony SMC-210 alongside the T-3100. We have actually had a Sony machine in the office, but halfway through the review Sony informed us that the machine would not after all be sold in the U.K. The company quoted an unfavourable exchange rate of the yen against sterling and the falling price of 8088-based machines as the reasons for its change of mind. This is the second time Sony has launched a machine and then announced that it would not be introduced, the first having been the Typecorder portable word processor. One wonders what will happen the next time it announces a new product.

CONCLUSIONS

- The Toshiba T-3100 provides the power of an 80286-based hard-disc machine while remaining truly portable.
- While it appears to be entirely software compatible with existing IBM PC programs, the machine has made compromises with the hardware that deviate from the full PC/AT specification.
- The advanced features incorporated into the T-3100 should keep users happy for some time; Toshiba is to be applauded for thinking of them in advance. PC

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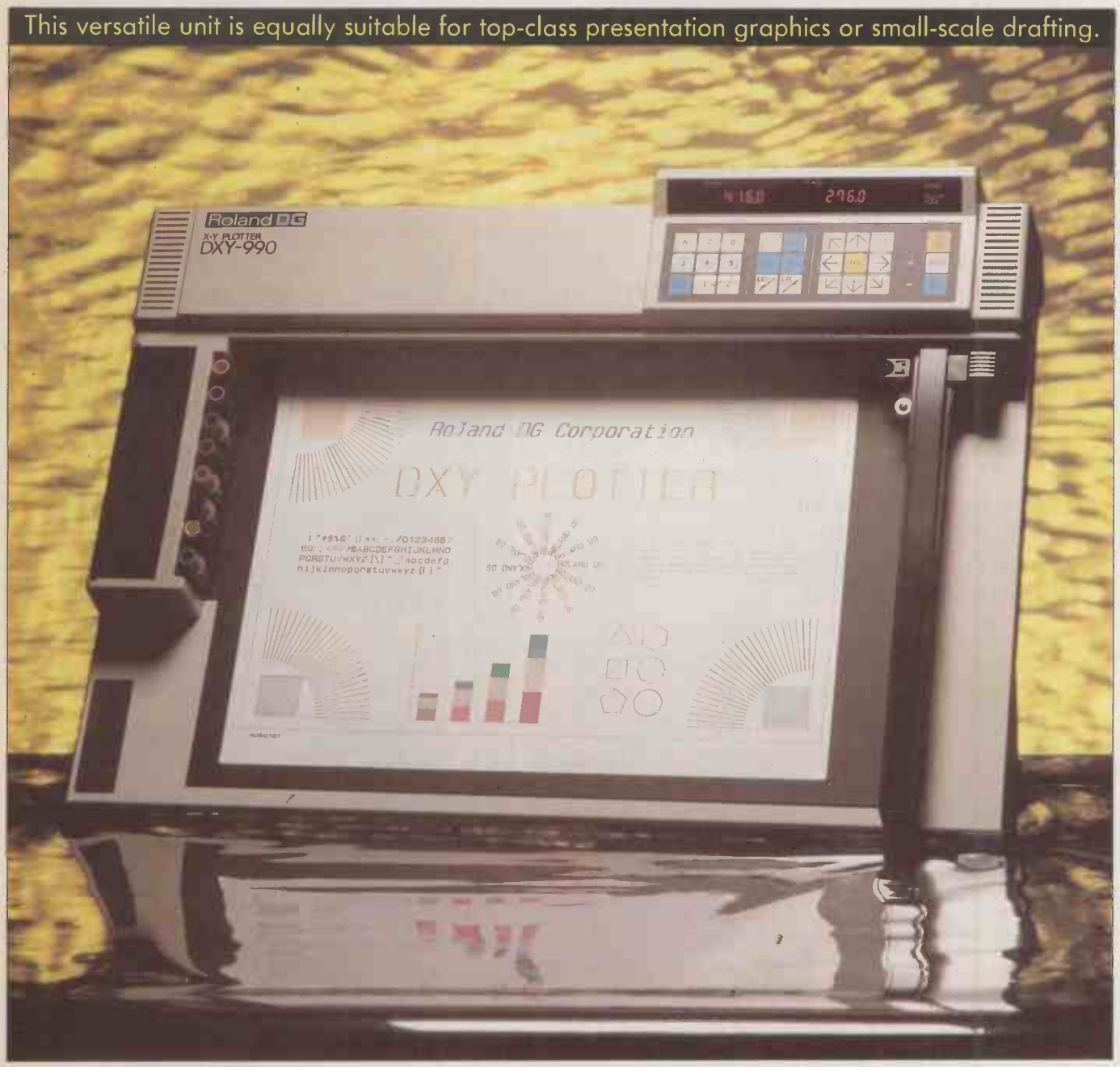
ROLAND DXY-990
FLAT-BED PLOTTER

By Roger Cullis

This versatile unit is equally suitable for top-class presentation graphics or small-scale drafting.



The newly introduced DXY-990 is the top of the range of Roland plotters. It is of flat-bed construction, with an eight-pen magazine, and has a mechanical resolution of 0.05mm. Maximum drawing speed is 300mm./s.

Paper is held to the base of the plotter by electrostatic attraction. The unit can be mounted flat on a table or tilted at about 60° on its built-in stand. It accommodates paper up to A3 size. Power is provided by a transformer unit in the mains lead.

The DXY-990 is equipped with a particularly comprehensive control panel and display for plotting under manual control. Four-digit LEDs provide a readout of the x,y co-ordinate values in 1mm. units. The display origin can be set at any positon using the Reset button. Any one of the eight pen positions can be selected from the numbered keys, and moved using the cursor-type keypad. Drawing is initiated by the Pen Down key.

Under software control the plotter is driven by the Roland Graphics Language. The language includes a comprehensive range of drawing commands as well as commands to select different operating modes and default values. Since it is compatible with the widely used Hewlett-

HEWLETT-PACKARD GRAPHICS LANGUAGE

Hewlett-Packard Graphics Language (HPGL) is a set of two-letter mnemonic commands by means of which a computer controls a plotter or other output device. These commands may cause the plotter to create an element in a drawing, perform a mechanical operation such as selecting a pen, or raising or lowering it, modify a subsequent drawing command or change the mode of operation of the plotting device.

The syntax of HPGL commands has a standard format, with a mnemonic followed by the parameters necessary to specify it. The mnemonic and parameters are separated by delimiters and the whole command is completed with a terminator character. As an example, the Arc Absolute command, which is used to draw an arc with a specified centre point, has the format

AA X,Y,θc(,θd) [terminator]

The X,Y parameters specify the co-ordinates of the centre of the arc, θc is the angle subtended at the centre and θd is the resolution parameter which specifies the smoothness of the arc.

The resolution is frequently limited by the physical properties of the medium. For example, the screen display may be restricted to 640 by 200 pixels, whereas the actual drawing produced by the plotter on an A2 sheet has a resolution of 0.0125mm. The software itself may set the co-ordinates with even greater accuracy. In a Basic program, the command is sent to the plotter in the form of a Print statement such as

10 LPRINT "AA 6000,5000,360,10;"

Computer-aided design packages and other applications software are a convenient way of assembling a set of plotter control commands using an input device, which may be a mouse, a graphics tablet, or even just a keyboard.

A feature of plotters and the software which drives them is that all trigonometric calculations are performed in floating-point arithmetic. If a large amount of CAD work is to be undertaken, it is therefore an advantage to install an arithmetic co-processor in the computer. However, not all applications packages support co-processors so you should check on this point before incurring the expense of installing the extra chip.

Packard Graphics Language (HPGL) the plotter will not be short of software support.

The DXY-990 supports 19 different character sets that can be used for annotating drawings. At any time, one may be designated as the standard character set and another as the alternate set. They are then switched into use under software control using the Select Standard and Select Alternate commands. Individual characters are selected by ASCII code. In addition to the normal upright form, characters may be printed in italic or rotated to different angles.

By setting scaling points using a scaling command or the P1 and P2 switches on the control panel, drawings may be enlarged or reduced. A further command specifies a window which limits the extent of the drawing.

Pens are stored in a magazine at the left-hand side of the plotter and are transferred to the plotting arm as they are required. When a pen is returned to the magazine it is automatically capped to prevent it from drying out. To minimise the danger of smearing, pens are automatically raised if no command is input for approximately three seconds. After a delay of 35 seconds the pen is returned to the magazine and capped.

The pen raising and lowering mechanism is equipped with a mechanical soft-landing device. This reduces plotting noise and permits the use of conventional drafting pens. The pen pressure can be adjusted by a small rotary control on the back panel.

The plotter comes with an eight-colour set of water-based fibre-tip pens in 0.3mm. and 0.6mm. diameters suitable for high-speed drawing on paper. Colours reproduce well, and these pens are ideal for general-purpose graphics such as charts and histograms.

Water-based ball-point pens are available for finer work. For very precise drafting applications ceramic-tip pens are available in 0.2mm., 0.4mm. and 0.6mm. widths. These pens have a maximum drawing speed of 150mm./s. and come with red, black, blue or green water-based inks. Oil-based fibre pens may be used with transparent film for the preparation of overhead-projection transparencies.

The DXY-990 has an unusually comprehensive control panel.

SPECIFICATION

Description: A3 flat-bed plotter
Resolution: 0.05mm.
Maximum plotting speed: 300mm./s.
Paper sizes: A3, A4, ANSI A or B; maximum plotting area 416mm.(16.3in.) x 276mm.(107in.)
Languages supported: HPGL-compatible Roland Graphics Language
Price: £1,525
Hardware option: SYA-350 disc-based auxiliary data buffer, £695
Manufacturer: made in Japan by Roland DG Corporation
U.K. distributor: Roland DG Corporation, 983 Great West Road, Brentford, Middlesex TW8 9DN. Telephone: 01-568 4578
Available: now

For drawings and illustrations that require high picture quality with constant line width there are various combinations of pen holders and tips available for different drawing media. The pens are manufactured for Roland by Staedtler and are handled, used and cleaned in a similar manner to manual drafting pens.

The plotter is equipped with both serial and parallel interfaces, with standard Centronics and DB-25 connectors on the back panel. A DIP switch is used to select the default mode; a full range of serial data formats and communications protocols are available. A further DIP switch selects the default paper size, which may be A3, A4, or ANSI A or B. Roland can supply connectors that enable a wide range of computers to drive the plotter. When connected to a computer via the RS-232 port the plotter can operate as a digitiser. In digitising mode the x and y co-ordinates and pen status are indicated on the LED display.

A dedicated 3.5in. 640K disc drive, known as the SYA-350 auxiliary data buffer, is available as an optional extra. It is normally connected between the computer and the plotter, and has both parallel and serial input and output ports, allowing it to act as a protocol converter. An entire drawing may be saved to disc, where it can form part of a library.

Data format may be set up either by software commands from the host computer or by means of a DIP switch, which also sets up default values. In a drawing office, the data buffer could replace a computer as the source of drawings. Floppy discs which have been previously prepared with the computer can be loaded into the buffer and drawn up by the plotter.

ROLAND DXY-990

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	☐	■
Ease of use	☐	☐	■	☐
Documentation	☐	☐	■	☐
Value for money	☐	☐	■	☐

☐ Top-of-the-range A3 plotter with a full complement of facilities and a price to match.

CONCLUSIONS

■ The Roland DXY-990 plotter is well made and offers a comprehensive range of facilities.
■ It is at the top of the range of A3 plotter in terms of both price and performance.
■ Suitable applications include high-quality presentation graphics as well as small-scale drafting.
■ Roland Graphics Language is compatible with the industry-standard HPGL, this giving the user a wide choice of software. PC

The data protector.

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CLAM is available for most micros with PC/MS DOS version 2.0 or later: These include the IBM PC and all compatibles. CLAM costs £148 + VAT for a single user licence. Site and corporate licences are available. Existing MENUGEN users may upgrade to CLAM for £110 + VAT. CLAM may be purchased from MICROFT TECHNOLOGY LTD. The Old Powerhouse, Kew Gardens Station, Kew, Surrey TW9 3PS or from most dealers. To order or obtain further information telephone 01-948 8255.

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WORLDWIDE COMPUTERS PLC

PFS PROFESSIONAL WRITE
SECOND TIME AROUND

By Susan Curran

PFS Write won acclaim as an easy-to-use if rather basic program. Now it has been upgraded and given some extra functions.

Software Publishing Corporation has replaced its original PFS series of programs with two new series. Last month Ian Stobie reviewed PFS First Choice, an integrated package for occasional users which supersedes all the existing budget-priced products. The PFS Professional series caters for users with more extensive needs. It consists of Professional Write, Professional File, Professional Plan and Professional Network. PFS Professional Write works on IBM compatibles with at least 320K of memory.

Professional Write comes in a neat package with a spiral-bound manual encased in a ring-binder folder and slipcase. The manual is full and clear. The program and its spelling checker are contained on two unprotected floppy discs. I tested an American version, but an anglicised version is now available.

TYPED-IN COMMANDS

The on-screen appearance of Professional Write is roughly the same as what you get when you print your documents. Justification is not echoed on-screen but is handled through commands which are typed within the text. If used incautiously such commands many make line breaks on-screen differ from those on the printed page. Margins are shown on-screen as are headers and footers. Single- and double-line spacing is echoed on-screen; other line spacings are not available at all.

The Page Break command is strangely inflexible. It is possible to order a new printer page at any point, but the screen ignores the effect of this and shows standard-length page breaks throughout a document. Since there is no automatic control over widows and orphans this could prove inconvenient in long documents as there is no way of foreseeing where all the real page breaks will come.

A simple main menu offers the choice of creating or editing a document, altering the setup arrangements or exiting. All normal WP functions are performed using the first option, though it is possible to return to the menu and alter, say, printer configurations without losing your document.

The program saves files with a short description as well as the usual MS-DOS name. The descriptions are reproduced whenever the directory is requested, and they are also available whenever the program prompts for a file name. Unfortunately it is not possible to access them for general housekeeping, nor are they sorted alphabetically.

The main editing screen is reasonably plain. It has margin lines down the sides, and a ruler and two lines of basic information at the bottom. There is no keyboard template but function-key assignments are listed at the top; in all four lines are taken up with system data. Documents up to 250 columns wide can be accommodated.

The function keys give access to good context-sensitive help and to five subsidiary pull-down menus. All the items on them can be selected either numerically or with the cursor; many of them are also accessible more quickly using control-key combinations which bypass the menus.

PFS PROFESSIONAL WRITE

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	■	☐
Ease of use	☐	☐	■	☐
Documentation	☐	☐	■	☐
Value for money	☐	☐	■	☐

☐ A good mid-range product.

The menu/key commands cover all the main editing functions of the program, apart from the Justify and page-break commands that you type into the text. Cursor movement was rather a mess on PFS Write, but is now handled by a well-chosen selection of Control and cursor-key combinations.

Professional Write normally operates in a push-forward Insert mode; typeover is available as an alternative. It will not insert tab spaces in existing text. On-screen it is neat and speedy, though its instant reformatting can slow it down when, for instance, you erase several words in succession.

Only one overall margin setting can be specified per document; it affects the entire document regardless of where the cursor is when it is selected. This is unduly inflexible for a program at this level. When the margin settings are changed the text is automatically reformatted, and this is done quite quickly. It is possible to set a temporary left margin but not a right one, and to indent a block of text from the left but not from the right. Multiple indents are not supported, and as on PFS Write it is difficult to remove unwanted indents and then reformat.

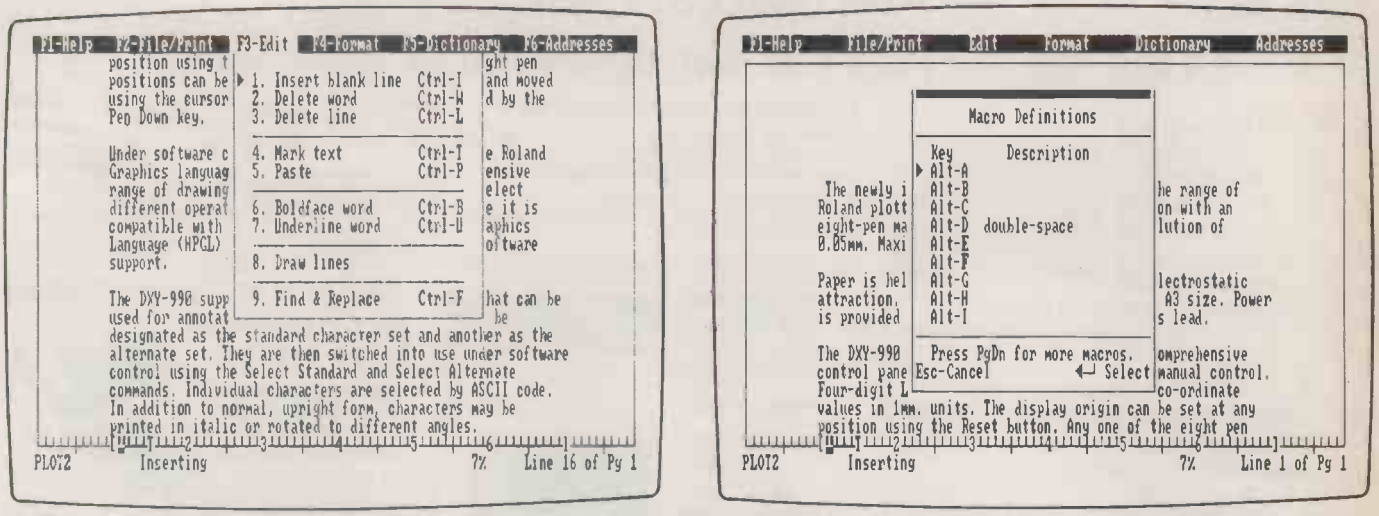
SPECIFICATION

Description: word-processing package with speller/thesaurus, address book and mail-merge
Hardware required: IBM PC, PC/AT or compatible with at least 320K RAM
Copy protection: none
Price: £189
Publisher: Software Publishing Europe, 85-87 Jermyn Street, London SW1Y 6JD. Telephone: 01-839 2849
Available: now

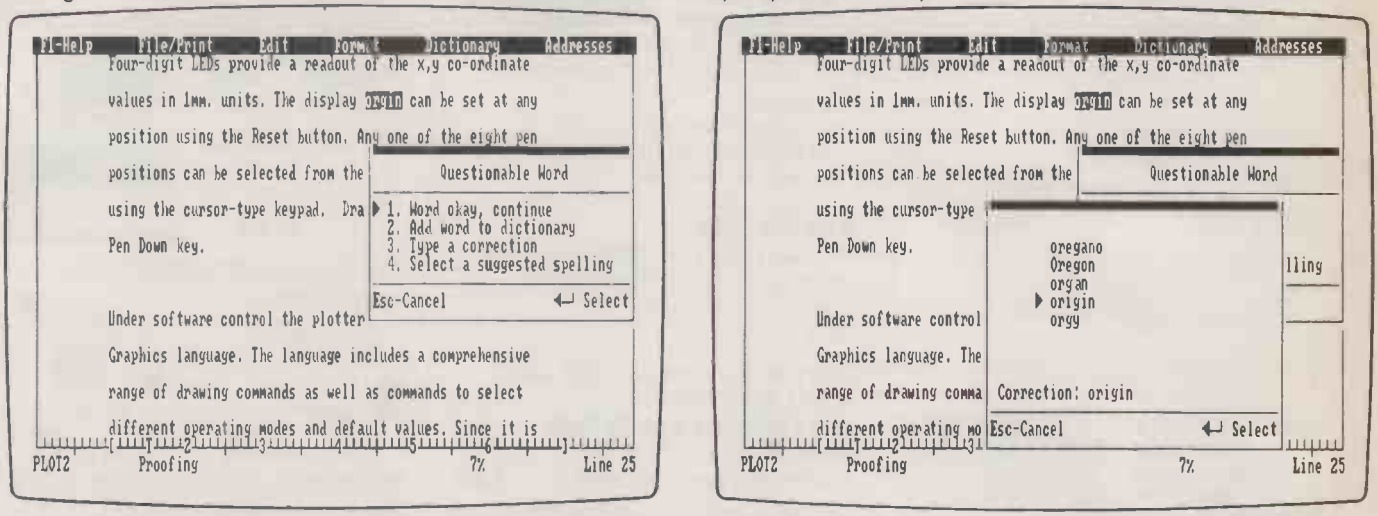
PRINT ENHANCEMENTS

Underlining and bold type are echoed on-screen, but they can only be added to text which has been typed already. They cannot be selected as a default typestyle. The only underline style is non-continuous. Removing underlining and boldface is tricky. Other printer typestyles can be selected, either from menus or by inserting printer-control codes into the document. Subscript and superscript are only available by the latter method.

The program handles only one document at a time, except in merge operations. There is no windowing or split-screen facility. Documents are handled in RAM only. The maximum length is 32 pages or less,



Editing commands can be called via a pull-down menu or Control-key sequences; Alt-key combinations are reserved for macros.



The spelling checker in operation (left); option 4 invokes a further window (right) displaying suggested alternative spellings.

depending upon the amount of RAM available.

The printer support provided is passable. Over 50 named printers are supported, and there is an Unlisted Printer option for others. This allows you to set up a basic printer driver, with initial codes, page-end codes and codes for basic printer features. However, it has limited flexibility and does not allow you to set up complex drivers. Either two printers or two variations on one printer can be set up at the same time, and it is possible to change the printer support at any point. Micro-justification is supported on selected printers.

It is possible to print a whole document, selected pages or blocks of text. The program will also automatically extract an address from a standard-format letter and print it in the correct position for a standard envelope. What Professional Write lacks is a background print feature; only the document being edited can be printed, and then only in foreground mode.

Professional Write has a 77,000-word spelling checker which works in context and offers alternative spellings on request. There are up to half a dozen of these, and they are reasonably well chosen. The checker works at decent speed and words can be added to a user dictionary. It handles capitalised words and words with hyphens and apostrophes, as well as number formats. Multiple user dictionaries can be set up, but this involves quite a bit of work renaming files. There is also a thesaurus feature which offers synonyms for 20,000 words.

Among Professional Write's special features are a line-drawing option which allows you to draw lines horizontally and vertically in various styles, password protection, and the ability to read and write ASCII and DCA files.

ADDRESS BOOK

The mail-merge facilities are outstanding for a mid-range WP program such as this. The program has a built-in fixed-format address-book database; in the program I tested this was set up for American addresses, but Software Publishing says it has been modified for the anglicised version of the program. Data can be extracted from the database either to form the address section of a letter or envelope or to fill fields in a form letter. Each address-book file will hold up to 256 records, and it is possible to set up multiple files. There are adequate facilities for adding, deleting, updating, and searching for or selecting records. Form-letter runs can be sorted, but the files cannot.

Data can also be merged either from the PFS Professional File program or from an ASCII file produced by a database. You can append Professional Write or ASCII files to an existing document, and insert graphs produced with Harvard Presentation Graphics, PFS Professional Plan or PFS Graph. A uniform header, footer and page-numbering format can also be applied to a series of linked files.

The macro feature will handle up to 35 macros based on Alt-key combinations. Macros can be listed with a brief description, but they cannot be edited. You can include commands in macros, and the macro will pause for variable input.

CONCLUSIONS

■Like PFS Write, PFS Professional Write is a neat and competent program. But it retains some of the earlier and cheaper program's annoying limitations, which could seriously affect some users.

■The program's limited range of features are covered in great depth. The spelling checker, thesaurus, and mail-merge and address book are excellent, but there is no easy subscript or superscript facility, no maths or column capabilities and there is no background printing.

■Though it is good value for money, Professional Write is no rival to the top-class, top-price programs. PC

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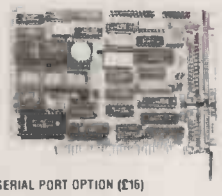

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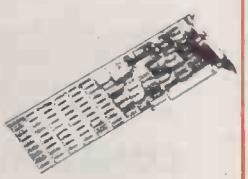

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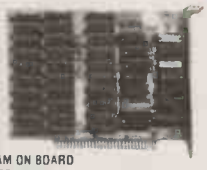

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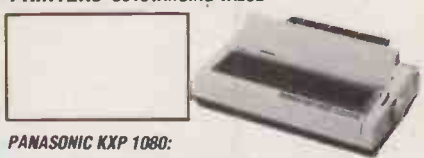

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ATARI ST

Power Without The Price!

520ST PACKAGES

The 520ST-M keyboard costs only £346.96 (+VAT=£399) and includes an RF modulator and cable, allowing you to connect it to an ordinary domestic TV set. The keyboard is supplied with 512K RAM, a mouse and a free set of 3½" disks containing applications software. For a limited period from August 11th 1986, we have some special packs offering combinations of the 520ST-M keyboard with a ½ Mbyte SF354 Atari disk drive and an Atari monitor (either the Mono SM124, or Colour CM36512). These packages offer up to £200 extra discount on a system. If purchased from Silica, they also come with our free 'ST STARTER KIT'. All of the pack prices shown in the chart include VAT.

UPGRADE TO 1024K RAM

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	ALL PACK PRICES INCLUDE VAT					
£100 DISCOUNT 1 DISK DRIVE			PACK 1			
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			Disk Drive	£149		
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			Discount	£100		
			Pack Price	£448		
£150 DISCOUNT 2 DISK DRIVES + MONITOR	PACK 2 (MONO)		PACK 3 (COLOUR)			
	Keyboard	£399	Keyboard	£399		
	Disk Drive	£149	Disk Drive	£149		
	Disk Drive	£149	Disk Drive	£149		
	Mono Monitor	£149	Colour Monitor	£299		
	Normal Price	£846	*Normal Price*	£996		
	Discount	£150	*Discount*	£150		
	Pack Price	£696	Pack Price	£846		
£200 DISCOUNT 2 DISK DRIVES + MONITOR + PRINTER	PACK 4 (MONO)		PACK 5 (COLOUR)			
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	Disk Drive	£149	Disk Drive	£149		
	Mono Monitor	£149	Colour Monitor	£299		
	Printer (SMM804)	£199	Printer (SMM804)	£199		
	Normal Price	£1045	*Normal Price*	£1195		
	Discount	£200	*Discount*	£200		
	Pack Price	£845	Pack Price	£995		

REDUCED PRICES

Atari's ST personal computers are now firmly established both in the USA and Europe. The main attraction of the ST range is the value for money which these computers represent, giving both private and business users a powerful asset at a very modest price. There are now several ST packages available from Silica at a reduced price, further enhancing the Atari 'Value for Money' reputation. In addition, we are giving away a FREE Silica 'ST STARTER KIT' with every 520 or 1040 ST purchased at Silica Shop. These offers will only be available for a limited period and commence on 11/8/86.

POWER FOR BUSINESS

The list below shows some of the new business products which have been recently launched for the Atari ST range. It gives an indication of the ST's potential to business buyers looking to install a powerful, low-cost system:

CP/M EMULATOR
20Mbyte HARD DISK
LOTUS 123™ CLONE
dBASE III CLONE
IBM COMPATIBILITY
VT100 EMULATOR
MICROSOFT WRITE
dBASE II

Any ST computer will provide its user with a very powerful asset, utilising a vast range of applications, particularly in the business world. Many software companies have been quick to recognise it for its business potential, and have produced programs for the ST which harness this potential. In addition, there are several peripheral and hardware products becoming available to add to the ST's 'Power For Business'. Software now available includes dBMan, a dBASE III clone as well as H&D Base, a dBASE II clone. In fact, First Software have now launched Ashton Tate's original dBASE II program for the ST. In addition, PC Intercomm is a VT100 emulator which enables you to use any ST keyboard as a terminal connected to a mainframe or mini. Other programs include a powerful accounts package by Cashlink and a Lotus 1-2-3™ clone called VIP Professional. Microsoft have announced that their powerful word processor 'Microsoft Write' will soon be available for the ST. Many packages are available for very specific market applications including a powerful CAD (Computer Aided Design) program called Easy Draw from Migraph. In addition, there is an engineering tool called PC Board Designer by Abacus Software which will enable the user to design printed circuit boards. For further details of how the ST can help in your business, return the coupon below. We will be pleased to send you our latest newsletter and price list.

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We hope you will find that the combination of our low prices, FREE delivery service, FREE Starter Kit and after sales support, will be enough to make you buy your Atari equipment from Silica Shop. If however, there is something you wish to purchase, and you find one of our competitors offering it at a lower price, please contact Owen Pascoe (Office Manager), or one of the telesales staff in our sales department. When you telephone us, please provide us with our competitors name, address and telephone number. Providing our competitor has the goods in stock, we promise to match his offer (on a 'same product - same price' basis) and still provide you with our normal free delivery. You will also be entitled to our full after sales service, including free newsletters and technical helpline support. We don't want you to go anywhere else for your Atari products. So shop at Silica, the U.K.'s undisputed No1 Atari specialist.

FREE SOFTWARE

When you buy a 520 or 1040 ST computer keyboard from Silica Shop, you will receive a large and varied software package free of charge. This package consists of twelve programs. Wherever you purchase your Atari ST computer, you should receive the first six software titles as standard. However, if you purchase your ST from Silica, you will also receive a further six extra titles, giving you a total of twelve. All ST's now have TOS/GEM already installed on ROM, so the list of free software you should receive is as follows:

1) GEM - *DR Desktop environment with WIMP (fitted in ROM)*
2) TOS - *Tramiel Operating System (fitted in ROM)*
3) 1st WORD - *Word Processor by GST using GEM*
4) BASIC - *Personal Basic by DR (with manual)*
5) LOGO - *Logo language by DR (with manual)*
6) NEOCHROME - *A powerful colour paint and graphics package (only useable with colour systems)*

If you purchase your ST from Silica, not only will you receive the standard six pieces of software as listed above, but we will also give you the following six additional programs FREE OF CHARGE:

7) MEGAROIDS - *Asteroids type game by Megamax*
8) DOODLE - *Simple paint/doodle drawing package (works on mono or colour systems)*
9) CP/M EMULATOR - *Allows use of DR's Z80 CP/M software to run on the ST range*
10) CP/M UTILITIES - *Various utilities to use with CP/M*
11) DEMONSTRATION & PUBLIC DOMAIN SOFTWARE - *Various games, demos and accessories*
12) CARDS - *A unique set of card games from Microdeal*

These additional free software titles are all part of the FREE Silica 'ST STARTER KIT', return the coupon below for further details.

FOUR FREE MANUALS

In addition to the free software which will be given to you when you buy your ST from Silica, you will receive four free manuals:

1) **ST OWNERS MANUAL (80 pages):** *Easy access to the information you require to unpack, set-up and become familiar with the ST.*
2) **ST BASIC SOURCE BOOK & TUTORIAL (240 pages):** *Gives you the information to increase your level of programming expertise.*
3) **ATARI LOGO SOURCE BOOK (77 pages):** *A source book for Logo, showing how to use the language in the GEM environment.*
4) **1st WORD MANUAL (48 pages):** *Instructions for 1st Word.*

ST NEWSLETTER

8 PAGES OF INFORMATION TO HELP YOU TO DECIDE
RETURN THE COUPON FOR A FREE COPY

1040ST-F

For the businessman and the more serious home user, there is the 1040ST-F with 1028K RAM. This can be used in a business environment as a stand-alone system, or can support a mainframe computer as a terminal. The 1040ST-F keyboard with integral 1Mb disk drive costs only £699 (+VAT=£803.85). As the 1040ST-F was manufactured solely with business use in mind, it does not come with an RF modulator for use with a domestic TV. Instead, it requires a monitor. There are three Atari monitors available and the prices for the 1040 with these monitors are as follows:

1040 Keyboard Without Monitor - £699 (+VAT= £803.85)
1040 Keyboard + High res mono monitor - £799 (+VAT= £918.85)
1040 Keyboard + Low res colour monitor - £899 (+VAT=£1033.85)
1040 Keyboard + Med res colour monitor - £999 (+VAT=£1148.85)

The 1040ST-F includes 1Mbyte of RAM as well as a 1Mbyte double sided disk drive and mains transformer, both built into the keyboard to give a compact and stylish unit, with only one mains lead. The 1040ST-F is supplied with a set of software disks as well as our own FREE Silica 'ST STARTER PACK'. Call into your nearest branch of Silica Shop for a demonstration.

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DESKSET
POP-UP DESK ACCESSORIES

By Mike Lewis

Another suite of memory-resident programs is muscling in on the market pioneered by Borland's Sidekick.

Desket is the latest offering in the fashionable new market for pop-up desk accessories. It has eight separate modules, ranging from a fairly trivial calendar to a respectable word processor. These modules are independent of each other; each may be loaded separately as needed and each is invoked with its own hot key. On balance, the package offers slightly more features than its obvious competitor, Borland's Sidekick.

We looked at the package marketed in Britain by Sagesoft, but an almost identical set of modules is available from Ideal Software. In addition, Ideal is marketing a package known as Desktop Plus, which includes an extra comms module. Ideal is also planning a series of two- or three-module packages based around the WP, calculator, comms and and DOS functions.

DOWNLOAD AFTER HOURS

The alarm clock, calendar and autodialler are unexciting. They allow you to flash messages on the screen at preset times, to view a calendar for any month or year, and to dial phone numbers from your main application. The best feature of the alarm clock is its ability to tell the operating system to run another program at a pre-defined time. This is very handy for downloading your electronic mail after office hours.

The pop-up calculators — there are two of them — are more interesting. The simple version is an ordinary four-function affair, with 10 separate memory registers and an optional hard-copy audit tape. The separate financial calculator incorporates a battery of financial and statistical functions such as compound interest, loan-repayment schedules, correlation and regression, and much more. Any self-respecting spreadsheet offers much the same, but having it as a pop-up is so much easier.

The module that will have the widest appeal is Popword, the mini word processor. It supports all the common WP features, including search and replace, block move and copy, automatic reforming of paragraphs and so on. You can cut and paste text between the pop-up and the main application, either as lines or as rectangular columns. Its printer support is slightly ahead of Sidekick's notepad, although it has no way of putting printer control codes in the text. It is adequate for note taking and for quick memos, but not for heavy-duty word processing.

Another useful module is Popdos. This program includes a mixed bag of DOS-style file-handling functions. It enables you to copy, delete, display or rename any file, or to list a directory, without having to quit your main application. You can also tell it to change the current directory and to keep the change in force after returning to the main program. This will be good news to users of packages like WordStar and Crosstalk that do not recognise full path names.

Popdos also sports some handy printer-related features. One option will set the printer up for different print styles, such as emphasised and double width. Unfortunately, only the lowest common denominator of Epson codes are supported, which means that you cannot use it to set the printer to double spacing or to NLQ mode. Another option puts the system into typewriter mode, which is terrific for typing a quick envelope or label.

DESKSET

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	■	☐
Ease of use	☐	☐	■	☐
Documentation	☐	☐	■	☐
Value for money	☐	☐	☐	■

☐ One of the better multi-function desk accessories, and a serious challenger to Sidekick.

POPANYTHING

The final Deskset module is called Popanything. In theory, this allows you to run any application as a pop-up from any other, provided of course that enough RAM is available. In practice it is not quite as wonderful as it sounds, although it is still very useful. It works by invoking, as a pop-up, a secondary command processor. This gives you access to the DOS prompt and therefore to any other program, no matter what you are doing. The limitation is that you cannot pop into and out of the secondary program at will. To get back to where you left off, you must close down the pop-up, then type Exit from the DOS prompt.

Although Deskset is ahead of Sidekick on functions, the Borland product has a nicer feel. In Popword, for example, you can only choose between a full-screen window and one occupying a fixed, narrow column. Other modules have similar limitations. In Sidekick, the user has complete control over the size and position of all the windows.

All eight Deskset modules work happily with each other, provided that you observe the correct order of loading. But using Deskset with other memory-resident products could cause problems. I found that Superkey and Metatext worked fine, but not Turbo Lightning. With Sidekick loaded, invoking the pop-ups was a bit hit-and-miss, and cutting and pasting would not work at all. Clearly, Sidekick users will have to decide between going over to Deskset completely or leaving it alone.

SPECIFICATION

Description: set of memory-resident utility programs comprising clock, calendar, two calculators, autodialler, mini word processor, DOS-style file functions and DOS command line; Deskset Plus has an additional comms program
Hardware required: IBM PC, PC/AT or compatible; comms programs require Hayes-compatible modem
Copy protection: none
Price: £69 from Sagesoft; Ideal Software sells Deskset for £59.95, Deskset Plus for about £75 and the mini-packages for £19.95 each
Publisher: Popular Programs of Kirkland, Washington, U.S.A.
U.K. distributors: Sagesoft, NEI House, Regent Centre, Gosforth, Newcastle upon Tyne NE3 3DS. Telephone: 091-284 7077. Ideal Software, Tolworth Tower, Surbiton, Kingston, Surrey KT6 7EL. Telephone: 01-390 6722
Available: now

CONCLUSIONS

■ Packages like Deskset can be enormously useful, helping your usual software to do all kinds of things that would not otherwise be practical.
■ Although a few of the Deskset modules are fairly trivial, most regular computer users should find a use for at least part of the package.
■ For those who only need one of the major functions the mini-packages are a very economical option. PC

NORTON UTILITIES 3.1
DOS EXTRA

By John Lee

This suite of programs adds extra functions to the standard DOS utilities, including the ability to restore deleted files. Now it is available in an upgraded version.

Most of the basic utilities needed for setting up an IBM-compatible computer and for its day-to-day operation are provided as part of the PC-DOS or MS-DOS operating system. Useful as these utilities are, they are not completely comprehensive — as the continuing popularity of the Norton Utilities testifies.

The latest release of this package, version 3.1, simplifies the main program and adds two new utilities: Quick Unerase and Unremove Directory. Many of the other utilities in the suite have also been enhanced. The programs run on almost all IBM PC compatibles. They are supplied on a single floppy disc and are supported by a 64-page manual.

The main program is a sophisticated tool for recovering erased files or attempting to recover damaged files. If you use the MS-DOS command Erase or Del to delete a program and then change your mind the Norton program can be used to restore it.

When a file is erased only the directory is altered; the data is left unchanged, though the sectors it occupies are released for reuse when needed. Provided you have not written anything to the disc after erasing the file the sectors containing the lost file will not have been reused, so the file can be recovered without fail.

Before you start to recover an erased file it is prudent to copy the whole disc if possible. This can be done easily with floppies, but is impractical with hard discs. To run the program you simply type

NORTON

A message

Reading disk information

appears followed by a menu. Selecting f3 calls up a further menu which offers you the following options:

f1 — change selected drive and directory
f2 — select an erased file to unerase
f3 — display information about an erased file
f4 — find erased file's data
f5 — save unerased file
Esc — return to top-level menu

You simply work through these steps in order. The bottom part of the menu shows the disc drive, the sub-directory and the file selected.

When you select f2 the program displays all the erased files in the relevant directory. The first letter of each file name is missing, and is replaced by a question mark. You simply select the appropriate file in the list and press Enter. You are then asked to type the missing first letter for the file name.

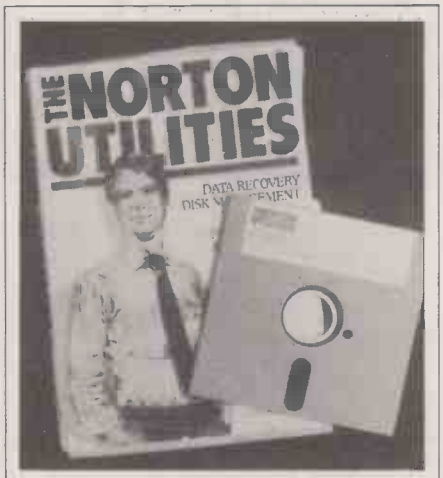
Keying f3 will display information about the erased file. This tells you if any of the space formerly used by the file has been used for other files; if it has, only partial recovery will be possible. With a .Com file or a highly structured file such as a Lotus worksheet, anything less than complete recovery is useless. For text files or Basic programs part of the file is better than nothing.

Several options are available for the data. The easiest is automatic selection of all the data clusters. With luck, the program will report that all the data clusters have been found; you then press Esc and return to the menu. Semi-automatic selection allows you to look at each cluster of data before adding it to the file. You can also search for specific data if you know some text that follows what you have already found, or you can specify specific sectors that you think hold the data.

You may try any method or a combination of methods, and change your mind. Nothing permanent happens until you move to the next step and save the file on disc by pressing f5.

If you have written to the disc after erasing the file, it is possible that the new file has not overwritten any of the sectors in the erased file, but if the old information has been overwritten it cannot be recovered. In that case you use another part of the program that explores the disc and shows the cluster number and sector numbers used for the file you require. With care you should be able to save the part of the file that remains, but you will have to rewrite or reconstitute the missing part.

The program can also be used to recover from errors introduced by spikes on the power supply, switching the computer off with a disc in the drive, corruption of the directory or the file-allocation tables, or a misaligned disc drive. You can examine the contents of a file, the directory or the file-allocation table. If you can find what is wrong, you can change the corrupt part. This requires both skill and luck.



SPECIFICATION

Description: set of utilities, mainly for disc management
Hardware required: IBM PC, PC/AT or compatible with DOS 2.0 or later and at least 128K of RAM
Copy protection: none
Price: £62
Publisher: Peter Norton Computing of Santa Monica, California
U.K. distributor: Softsel, Softsel House, Syon Gateway, Great West Road, Brentford, Middlesex TW8 9DD. Telephone: 01-568 8866
Available: now

WORK ON A COPY

Repair and recovery are not certain, and it is always best to work on a copy of the damaged disc rather than the original, in case your changes make things even worse. Copying should be done using the DOS command Diskcopy, which copies the disc regardless of its contents. The Copy command only copies intact files. It is also worth trying the DOS utility Chkdsk on the copy of the disc in these cases.

Of the remaining programs in the Norton Utilities set, 12 help with disc management. A novel feature is that you can choose whether to use long or short names to call the programs. Two programs called Short and Long are provided: running Short renames the Norton programs in the file directory from long descriptive names of six to eight letters to two-letter names, which are quicker and more convenient to type. The program Long changes short file names into long file names, which may be helpful for beginners.

Suppose you have forgotten what sub-

```
C:\LETTERS

  WS.COM          25,600 bytes   11:31 pm Sat Feb  1 86

  WSMSGS.OVR      32,256 bytes   12:39 am Tue Jan  1 80

  WSOVLY1.OVR     46,000 bytes   12:37 am Tue Jan  1 80
```

Figure 1 (above): Filefind locates the sub-directory of specified files.
Figure 2 (below): The Filesize command.

```
 4,736 IBMBIO.COM

17,024 IBMDOS.COM

 1,152 AUTOEXEC.BAT

17,664 COMMAND.COM

25,600 WS.COM

32,256 WSMSGS.OVR

46,000 WSOVLY1.OVR

144,432 total bytes
in 7 files
166,096 bytes disk space
occupied, 15% slack
```

directories exist on your hard disc or are using an unfamiliar machine. The Listdir (LD) program can then be used to give the names of all the directories and sub-directories on a disc. The options /P and /W may be used in exactly the same way as for the MS-DOS Dir command. Thus the command

LISTD/W

arranges the sub-directories in four columns across the screen. Adding /P is useful when you have a large number of sub-directories, as it pauses when the screen is full to allow you to read it, instead of scrolling off the screen. The option /A may be added to make Listdir search all disc drives, and the option /T shows the total number and sizes of files in the directory.

You may have forgotten which sub-directory you used to store a particular file. The program Filefind (FF) will search through all the directories to find a named file. The command.

FILEFIND FORMAT.COM

searches the default drive and shows a list of directories or sub-directories in which a file called Format.Com is found.

You may specify which disc drive you wish to search and you can also use wild card characters as a part of file names. Thus

FILEFIND C:WS*.*

would locate all files beginning WS, regardless of their extension. This might produce the output shown in figure 1. The dates and times when the files were created provide a useful reminder of which version of a file is the most up to date if two files with the same file name are found in different sub-directories. The /P and /W options can be used in the same way as with Listdir. You may also use Filefind to list all files on all drives with the command

FILEFIND /A

It is hard work to look for a particular file name in a large directory, since the file names are normally in a random order. The program Dirsort (DS) reads a directory, sorts it into order and writes the sorted directory back on to the disc. You may choose how you would like the files to be sorted by specifying one or more key letters. N sorts the files alphabetically based on the file name, E sorts on the file extension, D and T sort on the date or time the files were written, and S sorts on their sizes.

Putting a minus sign in front of any of the sorting parameters makes the program sort in the reverse order. Thus -S sorts files on their size with the smallest first, and -D will sort on the date with the most recent date first. These methods of sorting may be combined, and you can specify which directory is to be sorted. The command

DIRSORT EN C: /TEMP

would sort the files in the sub-directory Temp on drive C:. If you wish to sort all the sub-directories below the directory specified, you should include the /S option, thus

DIRSORT EN/S C:

would sort the files in the root directory and all the sub-directories below it — which would in fact be the whole of disc C.

The Disktest (DT) program will test that your disc is readable and free from damage. The command

DISKTEST/F

reads and test the contents of your files and their directory entries. The file name currently being checked is displayed, and this is continuously updated. A list of sub-directories that have been checked is also displayed. Used with the /D option Disktest reads every part of the disc, whether it is in use or not, starting with the system area, and reports the number of each cluster as it is checked. The /B option performs both tests.

If the program detects unreadable parts of the disc which are not at present in use, it will ask you permission to mark these as bad sectors so that they are not used. This is particularly important on Winchester discs. You may log the results of the test on the printer or in a disc file by adding /Log command, and

DISKTEST /B /LOG>>TEST.LOG

will send output to the file Test.Log. Disktest works in a different and complementary way from the MS-DOS command Chkdsk so both tests should be used regularly, particularly to safeguard hard discs.

The Filesize (FS) program will display the sizes of a group of files. It also shows the total size of a group of files added together, the number of files involved and how much disc space they actually occupy, including the inevitable wasted space. This program differs from the DOS Dir command in two important ways: Filesize does not display sub-directories, and the DOS files that are hidden from the Dir command are shown by Filesize.

On an IBM machine the command Filesize produces output like that in figure 2, where Ibmbio and Ibmdos are system files normally hidden from Dir. If you do not want to cover the whole of the current drive you can specify a set of file names and an alternative drive. For example

FILESIZE D:WS*.*

would display information only for matching files on drive D. If you wish to check if there is enough free space on another disc, for example on drive A:, to copy a set of files to, use the command

FILESIZE WS*.*A:

The program will work on sub-directories below the current directory if you add /S to the command. The option /P may be added to the end of the command to make the display pause when the screen is full, and /T lists only the bottom two lines of output, omitting the details of individual files.

The Fileattr (FA) program may be used to display the status of the archive and the read-only attributes of a particular file or a group of files. The archive attribute is set up when the DOS Backup program is run in order to copy the contents of a disc on to another disc or tape streamer. You may wish to change this to get another backup copy made, or conversely to prevent it being archived.

Normally a file can both be read and written to, but if the read-only attribute is set for a file it can only be read, and cannot be altered or deleted until the access has been reset to read and write. This ensures that deletion cannot occur by accident. The Fileattr program may be used to change either the archive status, the read-only status or both.

FINDING TEXT

The Textsrch program (TS) searches a disc for a portion of text data that you specify. Normally only the files on the disc are searched, but the option /D instructs the program to search the whole disc, including free space. Option /E searches the erased file area, and /S searches sub-directories below the current one. If any matching text is found the filename, the location and the adjacent text are displayed, and you are then asked if you want to search for another match. If you choose to search across the whole disc you are given the option to copy the text and its surrounding data into a file. Other options include /Eur to handle the extended character set, /EBCDIC to handle EBCDIC code, and /Log to send output to the printer or a file.

One simple use for this utility is if you have forgotten the name of a file but can remember some of its contents. Textsrch is also valuable in locating lost information in

(continued on next page)

(continued from previous page)

the erased space on the disc. If the Quick Unerase program cannot recover an erased file, it may be possible to recover it by unerasing using the main program; if that will not work, then partial recovery may be achieved by using Textsrch to copy blocks of data that you can recognise into a file.

The Qkuneras (QU) program provides a very simple way to recover files that have been erased. By default it will work on the current directory, or you can specify a drive or directory. The program reports how many erased files are present in the directory concerned and how many it can rescue.

If you accidentally erase a file, and run Qkuneras straight away, you are certain to be able to recover the file. If you have written other files to the disc after erasing the file you will not be able to recover the file if some parts of it have been overwritten. The program displays the file name of the first erased file — except for the first letter, which will have been lost — together with the file size. If the file can be unerased you are asked to type the missing first letter, and it is done. The program then moves on and repeats the procedure with subsequent erased files until all erased files in the directory have been examined.

You may add the parameter /A to make the program work automatically. It will recover all of the files in the relevant directory that have been erased but are still intact, replacing the first letter of the original file name with the first letter in the alphabet that gives a unique file name. You will have to rename any recovered files to reinstate their original names. You should always check the recovered file to make sure that it contains what you expected. If it is not the correct data, erase the file again and try using the more sophisticated Norton program instead.

RECOVERING DIRECTORIES

The program Unremdir (UD) will recover a file directory that has been erased. Before running the program you normally enter the parent directory — that is, the one immediately above the deleted one. Alternatively you may specify the parent directory in the command. The program reports the number of removed sub-directories present in the directory you specify, and prompts you with the name and the date and time that the sub-directory was created as a means of identification.

In the same way as with erased files, the first letter of the sub-directory name is lost. The program asks if you want to restore this sub-directory to working order. If you reply Yes, you are prompted for the missing letter. Provided that none of the space it used has been written on by other files, the directory is then restored. It is very important that you attempt to recover an erased directory as soon as possible, since writing a file could prevent recovery.

It is always a good idea to use a volume label to identify floppy discs. DOS allows you to write a volume label when you format a disc, but versions before 3.0 do not allow you to add a label or change it later. The program Volabel (VL), however, allows you to write a label or change an existing label on a disc at any time, without altering any of the files on the disc. You simply run the program and type the new label. The Volabel program distinguishes between upper- and lower-case letters, unlike the DOS facility, which renders everything you type in as a label as capitals.

The two programs Wipefile and Wipedisk are useful aids to safeguarding the security of confidential data. Erasing a file or formatting a disc does not actually remove the data from the sectors on the disc, so it is possible that a determined snooper could read confidential information from an erased file. But the Wipefile program actually writes zeros or any specified number over a named file, obliterating the original contents. Similarly Wipedisk writes over a whole disc, or just the erased area, thus wiping out any data left there.

Both commands must be used with great caution, since careless use can totally destroy data that is needed. Because the programs are so destructive, they do not have short two-letter names. Forcing you to type the full name makes it less likely that you will run one of these programs by accident.

NORTON UTILITIES 3.1

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	☐	■
Ease of use	☐	☐	■	☐
Documentation	☐	☐	■	☐
Value for money	☐	☐	☐	■

☐ A must for all serious PC users.

An assortment of miscellaneous programs is included in the Norton suite. Beep makes a noise in the computer's loudspeaker to attract attention when a long job or a batch job are complete, or if an error has occurred. The /F option specifies the frequency of the note, /D its duration and /R the number of times it is repeated. For example:

BEEP /F100 /D10 /R4

gives a fairly low-pitched note that lasts for about a second and is repeated four times. You use Beep to give distinctive warnings for different events.

Lineprnt (LP) is a simple program that formats a single text file or a family of files and sends it to the printer. There are 13 options that may be selected, most of which are followed by a number. Pages are output with the file name and the current date printed at the top, and by adding /N the page number is printed as well. If you do not want this information at the top of the page, you use the no-header option /Noh.

Four commands set the margins: /T the top, /B for the bottom, and /L and /R for the left and right margins. The page size is controlled by /H and a number, which sets the height of the page in lines, and /W and a number, for the number of characters in a line. Normally page numbering starts with page 1, but any other starting number may be set by /P and a number.

The spacing between lines may be controlled with /S, while /80 and /132 generate printer codes that set many dot-matrix printers to normal and compressed print modes respectively. The /Eur option allows you to use the extended character set with the eighth bit set. This program formats documents reasonably well, and could come in useful if you do not have a word processor.

The Scratr (SA) utility changes the screen attributes on a colour screen. It only works if the Ansi.Sys driver has been loaded, but this is usually done by putting the line

DEVICE=ANSI.SYS

in the Config.Sys file. The program is useful to set the colour combination used on a colour monitor screen both for letters and for the background.

The Sysinfo (SI) program reports technical information about your computer, including the type of machine, version of BIOS and DOS, number of disc drives and amount of memory installed. The program also shows the location in memory of your programs, and helps you to understand the memory map. Finally, a computing performance index is given, showing the raw power of your machine relative to an IBM PC.

The Timemark program may be used either to display the current date and time or as a stopwatch timer. Thus

TIMEMARK START

followed by

TIMEMARK STOP

displays the starting date and time on one line of the screen followed by the elapsed time on a second line. Any one of four different timer counters may be used by specifying /C1, /C2, /C3 or /C4 in the command, so that several different times may be recorded. You may also specify /Log, in which case the output is sent to the printer or to a data file.

Most of the Norton Utilities can be used with only the briefest reference to the documentation supplied. The only area where I would have liked more help from the manual is on the difficult subject of repairing damaged files. The manual itself is typeset, and is generally clear, well written and understandable, though it does not have an index.

CONCLUSIONS

■ The Norton Utilities will be useful to almost all serious users of IBM machines and compatibles.

■ I use some of the programs so regularly that I wonder why they were not included in the original system. Others are interesting, but of little use except for helping you understand how your system works.

■ All the programs work well and without any problems.

■ You need only recover a single lost file or damaged directory to justify the cost of the package. PC

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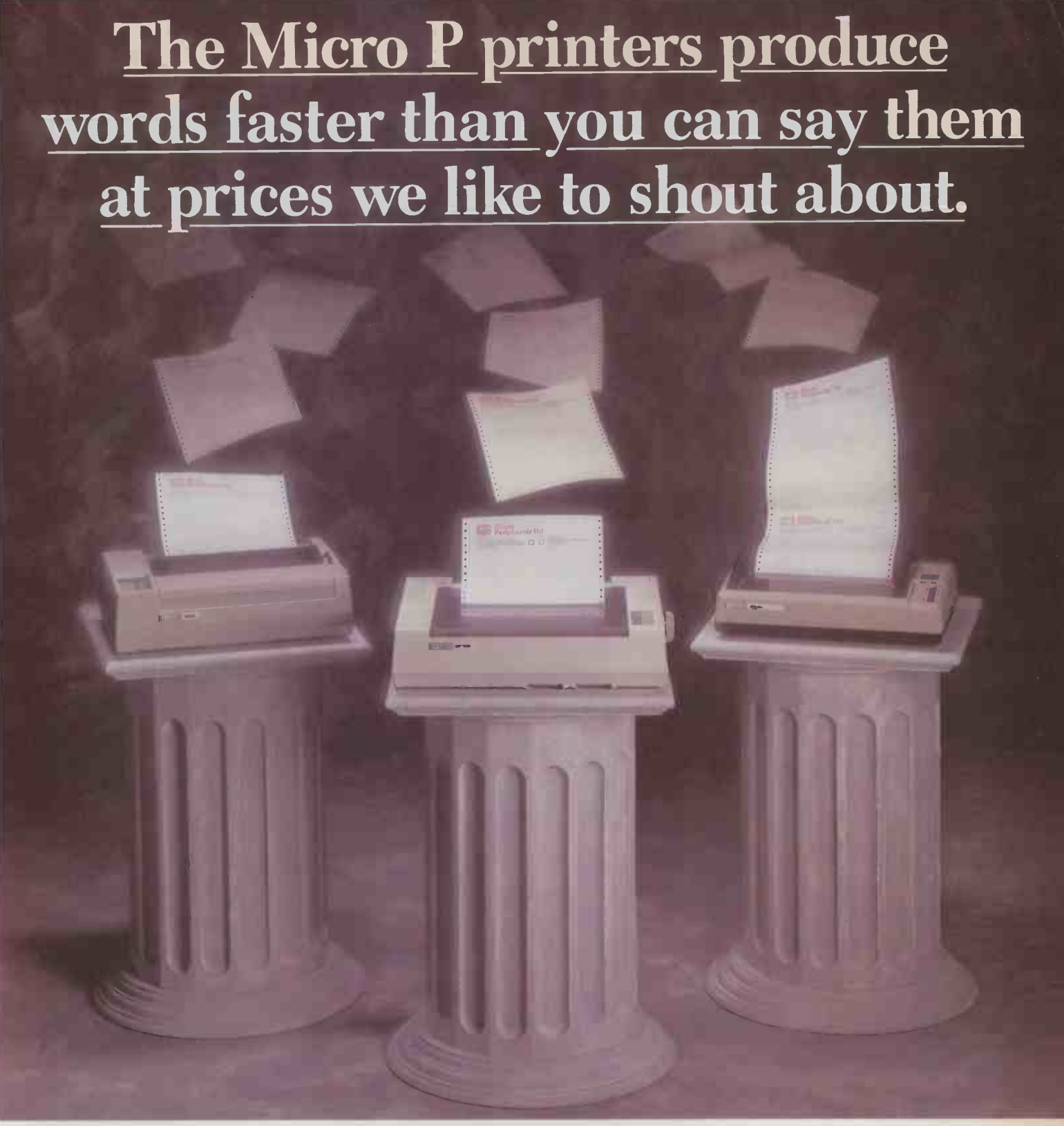

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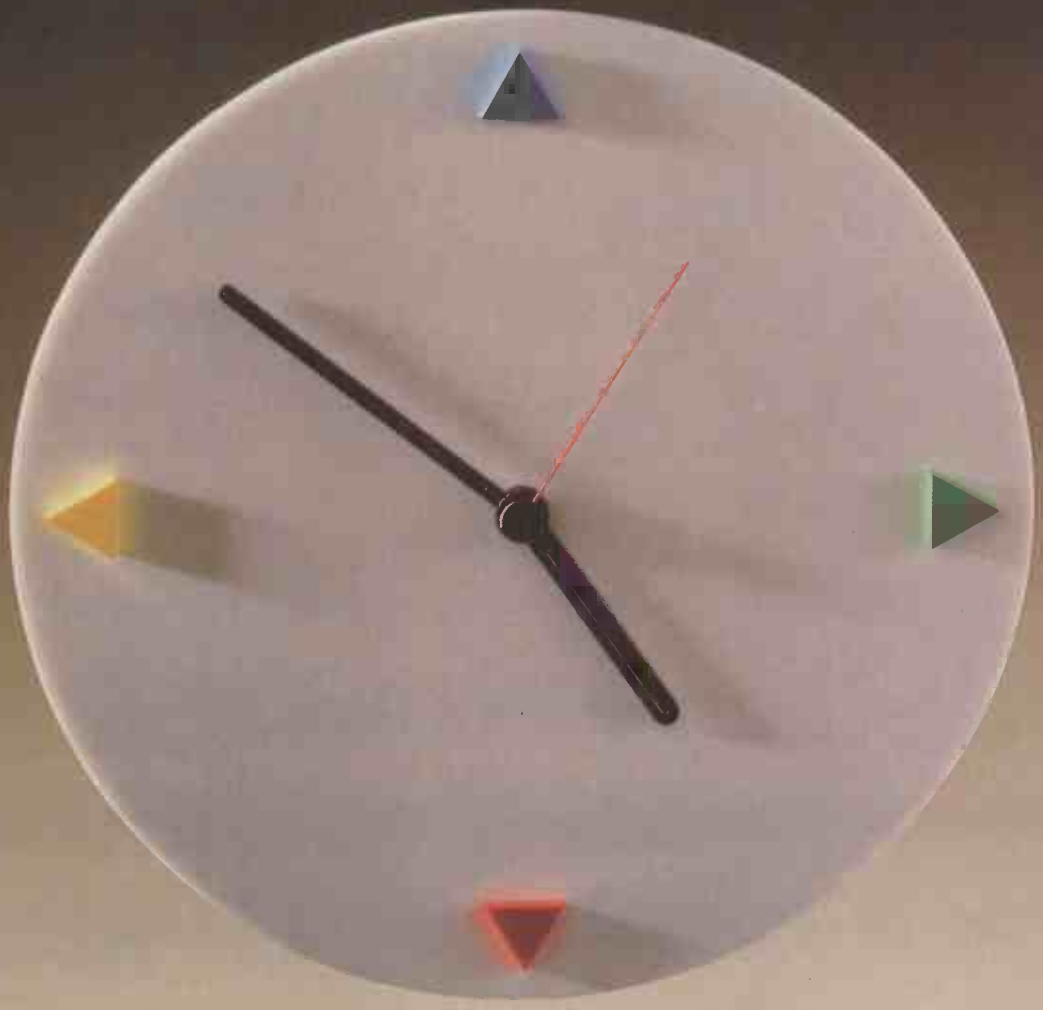

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MAC COMMS
PUBLIC-DOMAIN PROGRAMS

By John Lewis

A wide selection of comms software for the Apple Macintosh is available free of charge or at nominal cost. Much of it will stand comparison with commercial programs.

One of the results of the Macintosh being rushed on to the marketplace was that it lacked any form of credible communications software. A prerelease version of the Apple terminal package, Macterminal, was available in the early days, but it left a lot to be desired. The result was that some Mac owners wrote their own terminal emulators so that they could start communicating.

Today public-domain programs rival commercial packages like Vicom or the latest version of Macterminal. Typically they support data-transfer rates from 300 baud to 2,400 baud. To provide for the various communication protocols it is usually possible to set the key parameters, including the number of stop and data bits, parity and whether operation is at full or half duplex. They also have the ability to save or transmit files, and they can emulate VT-52 and VT-100 terminals in addition to the simple TTY mode plus one or more of the file-transfer protocols such as Macbinary, Xmodem or Kermit.

It is impossible to transmit Macpaint, Macdraw and Macwrite files using just an ASCII text transfer. So a number of leading Macintosh communications users in the U.S. drew up a specification for a transfer routine which would enable Macintosh documents to be transmitted in their expanded form, retaining all the relevant graphics and formatting information. Error-checking routines were also incorporated, so that if the receiving computer detected an error it would ask for the erroneous block of data to be retransmitted. The result is a program called Binhex, which is currently at version 5. Many of the terminal programs incorporate it as one of their menu options.

RED RYDER

Now in its 9.4 version, Red Ryder has become the standard against which public-domain comms packages are measured. Although it is in the public domain Red Ryder is not free; if you use it you are expected to send $40 to its author, Scott Watson. When you send your money you become a registered user and will get further releases plus another program called Red Ryder Host, which enables you to run your own bulletin board or electronic-mail operation.

The standard program is very powerful as it incorporates macros and procedures. Red Ryder has up to 30 macros which can be used for telephone numbers, log-on codes or passwords, and suchlike. You can also write procedures that, for example, dial a number, log you on, download a particular file, log off and shut down at a certain time. If you do not want to write a procedure Red Ryder has a macro feature which records the keystrokes you make while logging on, ready to play them back next time you want to access that particular service. Red Ryder is Hayes compatible and supports tone and pulse dialling.

Because communications have grown so fast there tend to be a number of different standards. For example, some systems expect a Carriage Return to be followed by a Linefeed, while others assume that a Carriage Return includes a Linefeed. Since the Mac does not have the traditional Control and Escape keys you have to define them. Red Ryder allows you to tailor the keyboard to suit the system you will be working on.

A number of different terminal protocols are in common use, the main ones being TTY, VT-52 and VT-100. TTY is the one used by most bulletin boards and for electronic mail. If you want to set up your Mac as a terminal to a mainframe you may find that you have to make it behave like a VT-52 or VT-100 terminal. These have special characteristics and control codes for cursor movement and the like which Red Ryder can emulate. A timer indicates how long you have been on-line.

Other terminals available include Free Term, PG Term, Squirm Term and Mock Terminal. They lack some of the more advanced features of Red Ryder but are adequate for most purposes. Mock Terminal has the convenience of being set up as a desk accessory, but it only supports TTY. It was written by Donald Brown who also produced the Mockwrite, Mockprint and Mockchart range of accessories. Mock Terminal, is available for a $25 honorware fee, which covers all the other programs in the series.

PG Term is shareware and costs $35. In addition to TTY it offers a limited subset of VT-100 so that it can communicate with some mainframes. It includes a filter facility to remove, say, incoming Linefeeds which may not be required. Like Free Term it comes with a manual on disc.

Squirm Term differs from the rest in that it supports rates of 19.2Kbaud and 38.4 Kbaud. While these are too fast for normal telephone-line communication they can be used to transfer data between two micros connected back to back.

For those terminal packages which do not themselves support macros, Autolog can provide the necessary dialling and log-on routines via a desk accessory. Autolog is offered as shareware and comes with a manual but it does not have a fixed charge; the author only asks that you send what you think it is worth.

Multichannel Communication System (MCS) is a useful error-correcting protocol for long-distance communications involving satellites, where the link tends to have a high noise level and long return times. Operators can chat via their keyboards while files are being transferred with little degradation of transfer time.

CONFERENCING

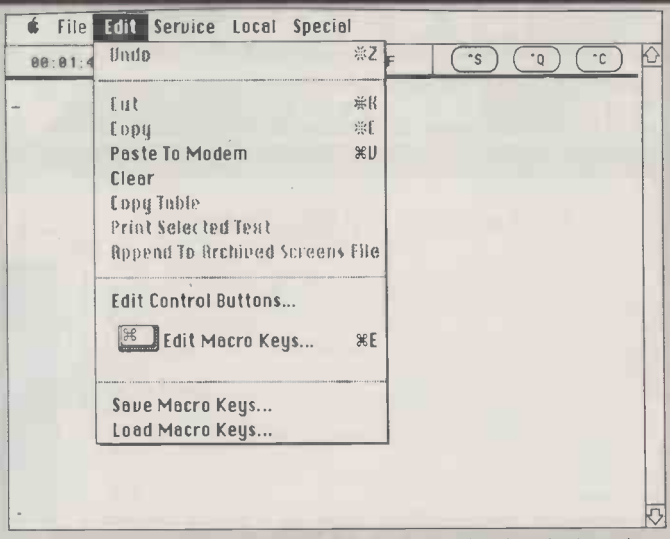
Many of the bulletin boards in the U.S. offer conferencing facilities whereby a number of people can be on-line at the same time. Bob Perez's VMCO includes an on-screen display that shows a conference table with chairs around it. The table top acts as the message window where all the dialogue appears. A speech synthesiser is installed so that you can hear the conversations taking place. Each person has a face which you can alter to represent their expression; many users have produced cartoon likenesses of themselves. There is even a sign to say you have had to leave for a few minutes.

In the U.K. many computer users favour the British Telecom Prestel system for electronic-mail and bulletin-board facilities. Unlike most other systems it uses a split baud rate of 1,200/75 baud, and this causes problems for a lot of communications programs. Pretzel, a desk accessory written by Paul Russell, copes with Prestel alphanumerics, flashing characters, etc., though it cannot yet deal with double-height characters.

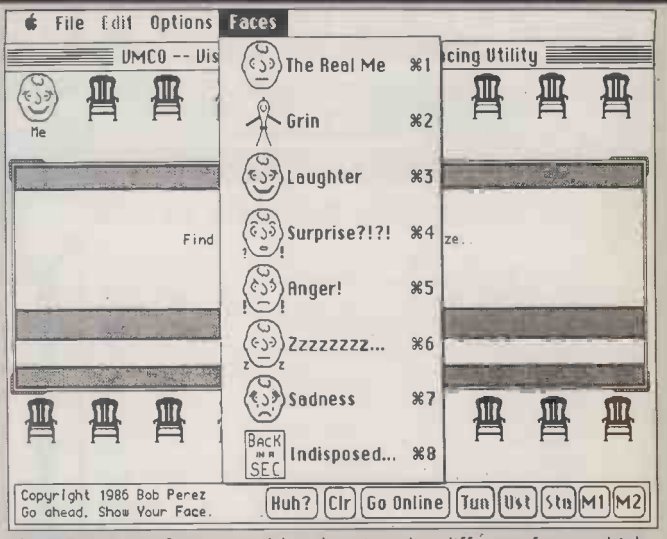
For modems that cannot handle a split baud rate Paul Russell also provides Baud Buster, which consists of a small piece of external hardware based around the 555 timer chip. It effectively reprograms the Mac's serial communications controller via the serial port, and includes desk-accessory software to control it.

John Lewis is the founder and operator of the Mac User Group.

SPECIFICATIONS



The Red Ryder screen. Elapsed time is shown by the clock at the top of the screen. The ^S, ^Q and ^C buttons are used to control the data flow. The Edit menu shows the other options available, including macros. The program is Hayes-compatible.



The VMCO conference table, showing the different faces which can be selected to indicate your level of interest in the proceedings. The text typed by participants appears on the table top; speech synthesis is also available.

APPLE TERM
Description: terminal program with restricted features
Baud rate: 300, 600, 1,200, 2,400
Registration fee: none
Author: Apple Computer, Cupertino, California

AUTOLOG
Description: desk accessory that automates log-on sequences; for use in conjunction with a terminal package; complete with documentation
Registration fee: none
Author: Steve Fine, 504 Lindon Raad, University Park, Pa 16802

BAUD BUSTER
Description: hardware modification that allows split baud-rate operation with standard modems; can be used in conjunction with the desk accessory Pretzel for Prestel
Baud rate: 75/1,200
Registration fee: none
Author: Paul Russell, ARC Electronics, Flat 27, Chain Pier House, 46-49 Marine Parade, Brighton BN2 1PE

BINHEX 5
Description: file-transfer protocol which allows formatted Macintosh files, such as Macpaint and Macwrite, to be transmitted intact
Registration fee: $10
Author: Yves Lempereur, 28611B Canwood Street, Agoura Hills, Ca 91301

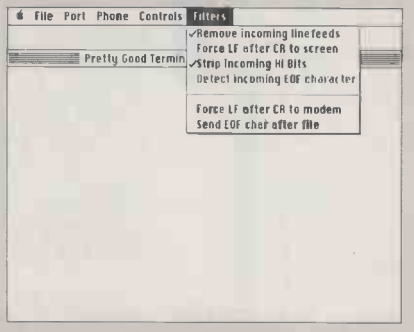
FREE TERM
Description: simple terminal package complete with documentation; supports both ASCII and Xmodem transfers and can send and receive files to and from disc
Baud rate: 300, 1,200, 2,400
Registration fee: none
Author: William Bond, Dreams of the Phoenix, PO Box 10273, Jacksonville, Fl 32247

KERMIT
Description: file-transfer protocol to ensure reliable data transfer in both binary and ASCII modes between the different hosts
Registration fee: none
Author: Bill Catchings, Columbia University, New York

MCS
Description: file-transfer protocol for long-distance communications channels; includes chat facility
Baud rate: 300, 600, 1,200, 2,400
Registration fee: $10
Author: Yves Lempereur, 28611B Canwood Street, Agoura Hills, Ca 91301

MACTEP
Description: a terminal emulator written in Basic; needs Microsoft Basic
Baud rate: up to 38,400
Registration fee: none
Author: Dennis Brothers, Brothers Associates, 197 Old Connecticut Path, Wayland, Ma 01778

MOCK TERMINAL
Description: simple desk-accessory terminal; needs a separate configuration utility to set up baud rate, data length, ports, etc.
Baud rate: 300, 1,200
Registration fee: $25
Author: Donald Brown, CE Software, 801 73rd Street, Des Moines, Ia 50312



The Filter Menu from PG Term.

PG TERM
Description: modem comms program that supports Macbinary and Xmodem file transfers as well as giving a VT-100 emulation; includes filters to strip unwanted incoming characters and macros to combine a number of keystrokes
Baud rates: 300, 1,200, 2,400, 4,800, 9,600
Registration fee: $35
Author: Phillip Zimmerman, 440 South 45 Street, Boulder, Co 80303

RED RYDER
Description: full-featured terminal package that supports text, Xmodem and Kermit file transfers with filters and forced line ends; macros, procedures, a dial facility and documentation are included
Baud rates: 300, 450, 600, 1,200, 2,400, 4,800, 9,600
Registration fee: $40
Author: Scott Watson, The Freesaft Co., 1028 Lacklink, St. Louis, Mo 63114

SQUIRM TERM
Description: simple terminal emulator written in one of the newer devleopment languages for the Macintosh, Rascal
Baud rates: 300, 600, 1,200, 2,400, 9,600, 19,200, 38,400
Registration fee: none

VMCO
Description: terminal program for conferencing calls; complete with documentation
Baud rates: 300, 1,200, 2,400
Registration fee: none
Author: Bob Perez, 5751 Choasset Way, San Jose, Ca 95123

● *All the programs mentioned above are available from the Mac User Group, 55 Linkside Avenue, Oxford OX2 8JE. Telephone: (0865) 58027* PC

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ZORLAND C
LOW-COST COMPILER

By Steve Malone

It is not only applications software that is beginning to appear at bargain prices, as this implementation of the C language demonstrates.

Perhaps the most fashionable programming language of the moment is C. It was developed at Bell Laboratories primarily for use with the Unix operating system, but has since found widespread acceptance among programmers as a means of producing tight, low-level code. On the hardware side, the flavour of the month is undoubtedly the Amstrad PC. This cut-price micro has brought in its wake a corresponding fall in the cost of IBM PC programs, with software houses indulging in an eager scramble to gain a following among its cost-conscious new users. It is clear that anyone who comes up with a low-cost C compiler for the Amstrad PC should be on to a winner.

Zorland International certainly appears to think this way, and has launched a C compiler that can be bought for the modest sum of £29.95. It is a full implementation of the language in line with the principles laid down by Kernighan and Ritchie, the originators of C. Zorland C is compatible with Microsoft and Lattice C source code, which provide a ready-made library of available utilities.

C is a language which bears a strong superficial resemblance to Pascal. Thus it contains Pascal-like features such as declaring variables at the beginning of the source code and encouraging nested subroutines. On the other hand, the language also shows the influence of Unix. For example, C uses the single-character separators { and } to mark the beginning and the end of functions. This is in contrast to Pascal, which uses the easier Begin and End. As a result C programs tend to be more prone to error.

Zorland C consists of an editor, a two-pass compiler and a number of library routines. The company has avoided any attempt to turn the compiled code into MS-DOS executable binary. This task is wisely left to the Microsoft utilities Link.Exe and Exe2bin.Exe, thus ensuring compatibility. The compiler is supplied on two discs. The first is the compiler itself, which includes the control program, parsing files and the other files necessary to produce the object code. The other disc contains an editor and a number of sample programs to get you started.

SPECIFICATION

Description: C compiler with library files, a full-screen editor and sample programs
Hardware required: IBM PC, PC/AT or compatible with at least 180K of memory and two disc drives; a hard disc is desirable
Copy protection: none
Price: £29.95
Publisher: Zorland International, 144 Griffin Road, London SE18 7QA. Telephone: 01-317 7240
Available: now

The requirements of Zorland C look to be tailor-made for the Amstrad PC. The company suggests that the compiler works best with about 512K of RAM — although it will work with 256K — and two floppy discs or a hard disc. Zorland also recommends that users set up a RAM disc to store the temporary files created by the compiler, allowing them to be accessed faster.

The first thing a user will want to do with the compiler is install it using the setup routines supplied by Zorland on the compiler disc. Two routines are provided. FD-Setup installs on a blank formatted floppy with the system, while you use HD-Setup for a hard disc. The utilities create a boot disc with suitable paths and instructions to optimise compilation.

DISC ORGANISATION

For floppy-disc installation Zorland recommends that source files be kept on one disc and compiler files on another. Accordingly it has arranged things so that the compiler looks on the second disc for source and temporary files. The Autoexec.Bat file created by the setup program contains a number of Set commands which redirect the files to the disc. The setup programs also alter the Config.Sys file to set the numbers of files and buffers. Like the use of the RAM disc this increases the speed of compilation and reduces the amount of disc accessing that is required by the compiler.

Zorland gave us several versions of the installation batch files, but all of them were bug-ridden to some extent. Paths created in the Autoexec.Bat file did not work, and Config.Sys files were not updated. A phone

```
ZORLAND  File:dump.c                          Line:11  Col:1       INS
#include<stdio.h>
#include<ctype.h>

main(argc,argv)
int argc;
char *argv[];
{ FILE *f;
  int i, buffer[16];
  unsigned offset = 0;

  if (argc != 2)
  {printf("Error: wrong number of arguments\n");
printf("Use: dump file\n");
exit(1);
  }
  f = fopen(argv[1],"rb");/* open file for binary read*/
  if (!f)
  {printf("Can't open file '%s'\n",argv[1]);
exit(1);
  }

  while (1)
  {for (i = 0; i < 16; i++)
```

```
B>zc dump -mci
ZC1  -ms -oB:\temp.tmp dump
 ZC1 1.10 Copyright (C) 1985,1986  ZORLAND LTD, written by Walter Bright
function main
 ZC1 complete. Time: 9.38 seconds

ZC2  B:\temp.tmp -odump.obj
 ZC2 1.10 Copyright (C) 1985,1986  ZORLAND LTD, written by Walter Bright
function main
 ZC2 complete. Code: 0x013f Data: 0x005f Time: 6.58 seconds

LINK A:\cci+dump,dump,,A:\nl

   Microsoft Object Linker V2.01 (Large)
(C) Copyright 1982, 1983 by Microsoft Inc.

Warning: No STACK segment

There was 1 error detected.

EXE2BIN dump.exe dump.com

DEL dump.exe

B>
```

Code for the Dump.C routine (left), and part of the sequence that is displayed on-screen (right) during compilation.

(continued on next page)

(continued from previous page)

call to Zorland sorted out the problems, and the company does seem to be working on getting it right, but it was annoying nonetheless. Early users might do well to set aside a day or so to make sure the program is installed correctly.

As C was designed to work within the Unix environment, which has adequate editors of its own, no editors are normally provided with the language itself. This typically Unix solution means that the compiler can work with source code written on a wide range of editors and word processors, always provided that the control codes used within the editor do not clash with C's own code. Zorland says its compiler will work with source code written in ASCII format, so any editor which uses this convention should be acceptable.

Zorland has also provided an editor of its own which you can use if you have any doubts about the suitability of your normal word processor. It is designed like a stripped-down version of WordStar, but without the Micropro embedded control codes. Thus, most of the WordStar Ctrl-key combinations work within the Zorland C editor. Loading a source file is performed by Ctrl-K R while for saving the format you use Ctrl-K S. There are certain quirks to be wary of. The extended Ctrl-K D to save and quit the editor is not implemented and quitting the editor via Ctrl-K X does not, as in WordStar, save the current file; veteran WordStar users should be careful not to forget which package they are in. Apart from this the editor is adequate if limited.

The data types supported by Zorland C are identical to those used in Microsoft C. Character size is eight bits, integers are 16 bits, floating-point and long types are 32 bits and double-precision is 32 bits. Char, Int and Long data types can be declared as either signed or unsigned variables.

DEFINES MACROS

If a floating-point variable is declared in the program the startup program will examine the hardware for the presence of an 8087 maths co-processor. If it is fitted the calculations will be performed by the 8087; if not they will be executed by the 8088. Other features of Zorland C include the ability to define macros and to include library files. They are implemented at compile time by the pre-processor.

Once the source code is complete, compilation is initiated from DOS. One way of doing this is to run as a batch both passes of the compiler followed, if required, by the DOS utilities to create either an .Exe or a .Com file. Alternatively you can run each of the compiler modules separately while developing and debugging the program.

The full two-pass system is executed by running the compiler-control program ZC.Com. The format for this command is

ZC filename [-xxx]

where [-xxx] is a series of switches which pass parameters to the compilation process. ZC.Com carries out all the steps for you. When ZC.Com is executed it calls ZC1, which processes the source file and checks for errors. Assuming everything is OK it then creates a temporary intermediate file with the extension .Tmp. The output is then passed to the second phase, ZC2, which creates an Intel .Obj file.

The most commonly used switches are the m series: m followed by i will tell the compiler to call the appropriate start-up module to support floating-point or integer calculations within the compiled program. Similarly, the c switch tells the control whether it should continue after compilation and linking to create a .Com file.

Other switches that can be submitted via ZC.Com are specific to the compilation process itself. For example, i followed by a path name tells the compiler to search the specified path for #Include environment variables, while o followed by a file name indicates that the .Obj file is to have a different name to the source file.

ZORLAND C

PC VERDICT

	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	■	☐
Ease of use	☐	■	☐	☐
Documentation	■	☐	☐	☐
Value for money	☐	☐	☐	■

☐ Not perfect, but at the price who can complain?

One of the major bugbears with many popular programming languages like GWBasic and Turbo Pascal is that they are limited to 64K even though the 8086 processor can access 1Mbyte. The default mode of Zorland C follows this convention, but by using the m switch four different memory models can be chosen. You can retain the 64K limit for code and allow 1Mbyte of address space for data, or vice versa. There is also the large-memory mode which permits 1Mbyte of code and data within the program, although you will need an AT and Xenix to do anything with it. The snag with the large-memory modes is that the necessary start-up files are not available with the standard Zorland C package; they are bundled with the C Developer's Upgrade which you have to buy separately.

Experienced C programmers will know that there is more to getting a C program running than simply turning a source file into binary code. One of the great attractions of C is its portability between different machines, and even between different processors. Code written on one machine can be compiled and run on another. This is achieved by keeping the drivers and other bits of code which interface the software to a particular computer entirely separate from the compiler itself.

Under the Kernighan and Ritchie implementation this purity even extends to communication with a terminal. The commands Scanf and Printf which respectively read and write to the terminal are not actually part of the C language, although they are so universal they might as well be. Instead they are regarded as part of the portable library of useful extras.

Zorland has thoughtfully included these utilities in its own library, along with a number of other useful modules. Many of them allow the program to interface with MS-DOS and contain routines to open disc files and create directories. Among the more complex utilities supplied, the Disp package provides several commands which speed up the display by writing direct to the screen rather than using the computer's BIOS routines.

HEADER FILES

While Scanf and Printf are called as subroutines from within a C program, many other utilities required to achieve compatibility with the hardware are implemented as instructions to the compiler. Under Zorland C much of the hardware interface is implemented by MS-DOS utilities but Link and Exe2bin are only really interfaces with DOS. In order to ensure that I/O is handled correctly a number of header files are necessary. They are used by the system's pre-processor to replace the symbolic labels within the source code with meaningful addresses supplied by the headers. Examples of the headers included by Zorland are the usual Stdio.H standard input/output file along with utilities specific to MS-DOS like Dos.H.

Two manuals are provided with the package. The user manual is a simple 60-page A4 booklet covering the operation, implementation, library and other features of the system. Zorland C is aimed squarely at the beginner, but a number of the sections included in the manual did not give sufficient explanation. Worse, it was actually misleading in regard to the crucial installation procedure. On the other hand, the manual is not detailed enough for the experienced programmer. The second booklet bundled with the compiler is called the Beginner's Tutorial. In fact there is not a great deal of tutorial provided at all; rather, you are given a definition of C's commands and structure together with an example. No attempt is made to put the commands into context or to develop skills. Zorland says the tutorial is not intended to be exhaustive, but is there just to start you off.

CONCLUSIONS

■ Zorland's C compiler is a full implementation of the Kernighan and Ritchie definition of the language. It is compatible with Microsoft and Lattice C.

■ The compiler works well and creates an executable .Com file in a few minutes. We encountered problems with the installation but they should be cured soon.

■ Any criticism of Zorland C pales before its price. At £29.95 for a full-blown C compiler, pointing out shortcomings seem churlish. Zorland C will probably do very well. PC

HAVING IT BOTH WAYS

Software houses are faced with a dilemma: how to tap the large new market for cheap products while continuing to charge premium prices to corporate customers. **Steve Malone** looks at the strategies they are adopting.

The days when an IBM-compatible product could be sold at a premium seem to have passed into history. It is not only the hardware side of the industry that has changed, software publishers are also having to adapt to changing conditions. The launch of Amstrad's mass-market IBM compatible has generated an immense amount of interest among software publishers. Alan Sugar's prediction of selling 70,000 computers a month is taken seriously by the software houses.

These expectations are due in large part to Amstrad's previous track record and the effect it has already had on the software industry. The decision to implement CP/M-80 on the Amstrad home machines and its subsequent success with the PCW word processor have appeared to be a lifeline to Digital Research, which looked in danger of becoming permanently eclipsed by Microsoft. It also proved that there was an immense untapped market for cheap, proven sofware even if it was not the state of the art.

The operative word is "cheap". A customer who has paid £400 for the computer is not likely to contemplate paying up to 50 percent more for a single program. The rule of thumb has been that software can be around 20 percent of the hardware price. That was fine when machines cost around £2,500 but with the asking price now starting at £400 software houses have a problem. The difficult question is how to enter the potentially lucrative Amstrad market with worthwhile products while maintaining the price of fully functional programs for the corporate business sector.

In the case of Lotus Development, the answer is you don't. Lotus's attitude is that it is not in the cheap clone market and doesn't intend to be. Its position was explained by company spokesman Phil Peters who said: "You have to look at the real cost when someone buys a product. This is not just the price on the package but you have to include training and the time it takes to use the product efficiently. In the end you find the real cost is service. We provide technical support, training courses, books and the Lotus magazine, all of which require funding. We see ourselves really as a service company rather than a customer products company."

Though to many people this attitude may seem dismissive there is more than a germ of truth in what Peters says. In business, time is money; all the time spent flicking through the manual is productivity lost. Lotus's position will therefore be tenable for as long as its customers continue to be willing to pay a premium for the additional service it provides.

The expensive service and support can be trimmed if you are looking to cut costs to produce a low-priced product. A number of companies have taken this route. Micropro, Ashton-Tate and Microsoft have all announced that they will not be supporting their budget-line products directly, but will support the retailers instead.

"Even when you do find out about someone doing illegal copies, who may have paid £400 for their computer, there is little satisfaction in suing them."

PAUL SLOANE, ASHTON-TATE

"We provide technical support, training courses, books and the Lotus magazine. We are really a service company rather than a customer products company."

PHIL PETERS, LOTUS

Another strategy is to remove some of the functionality of a product in a so-called "cut down" version to be sold cheap, retaining the full-function full-price version for those prepared to pay for it. This has been the path chosen by Microsoft in the release of its Word Junior and Multiplan Junior products. Thus, Microsoft has removed most of the power features from Word such as the spelling checker and indexing. The cynical might argue that this is to deter the corporate buyers from the temptation to settle for the cut-down product, but in truth few Amstrad users will require the Document Content Architecture facilities that allow the documents to be transmitted across networks.

The official Microsoft line is that it has removed those features which require the most support. But there is still some doubt in the Microsoft camp as to whether the strategy will work. A spokesman said: "My own feeling is that there is a lot about these products that will make selling the other ones difficult, although the market research surveys tell us different."

A variation of the cut-down philosophy is the release of older products which have been superseded by later versions. This was the strategy which proved so successful on the eight-bit Amstrads. A product that has been replaced by a more modern program is unlikely to prove a threat in the corporate markets.

Evidence of this is cited in the experience of software houses which found that the resurgence in CP/M software did not affect the sales of top-end products. The flaw in the argument is that corporate buyers were not about to junk their IBM PCs in favour of PCW-8256s just to take advantage of cheap software. When the cheap software becomes

available for the IBM universe things might turn out very differently.

The relaunch of older products has other attractions. As in the case of Digital Research and CP/M-80, software publishers find that money can be made from products that had been given up for dead. They have long since recovered their development costs in the days when they were still premium products, so the companies can afford to offer them at low prices.

This is the route taken by Ashton-Tate with its dBase II and Framework version 1 programs, and by Computer Associates with Supercalc 3. All of these programs have been replaced by more powerful successors and so are unlikely to appeal to corporate users. Of course, there may be a lot of red faces within a software house if it turns out that the big corporates also prefer low cost to the additional features provided by later products. Perhaps as an additional insurance against this happening, Ashton-Tate has removed the comms capability from Framework 1.

Another step taken by Ashton-Tate, and at the time of writing being considered by Microsoft, is the addition of copy protection to the programs. The reasoning behind this was provided by Paul Sloane of Ashton-Tate, which has recently removed copy protection from its flagship range. He told me: "With the potential volume of users it is difficult to police copying. Even when you do find out about someone doing illegal copies, who may have paid only £400 for their computer, there is little satisfaction in suing them."

Of course not all software houses with programs aimed at the Amstrad PC market are in the position of trying to maintain a differential between budget-priced and top-of-the-range products. Companies like Newstar, Sagesoft, Micropro and Digital Research have all managed to produce full-function, unprotected software at low prices. Interestingly enough, all these companies have had experience of producing business programs for the eight-bit Amstrad ranges and may have been encouraged by market reaction.

When we saw the PCW-8256 we reduced the prices of our CP/M software to match. We experienced increased volumes of 1,000 percent.

DAVID GOLDMAN, SAGESOFT

The position of these companies is one of piling it high and selling it cheap. This philosophy was explained by David Goldman of Sagesoft: "When we saw the PCW-8256 we reduced the prices of our CP/M software to match. It was a policy which had tremendous success, and we experienced increased volumes of 1,000 percent. We can increase profits on these margins while, as Alan Sugar has said, companies like IBM and Lotus have big overhead structures they are saddled with. Yet Sagesoft is still able to offer 90 days free support." Asked about other companies' policy of producing cut-down products Goldman replied: "I don't believe that the 'brain-damaged software' strategy will work. The public is not that gullible."

The final judgement on the budget software market will be given by the customers. While there is undoubtedly a huge pool waiting to be scooped it remains to be seen whether the larger software houses will be able to sell the budget software at the same time as the top-of-the-range products, or whether the strategy of marketing reduced-function programs will backfire.

If this happens, it could have a lasting effect on the industry beyond that of permanently reducing the price of software. To begin with, many within the industry say it could have a serious effect on the development of new and pioneering products, although the experience of Borland International would seem to contradict this.

A more interesting development will be the future of software-house support. The dual strategy of including support in the price tag while selling it more cheaply without support seems schizophrenic, and must be doomed in the long term. Companies will either have to adopt the Lotus approach of becoming a service company or join the box shifters.

The growth of software as a commodity may also lead to the emergence of an entirely new force in the computer business. This will be companies which specialise in selling third-party support and training to users unable to get support from software houses. Already there are a number of companies specialising in running courses in Locoscript for the PCW-8256, and there is no reason to suppose that the same will not happen with the Amstrad PC. PC

No matter how reliable your system has proved so far there is no guarantee that it will never go wrong. **Carol Hammond** reports on the steps you can take to minimise the damage if it does.

GARY WING

BE PREPARED

Once you have got over the initial hurdle of deciding what equipment to buy and how to use it, sooner or later you are likely to face another when it breaks down. How seriously such a calamity will affect you depends on a number of factors: how important the data is that you may have lost, destroyed or are denied access to as a result of the fault and the severity and nature of the fault itself. You might be able to borrow a printer from someone else in the office, for example. But it will also depend on how well you are prepared for such an event.

If your machine is still under warranty from the manufacturer, then you can go back to an authorised dealer for repairs, or to the manufacturer itself. Even if the machine is not under guarantee you may have some protection under the Sale of Goods Act should you be able to prove that the equipment sold to you was not of merchantable quality. Whether you can make a case on this basis depends on the nature of the fault and how long it is since you bought the machine.

However, it could just be that your machine breaks down through no fault of the manufacturer, and the warranty has expired. Even if your warranty has not expired you may find that it only covers defective parts; in any case there is often no guaranteed response time or any undertaking that you will be supplied with an alternative machine while yours is undergoing repair. So even if your machine is still under warranty it is worth considering a maintenance contract, particularly as newly installed machines are vulnerable to breakdown as a result of misuse by first-time users.

You can always rely on an insurance policy of course, which may seem cheaper. However, you come up against the same problem of no guaranteed response time; and you may have to go to a maintenance contractor or dealer yourself and then present the insurance company with the bill.

Most manufacturers will entrust maintenance to dealers who will have had to meet the manufacturer's requirements regarding the number of spare parts and spare machines they carry. They may well have had to undergo some training in repairing machines, or at least have maintenance engineers on hand themselves; they may even sub-contract repairs out to a third-party maintenance contractor (TPM).

Manufacturers and TPMs offer a variety of different maintenance contracts to customers. They may cater for different response times, courier service, tailor-made contracts for large companies and so on.

Typical maintenance contracts offer response times of anything from two hours to two days. Some contracts stipulate that calls will only be made during normal office hours, while others ensure that an engineer is on call 24 hours a day, seven days a week.

It is worth finding out what a company means by response time. It could be the time it takes for an engineer to arrive, or if you are lucky it could be the guaranteed time limit for fixing your fault. You should also find out whether you will be supplied with another machine while yours is taken away for repairs, or whether you will have to hire one.

You should get to know details of where a company's service centres are; how many engineers they have; what the ratio of engineers to clients is; what spare parts they carry; what training engineers undergo; and whether they graduate to dealing with more complex faults or are flung in at the deep end. This will help to give you an idea of whether a company will be able to keep to its promise of a guaranteed response time.

Engineers from Bell Technical Services and Olivetti's Customer Support Group (CSG) carry commonly used spare parts with them, just as any AA mechanic would carry car parts around. But even when an engineer

does not have the relevant spare part it is not always necessary to take the machine away.

Marketing manager of Olivetti's CSG, Terry Hannington, finds that it is not necessary to lend customers kit. As machines are now highly modular in design there is not much in them that cannot be taken out and replaced within 20 minutes. Where a spare part is not immediately available it may be just as quick for the engineer to fetch it from the service centre as to remove the machine.

It is also worth finding out what other clients a company services. Most companies will be willing to give you the name of existing clients; some, such as Computer Field Maintenance, even supply case studies. This may only serve to introduce you to satisfied customers of course, but it all helps when you are trying to evaluate a company's reliability.

Another way of checking up on a company is to contact the Computing Services Association (CSA). It has a third-party maintenance group, members of which are obliged to abide by the CSA's Code of Practice. The CSA will indicate which companies offer a service for your particular hardware, and will give advice on what to ask for and what to expect.

This may seem to be a lot of effort just to choose what maintenance contractor to opt for, but considering the price you are likely to pay it is worth making. What a company charges is often dependent on the purchase of the machine. A typical annual rate might be somewhere between eight percent and 14 percent of the purchase price. You may also be charged according to what machine configuration you have — say, according to the size of the memory board, or whether you have a maths co-processor or other enhancements.

AGE AND DISTANCE

There may be penalties related to the age of the equipment to be maintained and the distance an engineer has to travel. Whether the company caters for other clients nearby may also have some effect on your premium. After all, if you are the only customer within a radius of 50 miles you are more awkward to deal with then one among half a dozen on an industrial estate where an engineer can travel quickly from one site to another. Discounts are also sometimes given where a large number of machines are being maintained. A company using, say, 100 personal computers as terminals to a mainframe is probably going to be charged less per system unit than someone with a single PC.

Of course, you do not have to have a maintenance contract in order to get your machine repaired. You may be able to take your equipment to an authorised dealer or a TPM or even call them out to your own premises to have the work done on a time and materials basis. When an engineer makes a visit you may well have to pay for travelling time in addition to time spent on your job; there may also be a minimum charge. However, it is worth bearing in mind that as a casual customer you are likely to have to wait longer to get your kit repaired than if you had taken out a maintenance contract. You will go to the back of any queue, because existing customers will no doubt get preference.

The advantage of choosing a TPM instead of sticking with a manufacturer is that a TPM will be able to service all your equipment. For example, you may have computers, add-on boards and printers all from different manufacturers. TPMs will service most of the popular makes of equipment and will try to cover less common brands. They obviously aim to keep their customers happy and help out if they can. Most TPMs are customer-led, and if a machine starts to become popular they will take it on.

MANUFACTURERS

The disadvantage of opting for a TPM is that in some cases they suffer from the restrictive policies of manufacturers. Some equipment suppliers do not allow anyone but their authorised dealers and agents access to spares, training, manuals, repair facilities and diagnostic aids. Though this happens more at the mini and mainframe end of the computer market than with micros, it can happen with micros too.

It may seem bull-headed on the part of the manufacturers to operate in this way; but maintenance is big business. DPCE, the largest U.K. computer-maintenance company, turned in pre-tax profits of £4.23 million for the year to mid-1986, a figure that is 45 percent up on the previous year. The Frost & Sullivan report *Third Party Computer Maintenance in Europe* forecasts that TPM companies will hold a 15 percent share of the U.K. computer-maintenance market by 1989.

Manufacturers are unlikely to feel happy about this trend. When the pace of innovation starts to slow down the revenue gained from backup services such as training and maintenance will become all the more important. Some manufacturers offer free support when you buy equipment, in the hope of pre-empting the competition.

Bob Trower, marketing manager of Kalamazoo Maintenance Services, says: "Things are moving very fast in the maintenance market now and many of the large manufacturers are getting into TPM very aggressively, pricing TPMs out of sites in many cases. We are also finding more delays in getting information and technical support from some manufacturers. We believe that a market shakeout is coming in the next 18 months or so, with many of the middle-sized TPMs either being taken over or withdrawing from the main market and concentrating in their main areas of specialisation."

TPMs pride themselves on their independence. Unlike manufacturers, they are not in the business of selling machines. Above all it is in their interest to keep your present machines up and running rather than see you buy new ones. When a machine breaks down they may more prepared to tell you the truth about what has gone wrong.

TPMs are particularly well placed to assess what is reliable equipment and what is not. Many conduct their own surveys on which machines and parts go wrong; the information they gain helps them to set their premiums, and can also be used as a way of selling their services. Bell Technical Services (BTS) produces reports designed to help customers monitor their response and fix times. It also shows which categories of equipment break down most.

The company's marketing manager, Ted Marshall, says that printers are more liable to break down than anything else. This is not because they are particularly poorly built but rather an inevitable result of their large number of moving parts. They are also prone to misuse by users, who may misfeed paper or mistreat them in some other way. Also a machine must be fit for the job it is used for; a heavyweight printing application needs a heavyweight printer. In this area as much as any other you get what you pay for, and a cheap printer is unlikely to be up to the job.

By and large, TPMs agree that modern micros are pretty reliable. But as Graham Hallett, marketing director of CCA Micro Rentals, points out, no machine is 100 percent reliable. You only need to have it go down once, and you may be thanking your lucky stars that you have a maintenance contract and do not have to pay for an engineer's visit and an expensive spare part.

In fact, micros are becoming so reliable and the competition for repair work so fierce that TPMs are reviewing the standard maintenance contract to see what alternatives they can offer. For example, Olivetti is considering a hot line for users to ring in with their problems. BTS has introduced a scheme under which you can purchase maintenance on a pay-as-you-go basis; you buy a book of vouchers valid for a certain time, and use them up as and when you need them. This new line of thinking is good news for users, as they can look forward to the maintenance market stabilising, with better support and improved service. PC

ADDRESS LIST

Bell Technical Services 13 Mount Road, Hanworth, Feltham, Middlesex TW13 6JG. Telephone: 01-898 9631

Computer Field Maintenance Excell House, Trust Industrial Estate, Wilbury Way, Hitchin, Hertfordshire SG4 0UZ. Telephone: (0462) 51511

Computing Services Association Hanover House, 73/74 High Holborn, London WC1V 6LE. Telephone: 01-405 2171

DPCE Computer Services Cumberland House, Old Bracknell Lane West, Bracknell, Berkshire RG12 4AE. Telephone: (0344) 484648

Kalamazoo Maintenance Services Mill Lane, Northfield, Birmingham B31 2RW. Telephone: 021-475 2191

Olivetti Customer Support Group Olivetti House, PO Box 89, 86/88 Upper Richmond Road, London SW15 2UR. Telephone: 01-785 6666

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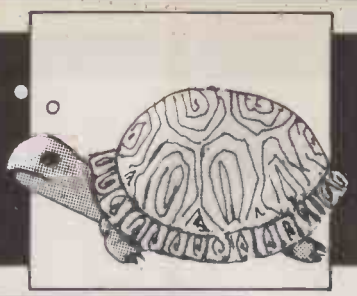

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WHO PAYS FOR FAULTY PROGRAMS?

Businesses routinely make vital decisions on the basis of information provided by computer software. **Anne Staines** explains who is liable if that information turns out to be incorrect.

How far are individuals or software houses responsible for faults in their programs? More often than not business packages for microcomputers are sold off-the-shelf by a retailer or distributor who is not the manufacturer. The contract of sale, which in any case is usually packed with exclusion clauses, gives no rights against the manufacturer, who is not privy to it. However, a business relying for its financial planning on, say, a spreadsheet which turns out to be faulty could conceivably suffer huge losses. Where can that business look for a remedy?

The answer may well lie in the area of product liability, a subject that is currently exercising many legal minds within the computer industry. A user is entitled to expect that the manufacturer of a program has exercised reasonable care and skill in its creation. If it can be shown that the manufacturer has not done this the user may be able to recover any loss suffered as a foreseeable result of the manufacturer's negligence.

Liability for negligent manufacture is a fairly new judicial concept. Even more recent is the notion that pure economic or financial loss is recoverable, as opposed to a loss consequent upon death or physical injury. In the computer industry speculation over the possible applications of negiligent manufacture has led to a rush for professional indemnity insurance. Premiums for this type of cover are sky-high in Britain and often fantastic in the U.S. — if you can get an insurance company to quote at all.

ACTIONS A THREAT

There are essentially two reasons why actions in negligence are such a threat to software houses. The first lies in the psychology of the advertising on which sales are frequently based. This encourages users to rely on a product and the labour-saving benefits it will bring. The second is the multiplicity of uses to which general-purpose programs such as spreadsheets are put. The manufacturer cannot possibly know the exact risks involved for any individual user if the program contains an error. All the same, given the target market, the manufacturer, must have a strong idea of the type of risk, and that is enough to render him legally liable for all damage of that type which the user suffers, no matter how severe.

Nervous software manufacturers have for some time been packing some powerful exclusion and indemnity clauses into their contracts with distributors, agents and publishers. Some of them are influenced by the restrictive nature of insurance policies; at least one commonly used standard form contains the stipulation that both parties shall insure with a reputable company and neither will claim against the other.

In addition to the seriousness of the damage, the manufacturer must worry about its extent. It is clearly foreseeable that faulty business software might have repercussions not only for its owner or licensee, but also for other businesses contracting with him. What if, for example, the owner or licensee cannot carry out his own contractural obligations as a result of faults in the software, and then goes bankrupt. The other business clearly has no none left to sue on the basis of a contract, but might sue the software manufacturer for damages caused by its negligence.

Somewhere along the line, loss or damage will be judged too remote or unforeseeable, but this position would only be reached after protracted and expensive litigation. Where the manufacturer does not sell direct, the consequential loss clauses now common in many contracts will not provide any direct protection from claims of this nature, although they should protect the retailer.

The user's problem, of course, is proving negligence. The standard of proof in civil cases requires merely that it is more likely than not that the user's loss resulted from negligent manufacture; it is not necessary to prove the case beyond reasonable doubt. Manufacturers, on the other hand, can adduce some strong arguments in their own favour, the most likely being that the user was negligent in operating the system and is therefore wholly responsible for his own loss, or at least contributed to it.

STEPHEN WRIGHT

UNEDUCATED USE

Such an argument is to be advanced next spring in the U.S. by Lotus Development Corporation in defence of a negligence action brought by a user of the Symphony package. General opinion in the United States is that the user's case is weak, and that his loss was the result of uneducated use.

Cases of this nature have implications for support documentation, too. If that is inadequate, a defence on the basis of uneducated use could easily backfire on the manufacturer. Tough exclusion clauses have their own drawback: they can make potential buyers wary. Reasonable limitations are a better marketing strategy, backed up by insurance.

Small or new businesses may find, however, that they cannot afford the premium for a meaningful amount of cover. This applies particularly where the application is connected with a high-risk industry. For any software business, there is one clear message: make sure you are incorporated as a limited company. Only then can you be sure where your responsibility ends. PC

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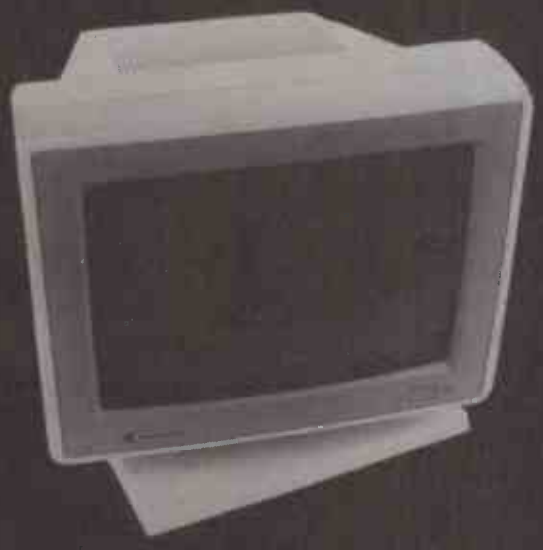

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For speed and cheapness the dot-matrix printer (left) reigns supreme, while high-quality output is catered for by laser printers (right).

TOP 10

New technologies and developments of established ones are providing a wider choice of printers than ever before. **David Barlow** picks out the key models.

Little more than five years ago there were just two manufacturers producing printers for the micro market: Epson and Centronics. While Epson has gone from strength to strength, Centronics all but disappeared and is only just re-emerging into what is now a heavily over-subscribed marketplace. What is good news for users in terms of choice and competitive pricing must inevitably be bad news for any manufacturer trying to make a profit.

Originally there were just two types of unit: the cheap and cheerful dot-matrix aimed at the hobbyist, and the more elitist daisywheel. Attitudes have changed, and nowadays the daisywheel's lack of flexibility and mechanical complexity leaves it vulnerable on all fronts. The once-humble dot-matrix unit is now stealing many sales, while most of the real excitement is reserved for the latest generation of laser and thermal-transfer units.

Prices for basic printers now start at around £160. This sector of the market is populated by dot-matrix units fitted with nine-pin heads. They are good enough for producing legible text and producing monochrome graphics, but they are slow and cannot produce the near letter-quality (NLQ) text which has maintained the sales of dot-matrix printers to business users.

By using more pins to produce a character — sometimes as many as 24 — the output quality of dot-matrix units has improved beyond recognition. It now takes a trained eye to detect the difference between the output of daisywheel and top-quality dot-matrix print. Speed is comparable too. The Epson LQ range produce full letter-quality output from their sophisticated 24-pin print heads; the head is built up from two columns of 12 pins slightly staggered so that the gaps between dots can be filled as the head traverses.

Although they are by no means cheap, the £600 price tag of these units pales into insignificance when compared with the current state-of-the-art letter-quality dot-matrix printer, the Honeywell 4/66. This machine will not leave you much change out of £2,000 once some of the essential extras are accounted for. But it does offer superb quality at high speeds. Unfortunately its price puts it firmly in laser territory, where the competition is much hotter.

Colour is now available at all prices and qualities. It has become fashionable for medium-priced dot-matrix units to provide this option simply by slotting in multi-colour ribbon. Quality is quite reasonable for business graphics, but if you want output without those tell-tale bands of extra intensity, or if you wish to print out on transparent film, then you will have to look at other types of printer.

The thermal-transfer technique is the current favourite, with prices varying from the amazingly cheap Okimate 20 at £169 to the highly sophisticated 2,048-element Mitsubishi G-500 at £3,933. For business graphics a plotter is probably something of a luxury, but reasonably priced machines like the eight-pen HP Colorpro are selling well. The Epson HI-80 is also good value at £400, though it only has four pens.

For top-class output quality coupled with speed and quietness there is nothing to touch the laser printers, though to get one you have to dig deep into your bank account. The market is currently dominated by models built around the Canon print engine, but other names now starting to get a look in include Kyocera, Sharp and Hitachi. Paper-handling techniques are improving and higher speeds are now offered.

The first generation of lasers required new drum and toner cartridges every 3,000 pages but later units are stretching this to 15,000 copies and more. This not only makes them more convenient to use but improves running costs as well.

The major laser-printer builders seem to be trying to maintain their rather inflated prices, leaving a gap for cheap machines which smaller manufacturers are starting to exploit. Most notable of these is QMS, whose Canon-based Kiss prints at a rather slow six pages per minute but retails at only £1,368. Slightly faster is the Centronics Laser 8, which prints at eight pages per minute and sells for £1,995.

SUPPLIERS

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Epson Epson (U.K.), Dorland House, 388 High Road, Wembley, Middlesex HA9 6UH. Telephone: 01-902 8892
Hewlett-Packard HP Literature Section, Eskdale Road, Winnersh Triangle, Wokingham, Berkshire RG11 5AR. Telephone: (0734) 784774
IBM IBM U.K., PO Box 32, Alencon Link, Basingstoke, Hampshire RG21 1EJ. Telephone: (0256) 56144
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Oki X-Data Ltd, 750-751 Deal Avenue, Slough Trading Estate, Slough, Berkshire SL1 4SH. Telephone: (0753) 72331
Star Star Micronics U.K., Craven House, 40 Uxbridge Road, London W5 2BS. Telephone: 01-840 1800

TOP 10

APPLE LASERWRITER PLUS

BASED on the much-used Canon engine, Apple's Laserwriter was one of the first laser printers to take off. Its success is due in part to the Macintosh's ability to put its high-resolution multi-fount output to good use. Although now being overtaken in technical terms, the Laserwriter is still generally regarded as the de facto standard printer for desk-top publishing. What makes the Laserwriter so suitable is its ability to interpret the specialised page-description languages, such as Postscript, used by desk-top publishing software. With a resolution of 300 dots per inch, output is good enough for all but the highest-quality presentation work.

PRICE: £4,995

FOR: Laser quality. The desk-top publishing standard.
AGAINST: Slow. Expensive.

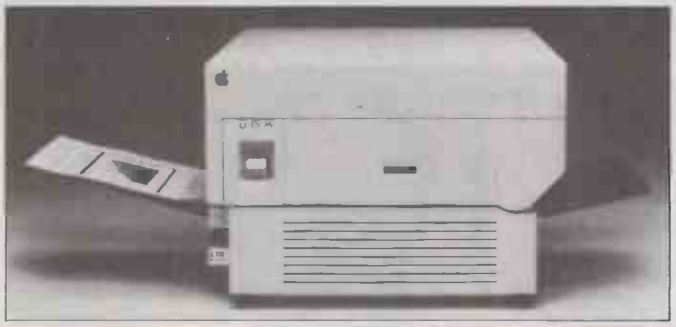
CANON LBP-8 A1

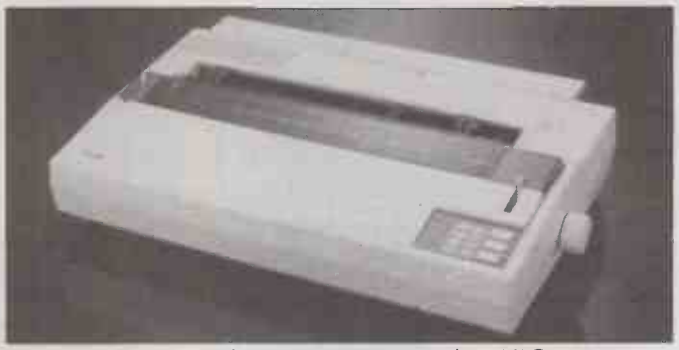
ALONG with Hewlett-Packard's Laserjet, the Canon was the first laser cheap enough to appeal to PC users. Canon makes the laser print engine which was at the heart of all the early models, but the A1 is beginning to show its age in the light of the improved print speed, flexibility and paper-handling techniques of more recent machines. The A1 prints eight pages per minute at a resolution of 300 dots per inch. The built-in fount is Courier 10 with the usual bold, italic and footnote characters; 16 other founts are available. As with any laser, running costs are likely to be higher than with a more conventional printer. You have to change the combined toner and drum cartridge every 3,000 pages.

PRICE: £2,600

FOR: Output quality. Field-proven.
AGAINST: Graphics are extra. Running costs.

The Canon LBP-8A1 (above) and the Apple Laserwriter (below) were among the first laser printers.





The Epson EX impact dot-matrix printers produce NLQ output.

EPSON LQ-800

EPSON'S range of letter-quality dot-matrix printers use a 24-pin head to achieve their impressive results. Available in both 80- and 132-column models, the LQ series prints at a claimed 60cps in LQ and 180cps in draft. Paper transport is by friction feed, with tractor feed and a cut-sheet feeder available as optional extras. The unit prints in Roman fount as standard; a further six founts are available on plug-in ROM cartridges. The LQ series also uses Epson's Identity Module, which enables the unit to interface with different types of computer. The software support is excellent.

PRICE: £595

FOR: Quality from 24-pin head. Compatibility with applications software.
AGAINST: Expensive.

EPSON EX-1000

INTENDED for applications where speed is more important than outright print quality, the EX impact dot-matrix printers use a simple nine-pin head, though they can also manage a reasonable NLQ output. Claimed print speeds are 300cps in draft Elite fount, 250cps in draft Pica fount and 50cps in NLQ. The EX series is one of the first ranges with models that include a full control panel for typeface selection; the days of DIP-switch selection should soon be gone. The unit can be made to print in colour simply by adding a colour-print module and ribbon. The standard interface allows users to select either IBM compatibility or standard Epson control codes. The printer is fitted with both serial and parallel interfaces.

PRICE: £665

FOR: Fast. Colour option.
AGAINST: Not yet proven.

HP COLORPRO

HEWLETT-PACKARD'S best-selling plotter is aimed more at the business-graphics sector of the market than the scientific and engineering community. It has a good range of colours which can be printed out solid as well as in the less striking hatched patterns. The Colorpro has a rotating eight-pen carousel from which the print head automatically picks the right colour, enabling the plotter to produce multi-colour output without intervention by the user. Output can be produced on A4 paper or transparency film which is held in place by a fast and accurate gripper-wheel system. It can produce a reasonably complicated draft plot in two minutes, and takes around 10 minutes in high-resolution mode. Detailed lettering is another of the machine's strong points. Compared to top-quality colour dot-matrix printers, such as the Oki 292, the Colorpro does not appear very good value, especially if paper is to be the usual output medium. However, the Colorpro is preferable for producing multi-coloured charts on acetate film for overhead projection transparencies.

PRICE: £1,160

FOR: Fast for a plotter. Quality colour graphics.
AGAINST: Price.

IBM QUIETWRITER

THIS letter-quality printer uses the thermal-transfer technique with a new type of resistive ribbon. This method of operation has three major attributes: minimal wear on the print head, better definition of printed characters and quieter operation. The Quietwriter can incorporate any two type styles at a time selected from four different ROM-based character founts, including Courier, Prestige Elite 12, Prestige Elite 15 and Boldface. As you would expect from a multi-national like IBM, eight national languages are supported. The machine will accept continuous stationery or cut sheets. An automatic sheet feeder is available as an optional extra. Maximum paper width is 15in.

PRICE: £1,316

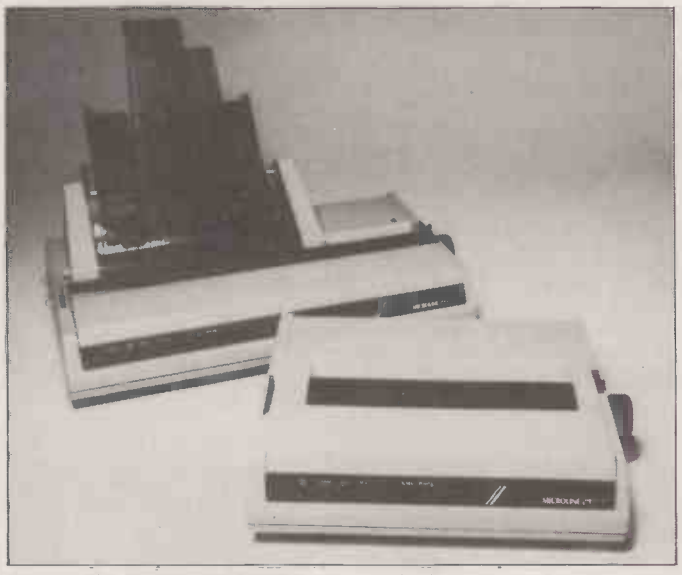
FOR: Output quality. Quiet. IBM name.
AGAINST: IBM price.

MANNESMANN-TALLY MT-910

ONE OF the new breed of laser printers, the MT-910 does not use the established Canon engine and offers considerable advantages over some of its competitors. Based on a new Kyocera engine, it prints at 10 pages per minute at a resolution of 300 dots per inch. A drum life of 30,000 copies makes it one of the cheapest lasers to run. The drum itself is made of non-toxic material and so can be disposed of easily. Paper handling is also a strong point: there are two bins, one for single sheets and the other for continuous stationery. Single sheets can be delivered face up or face down as required. Courier 10 and Prestige character founts are included as standard, with Gothic, Roman and Helvetica as options. Plug-in interfaces are available, so the MT-910 can be set up to look like an HP Laserjet, Epson, Diablo or Qume.

PRICE: £3,245

FOR: Quality. Speed. Paper handling.
AGAINST: Price. Running costs.



Above: The Microline 292/293 supports high-resolution graphics.
Below: The Star NL-10 uses a nine-pin head.

STAR NL-10

CONSIDERING the NL-10 only uses a nine-pin head, its NLQ output is excellent. In this mode it prints at a respectable 30cps, but can manage 120cps in draft thanks to its bi-directional logic-seeking head. The unit is supplied with a tractor feed as standard and also boasts a semi-automatic single-sheet paper feed. The control panel is easier to use and more informative than most, enabling the user to select draft, NLQ or italic modes if required. Plug-in cartridges are available to connect the NL-10 to IBM, Commodore 64/128, and Apple IIc micros. There are also cartridges for standard Epson and serial interfaces. Maximum paper width is 10in. but in compressed mode the Star can print a useful 160 characters within this width.

PRICE: £278

FOR: Output quality. Price. Ease of use.
AGAINST: No colour option.

OKI MICROLINE 292/293

ALTHOUGH originally launched in the U.K. as monochrome printers, the new machines can be made to print colour simply by substituting a colour ribbon. This is a very useful option to have on a printer which is in any case good value and an excellent all-rounder even in mono mode. Claimed print speeds are 200cps in draft and 100cps in its single-pass correspondence-quality mode. The 18-pin print head produces well-formed and attractive characters along with double-height, italics, subscript and superscript. The Microline 292/293 supports the high-resolution graphics options that are now available on many applications packages. Maximum continuous stationery width is 9.5in. on the 292 and 16in. on the 293. A cut-sheet feeder is available as an optional extra, along with a massive 32K print buffer.

PRICE: £599

FOR: Colour option. Good quality/speed rating.
AGAINST: Oki not set up in U.K.

MITSUBISHI G-500

BASED on the increasingly significant thermal-transfer technique the Mitsubishi G-500 can produce very high-quality colour output. Its print head is built from a massive 2,048 elements arranged in a row 8.5in. long. This enables a print resolution of 240 dots per inch to be achieved at an output speed of about two minutes for a full-page A4 colour image. The G-500 prints the three subtractive primary colours one after the other, winding the paper back between runs. Operating costs are high: the cost of ribbon usage works out at about 20p per page, and the paper it requires will add another 4p. Taken with the not inconsiderable expense of the machine in the first place, it becomes clear that the G-500 is aimed at a rather limited market of users who need to produce bold, high-quality colour graphics at high speed.

PRICE: £3,933

FOR: Quality. Speed.
AGAINST: High price. Running costs.

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HOT 100

A year and a half ago the microcomputer industry was starting to descend into its first real recession. It proved something of a shock to companies who had become accustomed to compound growth rates of 30 percent and more. Many have since gone to the wall, and more have subjected themselves to rigorous cost-cutting. Not even IBM has been spared. Going against a lifetime policy of no staff reductions it has introduced a retirement-incentive scheme to slim down its U.S. work force.

Against this gloomy background 1986 has been good news, and there is growing evidence to suggest that the upsurge in demand experienced by many companies in the business sector will be sustained. This is largely a result of the maturing of the computer market itself. After the initial home-computer boom and bust, followed by a transitional period as standards in the 16-bit world were established, the corporate sector has come through as the mainstay of the industry.

As companies begin computerising in earnest the micro market is no longer seen as a low-end adjunct to the mainframe. It is beginning to assert itself as the engine which is driving the whole process. The last couple of years have seen all the major mainframe manufacturers bringing out micros to tap this growing demand. Now, however, these machines have passed from being extras complementing the main sale to become important and sometimes indispensable revenue earners in their own right.

As a result, 1986 has seen numerous new products both in hardware and software. This peaked with the frenetic activity reported in last month's issue of *Practical Computing*. What is particularly encouraging is that there is every indication that this level of activity is likely to continue with significant launches of machines and programs.

In the following pages we review the past year and look forward to some of the likely highlights of 1987. Along the way we pick out the top packages in the various categories which have evolved over this period.

SOFTWARE

BY IAN STOBIE

Anyone setting out to write a new package has to make numerous fundamental decisions beyond just how best to implement particular functions. The first is whether to write to the dominant IBM standard, or whether to support what has become business computing's second standard — the Apple Macintosh. Even if you decide to go for the IBM market, there are other choices to be made, such as what graphics cards, memory sizes, brands of mice, operating systems and window managers to support.

All this is a sign that the underlying architecture of the IBM PC/XT/AT range has been pushed to its limit. The IBM product line is clearly due for a thorough revamp, but there is a widespread feeling that this must go beyond the AT or the recently announced XT-286.

Perhaps things will improve with the arrival of 80386-based systems and a clear message from IBM on what operating system it will be supporting in the future. Meanwhile the IBM universe is fragmenting. Software writers supporting the Mac have a more tightly defined hardware standard to deal with.

In the IBM world, utilities and pop-up programs have figured prominently in the best-seller charts this year. These programs allow you to get the best from your existing kit and help weld the varied components of their increasingly mongrelised systems together.

Other very active areas have been desk-top publishing and, in the U.S. at least, presentation graphics. These applications tend to be very memory or disc intensive, and increase the pressure on users to make ad hoc additions to their hardware collection.

The Mac has been doing rather well this year. In a few application areas — notably desk-top publishing — it has even managed to establish superiority over the IBM PC and its kin, with better software available for it. Now that the 1Mbyte Mac Plus is Apple's main machine software writers have got a system with adequate speed and power.

POP-UP PROGRAMS

BORLAND'S trailblazing Sidekick has spawned many imitators. In this general-purpose desk-accessory category Deskset was the pop-up program that impressed us most.

But the idea of memory-resident pop-up programs has won much broader acceptance. It is an ideal vehicle for any kind of performance-enhancement software which must work with a broad range of different application packages.

Graph-in-the-Box, for instance, lets you create different sorts of charts from almost any kind of numeric data displayed on the screen. You could use it with a spreadsheet, or perhaps while writing a letter containing a table of figures. You invoke Graph-in-the-Box, grab the data, choose an appropriate chart type and immediately display or print the graph.

We used another pop-up, Tornado Notes, to help prepare and write this Hot 100 feature. You run this program alongside your normal application, recording ideas and impressions which you can later work up into a more systematically organised report. Being able to have Tornado Notes running on your system all the time greatly increases its usefulness.

Two other pop-ups which impressed us were Superkey and PRD+. Superkey will redesign your keyboard layout, set up keyboard macros and encrypt disc files. PRD+ lets you create your own shorthand language and use it with virtually any package; once you have created your own dictionary of abbreviations, PRD+ expands them instantly as you type.

Several other good pop-ups appear in the word-processing and spreadsheet sections.

DESK-TOP PUBLISHING

DESK-TOP PUBLISHING is the current boom area of personal computing. The term covers everything in the way of document preparation that goes beyond straightforward word processing, from setting up business forms and high-quality correspondence to the production of typeset-quality reports, brochures and magazines incorporating line art and scanned pictures. It is a very broad area. There is room for software in several price bands as well as specialist products aimed at particular types of user.

Desk-top publishing requires a fairly hefty PC system with plenty of memory, good graphics and ideally a mouse, along with a suitable laser printer. At the moment Apple completely dominates the market with the Macintosh and its matching Laserwriter printer. Virtually all the best software is written for this combination.

Software for the IBM will arrive in volume next year. The latter part of 1986 has seen numerous deliberate product leaks and some announcements, but nothing of any importance has yet shown up in our office.

Only at the very bottom of the desk-top publishing market does an IBM solution make much sense today. The best of the existing top-end IBM word processors such as Word, Word Perfect and Wordcraft can drive laser printers very effectively. We tried these packages out with a cheap Canon laser printer and found them all pretty good for producing quality correspondence and straightforward text-orientated reports. They could also be used to produce acceptable text charts and business forms.

But this sort of thing is only the base level of desk-top publishing. The Mac can do this and more. In November we looked at Just Text, a top-end Mac system that in the right hands is capable of producing work layed out to the standard of a top-quality magazine. Earlier in the year we looked at Aldus Pagemaker and Ready Set Go, now the number 1 and number 2 Mac products by market share.

As soon as you try to upgrade an IBM-standard machine to a level capable of matching the Mac's performance as a desk-top publishing system you run slap into the problem of the confused standard.

Nonetheless, by this time next year the new wave of IBM desk-top publishing software will be in users' hands. Much of it will be running under Microsoft Windows or Gem. There is no obvious standard for IBM laser printers, so these packages will have to support a wide variety of different options.

Key products to keep an eye out for during the year are Ventura from Xerox and the IBM version of Aldus Pagemaker, currently the leading product on the Mac. We will be previewing the best new IBM software in a special desk-top publishing feature next month.

Of course no one expects the Macintosh to stand still, and it could be that the desk-top publishing market will still belong to Apple this time next year. Key products for Apple are a new version of Aldus Pagemaker, a complete rewrite of Ready Set Go, and Letrapage, an existing

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VP-Planner, Javelin and Supercalc 4 challenged Lotus 1-2-3 for the spreadsheet crown this year.

package recently acquired and revamped by the heavyweight graphic-art company Letraset.

Packages closely targeted at particular groups of users are also likely to be very important in desk-top publishing — they may be a lot easier to use than the more generalised packages. One example is the Display Makeup System for the Mac, which is designed specifically for producing classified and display advertisements.

PRESENTATION GRAPHICS

THERE SEEMS to be a big difference between American and British users when it comes to buying presentation-graphics packages. In the U.S., 1986 saw intense activity in this market, with sales of software and specialist output devices such as plotters and 35mm. transparency slide makers climbing rapidly. Major software houses such as Lotus and Ashton-Tate vied with each other in buying up suitable products and expertise in this area.

In the U.K., of all the new presentation products flooding on to the market only Harvard Presentation Graphics has made much of an impact. This is probably because it is one of the simplest. Although there are some things you cannot do with it, it has an excellent manual and you can start using it almost straightaway.

U.K. users in general do not seem very interested in the more expensive or complicated packages such as VCN Concord or Freelance. Presentation graphics at this level has more of the characteristics of a specialised niche market here, despite the fact that in the U.S. these very products sell well to quite ordinary business users.

Here mainstream business users are quite happy with the built-in graphics provided inside their regular application packages. It may well be that U.K. users are primarily interested in using graphics analytically, using it themselves inside a package to help them understand their own data. Using graphics as a tool to convince others is in reality a quite different application, and one which seems much less common here than in America.

Bearing this out is the fact that many of the packages high in the best-seller lists this year have had excellent graphics built-in alongside their other functions. One of the appeals of Borland's Reflex database is the ability it gives you to look at your data in chart form very quickly.

Of the year's new spreadsheets, Microsoft Excel running on the Mac probably had the best charting functions. On the IBM the graphics of the Smart spreadsheet were excellent and integrated well into other modules of the Smart system.

Even word processors are acquiring presentation abilities. With a laser printer it is easy to produce black-and-white overhead transparencies using any of the more powerful word-processing packages. These developments are discussed further in the word-processing section.

SPREADSHEETS

IN SPREADSHEETS 1986 was really a case of more of the same. There is a tremendous conservative bias built into this market, probably caused by the nature of corporate purchasing, where only software on the company's approved list stands a chance. The older the list the older the software.

So Lotus 1-2-3 continued to dominate. Great things were expected of version 2 of this program, but perhaps the most significant thing Lotus managed to do was introduce some new bugs. These have now been corrected in version 2.01.

The year did see a number of excellent challengers to Lotus 1-2-3. Javelin will probably turn out to be the most significant, but despite the backing of heavyweight software house Ashton-Tate it has not made much impact in the U.K.

Towards the end of the year Lotus got into a legal battle with Computer Associates over the marketing of Supercalc 4. Computer Associates had been trying to overcome the dominance of 1-2-3 in corporate purchasing by offering to take users' copies of 1-2-3 in part payment for its own.

Low-cost clones of 1-2-3 also kept coming, some of them of very high quality. VP-Planner in particular impressed us. Slightly further removed from 1-2-3 was Farsight, which has menus and a word-processing function taking the place of 1-2-3's graphics.

The Mac saw some very strong spreadsheet offerings. Microsoft's outstanding Excel arrived in the U.K. during the year; some people consider it to be the best spreadsheet currently available. Mindsight was another impressive if more specialised program running on the Mac. Designed for serious financial modelling, Mindsight uses a mixture of a conventional spreadsheet and a simple programming language.

It has definitely been a good year for spreadsheet add-on programs, most of them designed to work alongside Lotus 1-2-3. Lotus itself launched Report Writer, while Spreadsheet Auditor from Consumers Software helps you debug models by checking for things like circular references, and also lets you print out formulae. SQZ saves disc space by compacting and decompacting worksheets as they go to and from disc. What's Best is a more ambitious add-on for 1-2-3; it solves linear programming problems which you set up in 1-2-3.

DATABASES

FOR THE first time Ashton-Tate has had to face up to some serious competition in 1986. dBase itself received a thorough revamp, but there at last emerged some programs which looked capable of damaging its pre-eminent position in the database market.

The direct approach to taking on dBase is to come up with another more modern program of the same type — in other words, another heavyweight database language. This is the approach taken by Rbase 5000. But despite the marketing clout

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of Microsoft that is behind Rbase in the U.K., it is hard to see armies of dBase programmers abandoning something they have invested a lot of effort in learning. As long as dBase does the job it is probably safe from this kind of attack.

The low-cost dBase clones like VP-Info which will start to arrive in the new year may do the trick. But even this is in doubt: something as complicated as dBase requires good support, which may be hard to provide at the low margins available on a clone.

A more daring strategy is to try to beat dBase by doing something different. At least three innovative new products made a good attempt to do this in 1986. Paradox can cope with the same kind of big application-writing task as dBase, but it goes about it in a different way. There is a database language there when you need it, but you can get a long way in defining an application without resorting to it.

Many people have probably been sucked into using dBase because of its sales success, even though it is not necessarily the most appropriate tool for the job. To make sense of data you can make do with a program that is less complicated to use than an application generator.

Reflex and Q&A were the best and most original of the simpler browsing and analysis-orientated products. Reflex runs on both the Mac and the IBM PC in rather different versions, but both let you look at a set of data in a variety of different ways, and allow you to cross-reference and chart things that take your interest. Q&A is superficially like a conventional

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	PRICE	REVIEWED	SUPPLIERS
POP-UP PROGRAMS			
Deskset	£60	Dec 86	Ideal, Sagesoft
Graph-in-the-Box	£95	Aug 86	Zygos
PRD+	$195	Sept 86	Productivity Software
Superkey	£59	Aug 86	Altor, First, P&P, Softsel
Tornado Notes	£50	next month	Ideal
DESK-TOP PUBLISHING			
Aldus Pagemaker	£450	Jan 86	McQueen
Ready Set Go	£169	Jan 86	Heyden
PRESENTATION GRAPHICS			
Harvard Presentation Graphics	£295	—	Softsel, First Software
SPREADSHEETS			
Farsight	£99	Sept 86	SK Micro Systems
Javelin	£550	May 86	Ashton-Tate
Mindsight	£350	May 86	Package Programs
Spreadsheet Auditor	£116	—	Tekware, 4-5-6 World
SQZ	£66	—	Tekware, 4-5-6 World
Supercalc 4	£396	Oct 86	Computer Associates
VP-Planner	£100	Feb 86	Newstar, Centaur
What's Best	£122	May 86	4-5-6 World
DATABASES			
dBase III Plus	£595	June 86	Ashton-Tate
Paradox	£550	Apr 86	P&P, Softsel
Q&A	£250	Sept 86	Paradigm
Reflex	£100 IBM, £70 Mac	Nov 85 IBM, Nov 86 Mac	Altor, First, P&P, Softsel
VP-Info	£100	next month	Newstar
WORD PROCESSING			
PFS Professional Write	£189	this month	First, Softsel
Turbo Lightning	£99	Mar 86	Altor, First, P&P, Softsel
Ready	£81	Mar 86	Softsel
Word Perfect	£425	Aug 85, Aug 86	Sentinel Software
Word	£425	Sept 85, Aug 86	Microsoft, P&P, Softsel
LAN SOFTWARE			
dBase III Plus	£795, four users	June 86	Ashton-Tate
Intuitive Solution	£1,440, eight users	Oct 86	Intuitive Systems
Smart System	£1,395, three users	July 86	First, Paradigm, Softsel
Open Access	£1,300, three users	—	Softsel, SPI
Word	£1,195, five users	Sept 85, Aug 86	P&P, Softsel
UTILITIES			
Cubit	£50	—	Ideal, In Touch
Disk Optimiser	£50	—	Ideal, In Touch
Doubledos	£50	—	Ideal, In Touch
Fastback	£159	—	Ideal
Lettrix	£97	—	Ideal
Lightning	£100	—	Ideal
Metatext	£95	Feb 86	Image Computer Systems
Norton Utilities	£62	this month	Softsel, P&P, Newstar
Quickbasic	£85	Feb 86	P&P, Softsel
Software Carousel	£50	July 86	Ideal, In Touch
Turbo Prolog	£100	Aug 86	Altor, First, P&P, Softsel
Zorland C	£30	this month	Zorland

(table continued on page 90)

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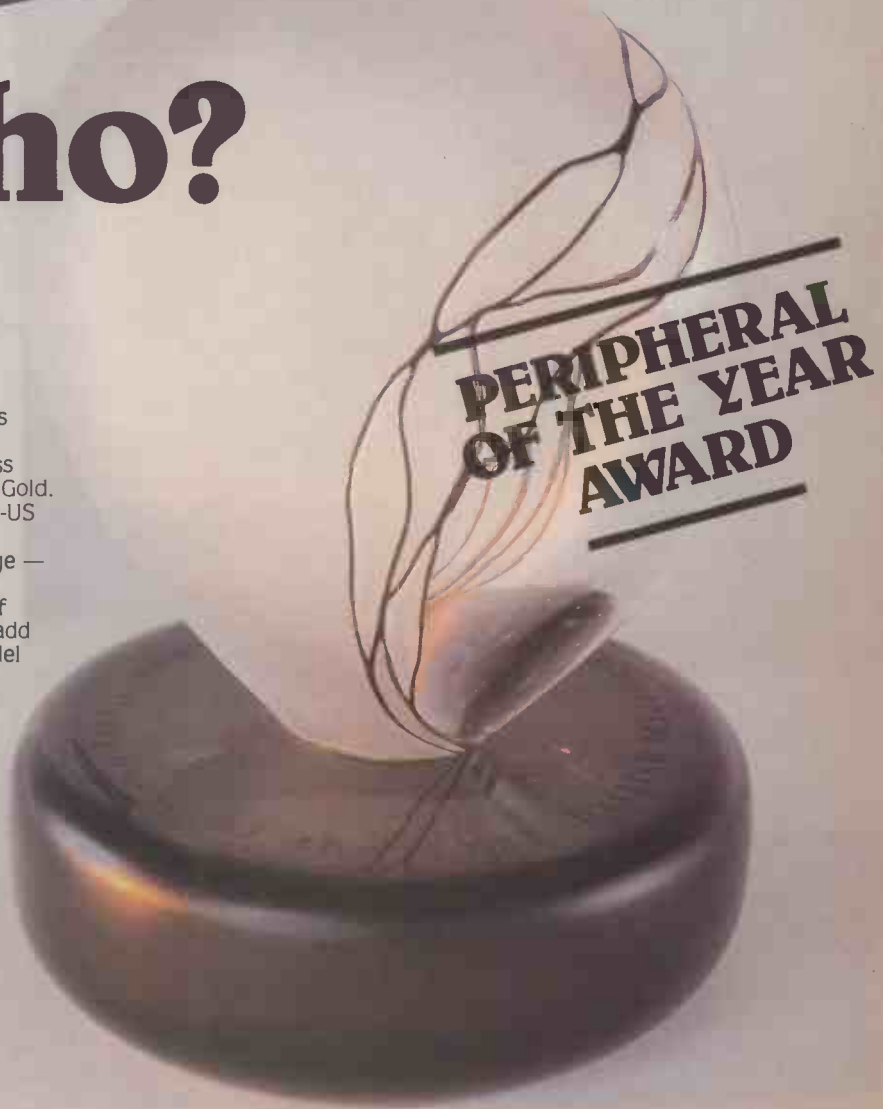

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flat-file database and report generator, but it has a query language which is genuinely easy to use.

The other major development in 1986 was the arrival of some decent database programs to run on a LAN, such as dBase III+ and the Smart database. They are discussed with other LAN software.

WORD PROCESSING

THIS WAS the year that WordStar finally succumbed to its rivals at the top end of the word-processing market. At the cheaper end things were rather disappointing — except on the Macintosh, where the unbundling of Macwrite produced a flurry of activity.

Word Perfect and Microsoft Word are the new top-selling heavyweights. In America at least they are now well ahead of WordStar, even aggregating the original and WordStar 2000 versions together. Our own reviews suggest the reason why — both the newer programs are superb, although at £425 neither is cheap.

Both heavyweights are capable of supporting laser printers well, and are available in LAN versions.

Of the cheaper products PFS Write took our fancy. However this program has recently been revamped and moved upmarket; the new version is reviewed in this issue. Sadly, few of the other cheap products are up to much. Perhaps the best bet for budget word processing is First Choice, an integrated all-in one product aimed at beginners which incorporates a word-processor resembling PFS Write.

Several good pop-up programs designed to operate alongside a word-processing package came out during the year. Ready is a memory-resident version of Thinktank; having a thought organiser available at the same time as a proper word processor probably makes more sense then the original stand-alone Thinktank concept. Turbo Lightning is a very fast spelling checker which has the potential of doing a great deal more in the future.

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	PRICE	REVIEWED	SUPPLIERS
OPERATING SYSTEMS			
DOS Plus	—	Oct 86	Digital Research
Gem	£49.50	Aug 85	Digital Research, First Software, P&P, Softsel
Windows	£85	Feb 86	Microsoft, P&P, Softsel
Xenix	—	—	Microsoft
EASY SOFTWARE			
First Choice	£149	Nov 86	First, Softsel
Works	£250	July 86	Microsoft
Vicom	£99	—	Digital Research

SUPPLIERS

Altor Computers Unit 11A, Anderston Centre, Glasgow G2 7PH. Telephone: 041-226 4211
Ashton-Tate Oaklands, 1 Bath Road, Maidenhead, Berkshire SL6 1UH. Telephone: (0628) 33128
Centaur Systems 17-21 Castle Street, Cardiff CF1 2BT. Telephone: (0222) 390714
Computer Associates Edinburgh House, 43-51 Windsor Road, Slough, Berkshire SL1 2EQ. Telephone: (0753) 77733
Ctrl Alt Deli 44 Brownboker Court, Milton Keynes, Buckinghamshire MK14 6JH. Telephone: (0908) 662759
Digital Research Oxford House, Oxford Street, Newbury, Berkshire RG13 1JB. Telephone: (0635) 35304
First Software Intec 1, Wade Road, Basingstoke, Hompshire RG24 0NE. Telephone: (0256) 463344
Heyden Datasystems Spectrum House, Hillview Gardens, London NW4 2JQ. Telephone: 01-203 5171
Ideal Software Talwarth Tower, Surbiton, Surrey KT6 7EL. Telephone: 01-390 6722
Image Computer Systems 27 Cobham Road, Ferndown Industrial Estate, Wimborne, Dorset BH21 7PE. Telephone: (0202) 876064
Intuitive Systems 66 High Street, Stevenage, Hertfordshire SG1 3EA. Telephone: (0438) 317966
In Touch Foirfield House, Brynhyfryd, Coerphilly, Mid-Glomorgan CF8 2QQ. Telephone: (0222) 882334
McQueen Systems Elliott House, 8-10 Hillside Crescent, Edinburgh EH7 5EA. Telephone: 031-558 3333
Newstar Software 200 North Service Road, Brentwood, Essex CM14 4SG. Telephone: (0277) 229509
Paradigm Southampton House, 192-206 York Road, London SW11 3SA. Telephone: 01-228 5008
P&P Micro Distributors Todd Hall Road, Carrs Industrial Estate, Haslingden, Rossdendale, Lancashire BB4 5HU. Telephone: (0706) 217744
Package Programs 91 Blackfriars Road, London SE1 8HW. Telephone: 01-633 0121
Productivity Software International 1220 Broadway, New York NY10001. Telephone: (U.S. area code 212) 967-8666
Sagesoft NEI House, Regent Centre, Gosforth, Newcastle upon Tyne NE3 3DS. Telephone: 091-284 7077
Sentinel Software Wellington House, New Zealand Avenue, Walton-on-Thames, Surrey KT12 1PY. Telephone: (0932) 231164
SK Micro Systems St. Michael's House, Norton Way South, Letchwarth, Hertfordshire SG6 1PB. Telephone: (0462) 679331
Softsel Computer Products Softsel House, Syan Gateway, Great West Road, Brentford, Middlesex TW8 9DD. Telephone: 01-568 8866
Software Publishing Europe 85-87 Jermyn Street, London SW1Y 6JD. Telephone: 01-839 2849
SPI Software Products International, 13 Horseshoe Park Estate, Pangbourne, Berkshire RG8 7JN. Telephone: (0735) 74081
Tekware Pallodium House, 139-141 Worcester Road, Hogley, West Midlonds DY9 0NG. Telephone: (0562) 882125
Zorland 144 Griffin Road, London SE18 7QA. Telephone: 01-317 7240
Zygos International Suite 9, Intec 2, Wade Road, Bosingstoke, Hampshire RG24 0NE. Telephone: (0256) 25927
4-5-6 World Saracen's House, St. Margarets Green, Ipswich, Suffolk IP4 2BN. Telephone: (0473) 225951

Word and Word Perfect were the top-selling WP programs.

LAN SOFTWARE

BUYING multi-user software to run on a network is beset with problems. Not only has the software got to work properly, but it also must run on the right brand of network. But this year things finally began to straighten out.

One development that helped was the beginnings of a shake out in the IBM network-hardware market. MS-Net and PC Network began to emerge as something of a standard, with Novell, 3-COM and, in the U.K, Torus emerging as leading hardware suppliers.

On the Macintosh things are less developed. A good low-level network exists in Appletalk, but not a standard file server. Little in the way of true multi-user software is likely to emerge until Apple launches its own file server.

So for the time being the major software houses can ignore the Mac and concentrate on the still fairly fragmented world of IBM LANs. Fortunately the software houses themselves finally got their act together over network pricing. Most now offer flexible network licences which work out considerably cheaper per user than the equivalent number of stand-alone systems.

Genuine multi-user software is a good deal more complex to write than single-user stuff. To prevent the various users on the network corrupting each other's data requires an effective locking scheme which at the same time must not degrade performance.

The problem is particularly acute in database and accounting applications, where users may quite legitimately

want to use the same file. Here locking has to be at the record level. dBase III+, Smart and Open Access were probably the most important databases to emerge in full-blown network versions. Both the Smart and Open Access databases are part of multi-module integrated systems, with multi-user spreadsheets and word processors also available.

Intuitive Solution is a slightly different kind of product. Aimed mainly at large corporate users, it provides a set of high-level tools for the development of multi-user applications. It has database, word-processing and network mail functions built-in, but its approach goes beyond the usual application generators embodied in products like dBase.

Word processing is a considerably simpler application to run across a network, but you can still have problems with file and resource contention. As the sponsor of MS-Net, Microsoft has not surprisingly made sure that Word runs properly on its own system.

UTILITIES

GIVEN the state of the IBM universe, with many users pushing up against limitations of their equipment, it is hardly surprising that utility software was one of the most active areas this year. Disc utilities, printer enhancement and operating-system extensions were all very popular. It was also interesting to see some new software houses and distribution companies enter the market; in this sector it is still possible to achieve success without large sums of money behind you.

With many users acquiring new hard discs, or running out of space on their existing ones, disc utilities were very popular. Fastback speeds up the process of backing up a hard disc to floppies. Lightning is designed to speed up all disc accessing by intercepting DOS calls and doing the job itself.

Several rival utilities save on disc space by compacting data before it is stored, Cubit and Disk Optimiser among them. Norton Utilities, a toolkit of assorted disc utilities that includes the important un-erase function, came out in a tidied-up and expanded version.

Metatext and Lettrix were the most interesting printer utilities. Both allow you to get very good print quality from an ordinary dot-matrix printer, although they do so at the expense of speed. Both are very easy to use.

Doubledos and Software Carousel both set out to let you multi-task on the IBM. A large number of other products with a similar purpose arrived during the year, the most notable being Windows, the full-blown operating-system extension. But a far simpler approach will do for many applications.

Doubledos gives you two DOS prompts. Having set your two applications running you can toggle between them with a hot key to bring them up on-screen. Software Carousel is a memory shifter, somewhat like Switcher on the Mac. It supports various expanded memory cards, so you can have several applications stacked up in memory and waiting for instant activation.

Following the success of Turbo Pascal, the language event of the year was Borland's launch of Turbo Prolog. It has probably already at least doubled the number of Prolog users.

Prolog is not a general-purpose language, so Turbo Prolog will not interest a lot of users. But it is the ideal tool for playing around with expert systems and other kinds of intelligent database. Borland is to be congratulated in moving the AI World on from expensive products and marketing hype to more widespread practical activity by users.

C continues its progress as the high-level language in which to write serious high-performance applications. We single out Zorland C because it is so very cheap; one of the most welcome trends of the year was the growing number of good products with low price tags.

Basic remains the most popular programming language. Microsoft took two shots at getting its Quickbasic compiler right, but in its latest debugged release it provides a powerful argument for staying with Basic.

OPERATING SYSTEMS

NOT SO LONG ago it seemed that MS-DOS had carried all before it. The system had become the de facto standard for Intel microprocessors, in particular the IBM PC and compatibles, as well as for certain non-compatible manufacturers such as Apricot and Research Machines.

Since the end of last year, there has been intense speculation as to when Microsoft intended to launch the multi-user version 4.0 of MS-DOS. Rumours also circulated about MS-DOS 5.0, which would be multi-tasking and breach the 640K DOS limit imposed by the IBM PC design.

The delay in delivering the new release meant that users increasingly began to turn to other operating systems, particularly Microsoft's multi-user Xenix and Digital Research's DOS Plus. The trouble was that while everyone admired Unix for its efficiency, many manufacturers preferred the DR product as it provided some compatibility with MS-DOS.

DR turned the screw even further in the autumn with the launch of Concurrent PC-DOS XM, which could take advantage of the AQA Enhanced Expanded Memory Specification.

The battle between Microsoft and Digital Research was

Utility software has been one of the most active areas this year.

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fought not only at the operating-system level but also between the rival Wimp shells, Windows and Gem. It now looks as though the two systems are becoming dominant in different areas of the market. Windows appears to be colonising the corporate end, while Gem looks like being dominant in the lower end — thanks largely to being bundled with the Amstrad PC range.

EASY SOFTWARE

ALMOST all software is intended to be easy to use, but in practice this is hard to achieve. Often it comes down to a trade-off between power and ease of use. A noticeable feature of 1986 was a renewed attempt to make software more usable. There are many packages we could mention, but three stand out.

Communications is potentially a very confusing application area for most people. Vicom, which is already well established on the Mac, is now available in an IBM version, targeted primarily at Amstrad users. Running under Gem, it succeeds in being very similar to the Mac version.

The two other programs, Works and First Choice, are all-in-one programs targeted at the beginner and occasional user. Works runs on the Mac, First Choice on IBM-type kit. Both offer word-processing, spreadsheet, database and comms functions.

Although integrating several major functions in this way is rather out of fashion, it does make sense for packages aimed at the less ambitious user. These people do not particularly want heavily feature-laden programs. On the other hand, they do want the consistency in the use of commands that an integrated package is able to provide.

Works is probably the better of the two programs, partly because it runs on the Mac which is more suitable for beginners. Although we obtained a more or less bug-free beta-test version of the program last June, Microsoft has only just released the program.

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IBM AND COMPATIBLES

A YEAR AGO the road ahead for the compatible manufacturers seemed fairly clear: either produce value-added IBM PC/AT compatibles or low-cost PC clones. In other words, carry on as usual.

There were clouds on the horizon. Amstrad was rumoured to be producing a PC clone at a competitive price, and there was some nervousness as to what IBM's next move might be. But all that seemed to be in the future. The only new microcomputer to be launched by IBM in1986, apart from the non-standard RT/PC, was the indifferently received Convertible lap portable.

So for the first half of the year we had a series of IBM PC/AT compatibles from respected manufacturers. Machines like the Mitsubishi 816F and Olivetti M-28 were followed later in the year by the Ericsson WS-286, the Sperry Micro IT, the Wyse 286 and most surprisingly by Apricot with the Xen-i and DEC with the Vaxmate — two manufacturers who had previously sworn not to fall in behind IBM.

The Compaq Deskpro 286 became the benchmark for these machines which, by the end of the year, were easily overtaking it. This was mainly due to the availability of high-speed RAM chips which could cope with the higher 10MHz clock speeds which were becoming standard.

Another feature of the value-added AT clones was the ever-increasing capability of their hard discs. At the beginning of the year a 20Mbyte hard disc was something to write home about; now a 20Mbyte drive bundled with a premium AT clone is beginning to look a bit parsimonious — cheapskate even. The real top-of-the-range machines are being equipped with hard discs of 120Mbyte and more. In 1987, woe betide any manufacturer building a value-added AT-compatible machine that does not start at a 40Mbyte hard disc.

The search for a product differentiator has led to a steady increase in performance of the up-market machines. The established pattern for the added-value AT-compatible machines is now to provide IBM compatibility with greater-capacity hard discs and a 10MHz clock speed to justify the premium price. For good measure, the machines often come bundled with a 1.2Mbyte hard disc and EGA card or equivalent, at least 640K of memory — if not 1Mbyte — and the usual parallel and serial ports.

AT clones: Sperry Micro IT (above); Wyse PC-286 (below).

Manufacturers have also made other offers to tempt customers. The Ericsson WS-286 has unique styling and offers a high-resolution paper-white display. Elsewhere the Vaxmate offers not only AT compatibility but also plug compatibility with DEC's Vax superminis. Apricot has taken a different approach with a service whereby customers can have their machines upgraded in stages from the simplest Xen-i to the full-blown Xen Mainframe machine.

Meanwhile, down in the bargain basement, clone prices have plummeted as importers of Taiwanese PC compatibles vie with each other to offer the best deal. The £500 barrier was broken by the Osborne PC in May, and at the PC User Show in July the Dutch firm Genisys was offering The Competitor for about £375.

Even among the cheap compatibles extra features are a factor. A year ago the concept was simply to sell a cheap IBM compatible; now most companies are offering XT compatibles, although the cheapest do not have a hard disc. Most machines now have at least 512K of memory.

The Amstrad PC-1512 range, announced at the beginning of September, was better than anyone imagined with prices starting at a mere £399. Far from being the simple PC clone machine that everyone had expected, the Amstrad is closer to the Olivetti M-24, with an 8086 CPU along with a parallel

HARD

BY STEVE MALONE

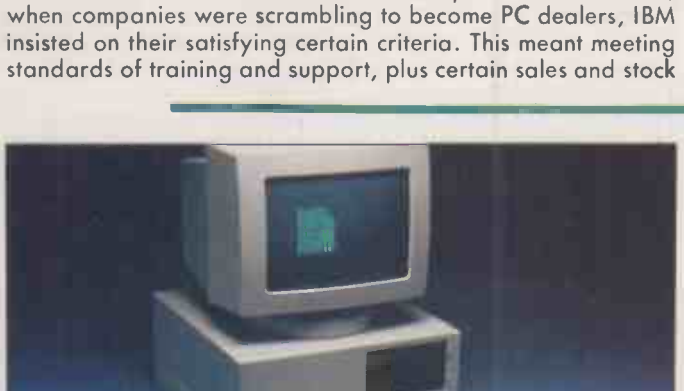
It is always difficult to write a review of the year. Usually you are too close to the events to be able to put them in any context and often you end up making assertions which look silly six months later. On the other hand, 1986 looks like being something of a watershed year in terms of marketing computers.

Harsh reality has finally caught up with those in the business-computer market in the same way that 1984 was the year it caught up with the home market. A lot of companies who thought they were safe from the recession behind their high-tech armour found that their protection had a few chinks. Many of them were wounded and turned to IBM compatibility for salvation. Now of all the major international manufacturers, only Apple is brave enough not to have an IBM-compatible computer in its range.

But even the mighty IBM appeared to be on the defensive in 1986, with the rest of the industry looking on in glee and disbelief at Big Blue's apparent disarray. The main reason for IBM's discomfort was the deluge of Far Eastern clones which swamped the low end of the market.

When IBM chose the 8088 processor, it did so because the eight-bit peripheral chips to support it were cheap, plentiful and easily sourced from the Far East. In the intervening five years these chips have become even cheaper, more plentiful and available to all. It is this, together with the hard work and low wages of Taiwanese and Korean assembly workers, that has undermined IBM. The company's one chance of avoiding the flood was to stand firm on the proprietary BIOS ROM. Its failure to head off Compaq in the heady days of 1982 led to the £399 clone of today.

The retreat of IBM has had other consequences too. In 1982, when companies were scrambling to become PC dealers, IBM insisted on their satisfying certain criteria. This meant meeting standards of training and support, plus certain sales and stock



The Olivetti M-28 was one of the early AT look-alikes.

WARE

Apple's top-of-the-range Mac Plus easily matches the IBM PC/AT.

targets. Following the successful U.S. model, IBM also insisted that the dealers take expensive High Street sites as a glamorous shop window for IBM products. Today these same businesses find themselves with overheads that they can no longer maintain and are moving to more modest premises and setting up as value added resellers in order to take advantage of the corporate move towards more complex and integrated systems. Others are simply going out of business.

At the low end of the market, the clones are triumphant. The fight now begins for who will control the field in the future. At the moment it is hard to find anyone who will bet against Amstrad sweeping the market, but there is no such thing as a certainty in this business; Alan Sugar will not sit back and wait for the money to roll in but will scrap for every sale.

Meanwhile the technology progresses. The baseline for a corporate machine is now 32 bits. This is typified by the Compaq Deskpro 386 and Rair Turbo 386 which have done the unthinkable and launched ahead of IBM. The PC/AT now looks like being the next to fall prey to the clones, and IBM must be planning to pull something out of the bag soon if it is to avoid leaving itself without any top-end machines.

Rumours abound as to what the next generation of IBM business micros will feature. It takes bravery — or a job at Microsoft — to predict what those features will be. Although the details change, the basic theme of the rumours is that the new machines will contain unclonable proprietary code, which seems a logical course for IBM to follow.

The question is what will the code contain? Here the speculation ranges from a proprietary graphics display to a built-in SNA facility. It will certainly have to be something special to carry the user base with it.

And what of the customers themselves? The low-end users will be queuing in Dixons for their PC-1512s while the corporates, who already have hundreds of PCs, will be busily linking them together through the company mainframe. Everyone will be looking for bargains.

port, a serial port and a unique video display on the motherboard. The system's 512K of RAM also means that the clone-makers have had to upgrade hurriedly to stay in the race.

In an unprecedented show of respect for Alan Sugar, IBM chose the day of the Amstrad launch to unveil its PC/XT-286. It joins the Sperry Micro IT among the mid-range 80286-based machines.

At the top end, Compaq has launched the Deskpro 386 32-bit machine. The Deskpro 386 comes with a range of features that are intended to maximise the speed of the machine, including an extra-fast hard disc, static-column RAM chips and a clock speed of 16MHz. The opposition — which includes IBM — will have to come up with something rather special in order to compete.

NON-COMPATIBLES

FOR THE non-clone manufacturers life has become increasingly lonely. Only the Amstrad PCW-8256 is now sustaining mass-market sales in the U.K., though the success of this machine has been a phenomenon in itself. Alan Sugar's assault on the IBM-compatible market would surely not have made such a commotion without it. The PCW-8256 is based around eight-bit technology that most other manufacturers in the business market abandoned a while ago. As a consequence of its success, it has generated a whole new market for CP/M software and caused numerous software houses to ferret in their vaults for products which had previously, but prematurely, been pronounced dead. The question now is whether Amstrad can maintain sales of the PCW-8256 and its sibling, the PCW-8512, against the newly launched PC-1512 IBM compatible.

For the other non-compatible manufacturers it has been a matter of establishing niche markets where IBM has not been all-conquering, or becoming IBM compatible where they could. Many of them have found even narrower niche markets to be profitable. Research Machines has long been established among U.K. educational users, while the Macintosh is now pulling in sales in the rapidly accelerating desk-top publishing market.

Apple has realised its advantage in a market where the IBM PC is unable to compete due to its greatly inferior screen display, and is pushing hard for dominance before IBM can enter the fray in earnest. To this end, Apple now bundles a complete desk-top publishing system in a single package.

While Apple holds a number of key cards in the battle for this market, it could still end up the loser. To continue to make headway, Apple needs a high-capacity network to enable several people to work on the same system.

The only major launch in the non-IBM sphere has been the Commodore Amiga, and it has had some success in its chosen fields of computer graphics and art. Commodore has actually been selling machines through graphics and arts-materials suppliers.

No non-compatible manufacturer nowadays could be so quixotic as to attempt to challenge IBM in its corporate strongholds. On the other hand, if you want any business sales at all, you have to be able to offer some kind of access to the IBM PC software base. The favourite technique to achieve IBM compatibility for the non-IBM compatible manufacturers is to produce a bolt-on box with an 8088 processor inside. This technique was first established with Mac Charlie for the Apple Macintosh. The idea has since been embodied in the Sidecar for the Amiga; a similar device is promised for the Atari ST.

The problem here is to provide IBM compatibility at a competitive price. After all, if you want to run IBM software, why spend around £1,000 for a bolt-on box when for £399 you can buy a complete machine? Atari seems to understand the problem better than Commodore: the ST device is to be priced at under £300, while present indications are that Sidecar will be more than twice this price.

Though Apricot has joined the ranks of IBM-compatible manufacturers it is still producing the original Xen. Its position in the Apricot catalogue must be precarious now that the IBM-compatible Xen-i is establishing itself in the market, although Apricot has repeatedly confirmed its commitment to the original, non-compatible Xen.

One surprising entry to the non-compatible club has been IBM itself, with the launch of the RT/PC, otherwise known as the 6150. Of course, the machine is not intended for the business market but as a scientific and engineering computer and for CAM applications. It seems that IBM got a taste of its own medicine when it introduced an AT board for the machine to enable it to run standard PC software. In effect, IBM brought out a Mac Charlie for one of its own machines.

Quite what the future holds for the RT/PC is hard to say. Certainly it was never intended to capture the imagination of the mass market; on the other hand, niche machines are not IBM's style. Its posture has always been geared towards the corporate mainstream rather than the smaller though profitable R&D marketplace. Perhaps IBM is considering it as

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an experimental machine designed to test the water.

Finally, another threat has emerged to the non-compatible manufacturers in the form of a different kind of 32-bit machine. They have previously managed to survive on the basis that their machines are technically far in advance of the IBM specification. The launch of the Compaq Deskpro 386 has meant that the non-compatible machines now have the inferior spec. Companies like Atari, Commodore and Apple can therefore be expected to announce upgrades to the Motorola 68020 32-bit chip for their top-of-the-range machines over the next year. Already Atari has said that it intends to launch a Unix work station based around the 68020, and it is hard to imagine that Apple is not working on something similar for the Mac.

PORTABLES

WHILE the technology of low-power lightweight computer components has been developing as much as any other area of the industry, transportable and lap-portable computers have still not made the crucial breakthrough into the mainstream that has long been expected. The main reason for this remains the display. Machines fitted with a standard CRT display are uncomfortably heavy, while most of the lightweight LCD screens are hard to read.

The alternative is to simply regard mains-powered transportable as compact desk-top machines. This is the background to the success of the Compaq portable series, which has even managed to drive IBM from the transportable market. The Compaq Portable 286 is at the top of the range. Fitted with a monochrome monitor, 640K of memory, a 10Mbyte tape backup, a 1.2Mbyte floppy disc and 20Mbyte hard disc, the machine is almost everything the business user might want.

Almost everything the engineer could want in a transportable is provided by the Hewlett-Packard Integral. This beast resembles a large ghetto-blaster and comes equipped with an 8MHz 68000 processor running Unix, an 80- by 31-character back-lit LCD screen, integral 150cps ink-jet printer and two 3.5in. floppy-disc drives. It is a shame that there is little business software available for the machine.

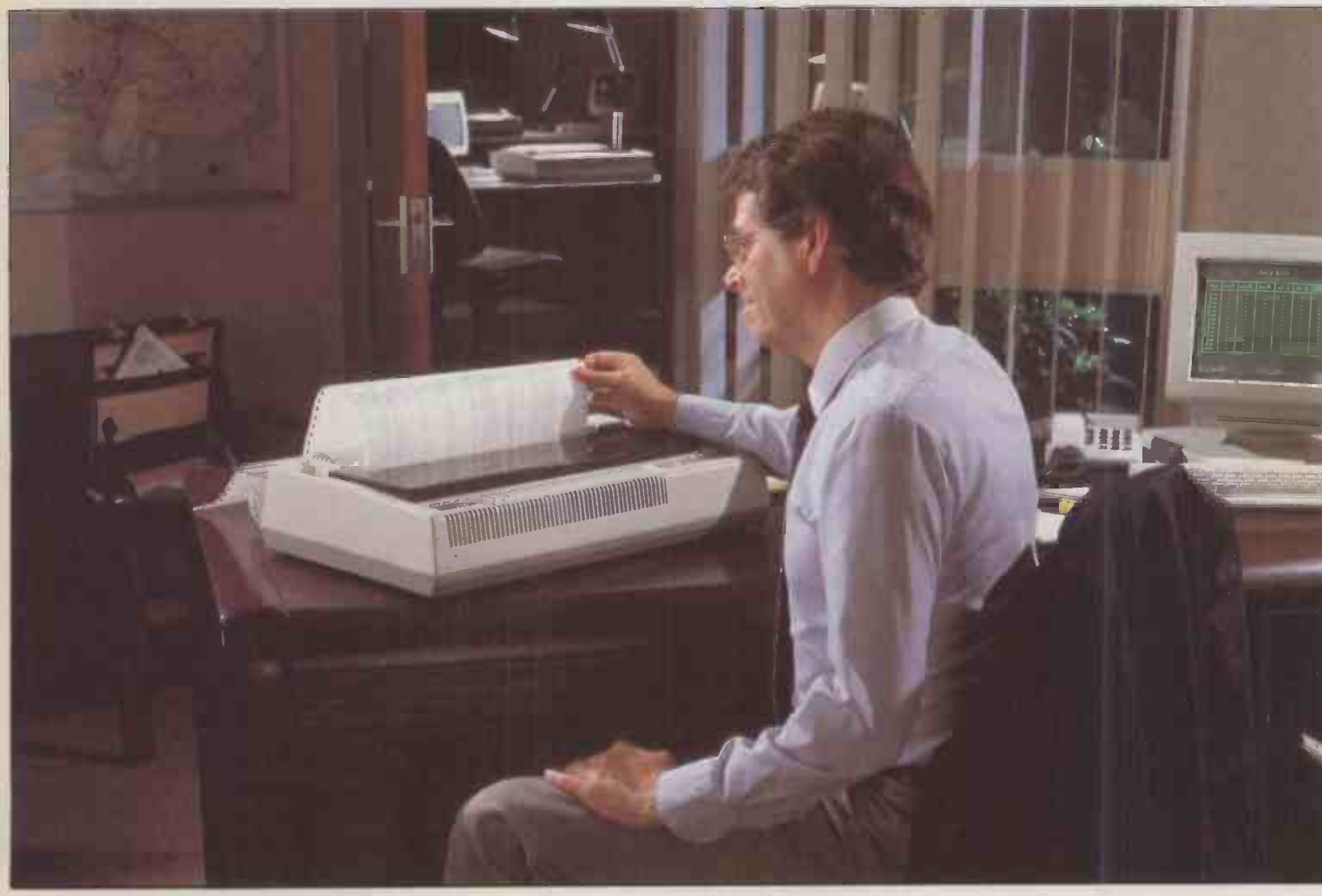
At the cheaper end of the market most machines still stick with LCD displays. However, Electro-luminescent and plasma displays are now becoming increasingly common on transportable machines. Among the most successful of the new breed is the T-3100 from Toshiba, reviewed on page 48 of this issue. The machine has a 10Mbyte hard-disc drive, a 720K 3.5in. floppy drive, 640K of RAM and an 80- by 25-character plasma display, yet it weighs in at only 15lb. Although the T-3100 is not the nippiest machine around, in many ways it is the perfect business transportable.

At the other end of the scale good-value CP/M transportables are still around for a modest outlay. The Opus Supplies Wren is a full-function CP/M machine with two disc drives, a whole stack of software and a built-in modem, all for the princely sum of £495.

Hewlett-Packard's Integral.

The battery-operated true portables are probably stuck with an LCD screen for the foreseeable future. However, improvements are being made. Data General has recently introduced the DG One model 2, which sports a new back-lit LCD display. The screen is a great improvement over the original, through you still find yourself squinting at it in a strong ambient light.

Another company which has recently improved the quality of its lap portable is Tandy, with its Model 102. It comes with 32K of memory and a built-in modem although the screen is still a limited 40-character by eight-line resolution. The machine is fine for text input and as a programmable calculator, but not for a great deal else. Still, at £299 you cannot really complain.



MULTI-USER

THE AREA of multi-user systems is one of the few at the microcomputer level that is not dominated by IBM. The cause is not sluggishness on IBM's part but Microsoft's failure so far to produce a multi-user release of MS-DOS. Without a clear standard to go by, the multi-user market is still subject to the glorious chaos that typified the stand-alone micro market prior to the entry of the IBM PC.

Without a clear IBM/Microsoft standard to go by, a non-compatible multi-user business machine can still be viable. Thus ICL has managed to launch the non-compatible DRS-300 multi-user engine without attracting pitying looks from other manufacturers. The DRS-300 is unusual in that the major components are housed in separate modules.

Although the PC-based multi-user systems have been talked about for years, their entry into the wider business arena has only really taken place since the development of true 16-bit processors. Until the middle of 1985, this generally meant a Unix-based system built around the Motorola 68000 chip. Since then, there has been a surge of systems based on the Intel 80286 running Xenix, and more recently Concurrent DOS.

The multi-processor North Star 100 system.

The increasing power of processors has meant that the single-processor multi-user system has become a much better proposition. The prime example is currently the Rair Turbo 386. The system is based around the Intel 80386 processor, providing its users with 32-bit performance. The system can support up to 24 users via the multi-protocol serial ports. Like most modern multi-user systems, the Rair can run under either Concurrent DOS or Xenix System V.

Over the past couple of years the trend in stand-alone business computers has increasingly been towards turnkey systems, where the user gets all the equipment to be able to start right away. This movement has transferred to the multi-user system manufacturers, typified by the Comart Quad. For £4,995 you get a 12.5MHz 80186 CPU, a 20Mbyte hard disc, a 1.2Mbyte floppy, four terminals and Concurrent DOS. This kind of approach is clearly preferable to buying the elements separately and then trying to get them working together.

A good idea is bound to attract the attention of the competition, and following the launch of the Quad, rival multi-user manufacturer Bromcom introduced the QC. As in the Comart system, purchasers get a complete package and four terminals to create a working setup.

The single-processor configuration for multi-user systems is not the only solution on offer. The traditional route was to have a processor acting as file server, communicating directly with several slave processors connected via a bus. This strategy can still be seen in the 100 system from North Star Computers. It consists of a 6MHz 80186 acting as the file server connected to several 8088-2 processors dedicated to each of the terminals.

Although the North Star 100 system is very different in concept from the Comart and

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Bromcom offerings, the company has been influenced by the new low prices offered by its competitors and has recently slashed the prices on a range of its systems. The North Star 100 low-end multi-user system is now being offered at £5,600, compared with a previous price of £9,500, though the old price includes a tape backup unit.

The growing market for office-automation systems will undoubtedly lead to higher performance and lower prices over the next 18 months. The market will also probably divide, like the PC market, into high-performance premium products like the Rair, and the small, budget-priced all-in systems typified by the Comart Quad.

EXPANSION CARDS

WHILE PC manufacturers have been in the doldrums, sales of plug-in boards for IBM machines have surged ahead. One of the biggest current trends is plug-in hard discs. The Western Digital Filecard 20, the Insider 30 and the Olivetti OPE are among the high-capacity drives now available at prices of £600 upwards. Doubtless prices will fall, capacities will rise and successful manufacturers will cash in while they can. The boom in plug-in discs is likely to be short-lived, as more and more customers buy machines with high-capacity hard discs built-in.

The market for expanded graphics adaptors has also taken off. The basic 64K IBM EGA card has been cloned by a number of manufacturers. Interquadram alone claims 40 percent of the market for its EGA+ card. Other manufacturers have been busy adding features to the basic EGA card, most notably Orchid with its Turbo-EGA, which carries an 80286 processor.

Hercules proved there was still life in the monochrome card with the release of its Graphics Card Plus. It can support a variety of bit-mapped founts, yet maintains the speed of the standard monochrome card. Quite how long the boom in EGA cards will last is still a matter for conjecture. Like the

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	PRICE	REVIEWED	SUPPLIERS
IBM COMPATIBLES			
Amstrad PC-1512	£399	Nov 86	Amstrad
Apricot Xen-i	£2,998	Sept 86	Apricot
Compaq Deskpro 386	£6,444	Nov 86	Compaq
Dec Vaxmate	$3,795	—	Digital Equipment
Ericsson WS-286	£5,095	Oct 86	Ericsson
Genisys Competitor	£440	—	Genisys
IBM Convertible	$1,995	Oct 86	IBM, Entry Systems Division
IBM PC/XT-286	£3,284	—	IBM
Mitsubishi 816F	£2,600	Aug 86	Mitsubishi
Olivetti M-28	£3,288	June 86	British Olivetti
Sperry Micro IT	£3,250	Oct 86	Sperry
Wyse 286	£3,105	Oct 86	Wyse
NON-COMPATIBLES			
Amstrad PCW-8256	£399	Nov 85	Amstrad
Apple Macintosh Plus	£2,295	Apr 86	Apple
Apricot Xen	£2,147	Jan 86	Apricot
Atari 1040ST	£699	—	Atari
Commodore Amiga	£1,675	—	Commodore
IBM RT/PC	£7,417	June 86	IBM
RM Nimbus PC1	£995	Mar 85	Research Machines
PORTABLES			
Compaq 286 Portable	£4,395	Apr 86	Compaq
DG One model 2	£1,472	—	Data General
HP Integral	£5,450	—	Hewlett-Packard
Wren Executive	£500	June 84	Opus Supplies
Tandy 102	£299	—	Tandy
Toshiba T-3100	£3,200	this issue	Toshiba
MULTI-USER			
Bromcom QC	£4,495	—	Bromcom
Comart Quad	£4,995	—	Comart
ICL DRS-300	£6,217	July 86	ICL
North Star 100	£5,600	—	North Star
Rair Turbo 386	£19,000	—	Rair
EXPANSION BOARDS			
Allcard	£695	Sep 86	All Computers
3270 Coax	£995	—	AST Europe
Rampage	£595	Sep 86	AST Europe
Hayes 1200B modem	£465	—	Softsel
Hercules Graphics Card Plus	£249	Oct 86	First Software
IBM EGA	£294	Nov 84	IBM
Insider 30	£949	Sept 86	X-Tech
Intel Above Board PS	£375	Sept 86	First Software
Intel Above Board PS/AT	£565	—	First Software
Interquadram EGA+	£293	Nov 86	Interquadram
Interquadram EMS+	£425	—	Interquadram
Interquadram Quad VI	£2,695	—	Interquadram
Interquadram IX	£3,695	—	Interquadram
Olivetti OPE	£599	—	Personal Computer Upgrade
Orchid Turbo-EGA	£749	Nov 86	First Software
Filecard 20	£899	Oct 86	Western Digital
PRINTERS			
Epson EX-800	£505	—	Epson
IBM Quietwriter II	£1,316	—	IBM
Mannesmann-Tally 910	£3,245	—	Mannesmann-Tally
Oki Microline 292	£549	Aug 86	X-Data

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(continued from page 96)

plug-in hard discs, graphics cards are being bought by existing users who want to upgrade older systems.

One area of the expansion-card market that seems secure for the foreseeable future is the plug-in modem. The most popular is currently the Hayes 1200B. It can take up to six months and an outlay of £10,000 to gain approval for use in the U.K., and most computer manufacturers are unwilling to wait that long before launching their products. The result is that few new micros are likely to be sold with a built-in modem, and so demand for plug-in units will remain.

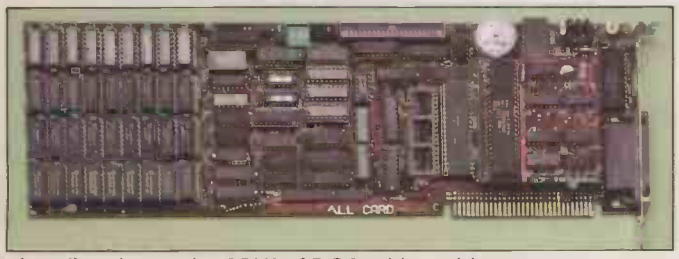
The continuing problem with the PC-DOS 640K limit has proved another happy hunting ground for the board manufacturers. The announcement of the Lotus/Intel/Microsoft specification has led to a flurry of expanded memory boards, with Intel's own Above Board PS and PS/AT leading the pack. AST was not far behind with the Rampage card, while Interquadram has the EMS+.

Interquadram has also been among the collaborators behind the superior EEMS specification, which can support a multi-user system. This has led a number of multi-user manufacturers to standardise around the EEMS system rather than go it alone. Even Microsoft has had to take notice, and future versions of Windows will be able to take advantage of the EEMS specification.

Going one better, the Allcard not only supports the existing specifications but has its own memory-management device on board to redirect calls to the reserved areas of PC memory. This frees a large expanse of memory to the 8088 and provides a DOS area of 952K.

The market for Irma and network cards is growing steadily, and 3270 emulation cards are now consistently among the top sellers. These cards are the means by which a third-party manufacturer has been able to develop a system that is cheaper and better than the existing IBM configuration, yet still compatible with it. The AST-3270 Coax card has been a particular success.

Interquadram's Masterlink series includes token-ring systems, known as the Quadnet VI and Quadnet XI networks, and 3270 emulation packages. Interquadram expects they will constitute the majority of its sales by the end of 1987. The micro-to-mainframe links in the series are a fraction of the price of current IBM systems, though with the real office-automation market still in its infancy, it is unlikely that IBM will allow this situation to persist for long.



The Allcard provides 952K of DOS-addressable memory.

SUPPLIERS

All Computers 2nd Floor, Prince Rupert House, 64 Queen Street, London EC4R 1AD. Telephone: 01-248 8895

Amstrad Consumer Electronics Brentwood House, 169 Kings Road, Brentwood, Essex CM14 4EF. Telephone: (0277) 228888

Apple Computer (U.K.) Eostmon Way, Hemel Hempsteod, Hertfordshire HP2 7HQ. Telephone: (0442) 60244

Apricot Computers Apricot House, 17 Westbourne Road, Edgbaston, Birmingham B15 3TR. Telephone: 021-454 9091

AST Europe AST House, Goat Wharf, Brentford, Middlesex TW8 0BA. Telephone: 01-840 7200

Atari Corporation Atari House, Railway Terrace, Slough, Berkshire SL2 5BZ. Telephone: (0753) 33344

British Olivetti Olivetti House, PO Box 89, 86-88 Upper Richmond Road, London SW15 2UR. Telephone: 01-785 6666

Bromcom 417-421 Bromley Road, Downham, Bromley, Kent BR1 4PJ. Telephone: 01-461 3993

Comart Computers Little End Road, Eoton Socon, St. Neots, Combridgeshire PE19 3JG. Telephone: (0480) 215005

Commodore Business Machines (U.K.) 1 Hunters Rood, Weldon, Corby, Northamptonshire NN17 1QX. Telephone: (0536) 205555

Compaq Computer Ambossodor House, Porodise Road, Richmond, Surrey TW9 1SQ. Telephone: 01-940 8860

Data General Hounslow House, 724-734 London Road, Hounslow, Middlesex TW3 1PD. Telephone: 01-572 7455

Digital Equipment Company Digital Pork, Imperial Way, Reading, Berkshire RG2 0TE. Telephone: (0734) 868711

Ericsson Information Systems 7 Gresham Street, London EC2V 7BX. Telephone: 01-606 0425

Epson U.K. 388 High Road, Wembley, Middlesex HA9 6UH. Telephone: 01-902 8892

First Software Intec 1, Wade Road, Basingstoke, Hompshire RG24 0NE. Telephone: (0256) 463344

Genisys Europe Schermerweg 74, 1821 BJ Alkmaar, Netherlands. Telephone: (010 31 0) 721-27225

Hewlett-Packard Miller House, The Ring, Bracknell, Berkshire RG12 1XN. Telephone: (0344) 773100

IBM Entry Systems Division Boco Roton, Florido, U.S.A. Telephone: (U.S. oreo code 305) 998-2000

IBM U.K. PO Box 32, Alencon Link, Basingstoke, Hompshire RG21 1EJ. Telephone: (0256) 56144.

ICL Bridge House, Putney Bridge, London SW6 3JX. Telephone: 01-788 7272

Interquadram 653 Ajox Avenue, Slough, Berkshire SL1 4BG. Telephone: (0753) 34421

Mannesmann-Tally Molly Millar's Lane, Wokingham, Berkshire RG11 2QT. Telephone: (0734) 788711

Mitsubishi Electric U.K. Hertford Place, Maple Cross, Rickmansworth, Hertfordshire, WD3 2BJ. Telephone: (0923) 770000

North Star Computers 39 Queensway, Hemel Hempstead, Hertfordshire HP2 5HE. Telephone: (0442) 41266

Opus Supplies 55 Ormside Way, Holmthorpe Indsutrial Estate, Redhill, Surrey RH1 2LW. Telephone: (0737) 65080

Personal Computer Upgrade Voss House, Thames Street, Walton-on-Thames, Surrey KT12 2PU. Telephone: (0932) 231100

Rair 145-157 St. John Street, London EC1V 4QJ. Telephone: 01-250 3535

Research Machines Mill Street, Oxford OX2 0BW. Telephone: (0865) 249866

Softsel Computer Products Softsel House, Syon Gatewoy, Greot West Rood, Brentford, Middlesex TW8 9DD. Telephone: 01-568 8866

Sperry Sperry Centre, Stonebridge Pork, London NW10 8LS. Telephone: 01-965 0511

Tandy U.K. Leamore Lone, Bloxwich, Walsall, West Midlands WS2 7PS. Telephone: (0922) 477778

Toshiba U.K. International House, Windmill Road, Sunbury, Middlesex TW16 7HR. Telephone: (0932) 78566

Western Digital 55 Eost Street, Epsom, Surrey KT17 1BP. Telephone: (03727) 42955

Wyse Technology (U.K.) 26-28 King Street, Maidenhead, Berkshire SL1 1EP. Telephone: (0628) 784037

X-Data 750-751 Deal Avenue Trading Estate, Slough, Berkshire SL1 4SH. Telephone: (0753) 72331

X-Tech U.K. Court Farm Estate, Greens Norton Road, Towcester, Northamptonshire NN12 8AN. Telephone: (0327) 53399

PRINTERS

LASERS dominated 1986. Their quietness, speed and high quality make them unquestionably a step forward for the average office users. But matrix printers are not finished, and there have been improvements in quality and speed in this area too.

Price is a major focus of interest in the laser market. QMS's Kiss, a basic Canon-derived machine for straightforward word processing, sells for under £1,400, and with discounting a Canon A1 laser printer can be had for little more.

The major technical development in the laser market was the arrival of quicker, heavier-duty machines that operate at a lower cost per copy. The Mannesmann-Tally 910 impressed us a lot, but both Qume and Kyocera also launched good heavy-duty lasers.

In matrix printers the emphasis this year shifted to improving output quality. Most of the nine-pin machines launched had at least two speeds: a fast draft speed and a higher-quality but slower NLQ mode. Epson still dominates the dot-matrix market despite intense competition. We were very impressed by the fast nine-pin EX-800, which offers NLQ mode and has good graphics-printing ability.

The year was not outstanding in terms of technological innovation. IBM launched an improved version of its Quietwriter which uses a variant of the thermal-transfer printing method and is excellent as a near-silent daisywheel replacement. This technology undoubtedly has great potential for the future, but at present suffers from fairly high ribbon costs.

There has not been much excitement in the world of colour printers either. The major hold-up seems to be the high cost of colour photocopiers, which restricts the usefulness of being able to print in colour. However, dot-matrix printers with multi-coloured ribbons, such as the Oki Microline 292, seem to satisfy most people's needs, and more ambitious business users appear happy buying slow pen plotters for colour work. Newer colour-printing technologies such as ink-jet and colour thermal-transfer are improving, but as yet sell mainly into niche markets. More of the year's best printers are discussed on page 81 of this issue. PC

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Submissions should include a brief description which explains what your program does and how it does it. This should be typed with lines double-spaced. The program should be printed with a new ribbon or at double-intensity; the width should be between 75mm. and 90mm., or between 105mm. and 135mm. Also include a disc of your program.

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TURBO PROLOG

DISPLAY UTILITIES

Jim Bates presents three Turbo Prolog routines to tackle basic keyboard, arithmetic and screen-handling problems.

During the initial stages of getting to grips with a new language there are two main areas which must be sorted out and thoroughly understood before much further progress can be made. They are keyboard input and screen output. In Turbo Prolog screen output is fairly easy using the Write, Writef and Cursor predicates, together with the various Window constructions.

On the other hand, keyboard input can become quite involved, particularly when you wish to use the special keys like Home, Ins, Esc and so on. The symbolic keyboard access routine shown in listing 1 is a development from the keyboard access routine given in the Geobase example supplied with Turbo Prolog. It is worth writing into a file for general inclusion in programs that require access to these keys.

The program first sets up a domain called Key and lists the relevant symbolic values that you are going to access. I have laid out the listing in a logical manner to represent the cursor-control area of the keyboard. I have not included all the symbolic keys; you must add any others that you require, like Backspace, Tab and so on.

The IBM keyboard has a particular way of recognising certain special keys called scancodes. When you press an ordinary key, like lower-case a, the keyboard responds by sending the relevant character number back to your program — in this case the number would be 97. However, when you press one of the function keys, cursor keys or certain combinations of Alt and a key, the keyboard sends back two characters in response.

Whenever one of these two-character sequences is sent, the first character code is always 0. The problem then is simply to check whether the character code received is a 0. If it is then the next character code is read and decoded accordingly. If it is not then the character code is treated normally. One added complication is that certain single-character codes do not represent printable characters but functions like Escape, Tab, Backspace and so on. Within Prolog, you can conveniently represent any character code by a symbolic name, and it is these symbolic names which are listed in the domain statement here.

Three defined predicates are required by the routine. They are

readkey(KEY)

which is used to access the routine,

readcode(KEY,char,integer)

which is used to read the first character code, and

scancode(KEY,integer)

which is used to read the second character code.

The procedure begins at line 4, where Readkey(Key) is attempted. Line 5 is a standard predicate which waits for a key to be pressed, and then sets X to the value of the received character code. Line 6 sets Val to the integer value of this code — again by use of a standard predicate Char_int. Finally, line 7 uses the Readcode predicate to check whether the code equates to one of your required symbolic values.

Lines 8 and 9 in the listing attempt to equate character codes 13 or 27, which are given the symbolic names CR and Esc. Further codes can be added here if required. For example, the Backspace key could be detected by adding the clause

readcode(bs,_,8)

The cut symbol is necessary to prevent further searching by Prolog whenever one of these clauses succeeds.

If the received code is not found in one of these clauses, Prolog then attempts the clause at line 10 to check if the received code was a 0. If this is not the case, then the clause at line 15 is attempted. This will always succeed and returns the character corresponding to the received code in the variable Key.

If the received character code is a 0, then the clause at line 10 will be attempted, and processing will continue with the clauses in lines 11 to 13. Line 11 reads the next character code and line 12 puts its integer value into Val. Finally, line

(continued on next page)

LISTING 1. SYMBOLIC KEYBOARD ACCESS

```
/*************************************************************/
/*                                                           */
/*   Symbolic Keyboard Access -  TURBO PROLOG                */
/*                                                           */
/*        readkey(KEY) - Returns symbolic value of           */
/*                       key pressed in variable KEY.        */
/*                                                           */
/*************************************************************/

/* Line Numbers are for reference to text only */

/* Line */

            DOMAINS

              KEY =   cr  ;  esc  ;

                  home ;   up   ; pgup  ;
                  left      ;     right ;
                  end  ;  down  ; pgdn  ;

                  ctrl_home ; ctrl_pgup  ;
                  ctrl_left ; ctrl_right ;
                  ctrl_end  ; ctrl_pgdn  ;

                  ins       ;    del    ;
                  fnkey(integer)    ;
                  chr(char)     ;
                  some_other_key

            PREDICATES
/*  1 */      readkey(KEY)
/*  2 */      readcode(KEY,char,integer)
/*  3 */      scancode(KEY,integer)

           CLAUSES
/*  4 */      readkey(KEY):-
/*  5 */      readchar(X),
/*  6 */      char_int(X,VAL),
/*  7 */      readcode(KEY,X,VAL).


/*  8 */      readcode(cr,_,13):-  !.
/*  9 */      readcode(esc,_,27):- !.

/* 10 */      readcode(KEY,_,0):-  !,
/* 11 */                           readchar(X),
/* 12 */                           char_int(X,VAL),
/* 13 */                           scancode(KEY,VAL).

/* 14 */      readcode(chr(X),X,_).

/* 15 */      scancode(home, 71):- !.
/* 16 */      scancode(up,   72):- !.
/* 17 */      scancode(pgup, 73):- !.
/* 18 */      scancode(left, 75):- !.
/* 19 */      scancode(right,77):- !.
/* 20 */      scancode(end,  79):- !.
/* 21 */      scancode(down, 80):- !.
/* 22 */      scancode(pgdn, 81):- !.
/* 23 */      scancode(ins,  82):- !.
/* 24 */      scancode(del,  83):- !.

/* 25 */      scancode(ctrl_home, 119):- !.
/* 26 */      scancode(ctrl_pgup, 132):- !.
/* 27 */      scancode(ctrl_left, 115):- !.
/* 28 */      scancode(ctrl_right,116):- !.
/* 29 */      scancode(ctrl_end,  117):- !.
/* 30 */      scancode(ctrl_pgdn, 118):- !.

/* 31 */      scancode(fnkey(K),VAL):-
/* 32 */                                VAL>58,
/* 33 */                                VAL<69,
/* 34 */                                K=VAL-58, !.

/* 35 */      scancode(some_other_key,_).
```

(continued from previous page)
13 uses the Scancode predicate to check whether the code equates to one of your remaining symbolic values for two-character codes. These are listed in lines 15 to 30 and can be added to as required.

The function keys on the IBM keyboard return their own specific two-character codes and the clauses at lines 31 to 34 are added to select these codes into the Fnkey() variable. The limits here are set to check that the second character code was less than 69 and greater than 58. These limits cover the range of codes received from the 10 function keys pressed alone. Other codes are generated when the function keys are pressed in conjunction with the Control, Alt and Shift keys. The clause at line 35 will always succeed, and returns the symbolic value of Some_other_key for any code which was not specifically listed in the other clauses.

MULTIPLE SOLUTIONS NOT REQUIRED

The cut symbol is used in order to prevent multiple solutions being returned as a result of the catch-all clauses on lines 14 and 35. These clauses will always succeed, and could return alternative answers to the respective codes. For example, if the cut is removed from line 8, the Readkey procedure will return a symbolic value of CR and the character number 13 when the Return key is pressed. Try it and see.

Finally, this procedure can also be used to find out just what codes are generated by changing line 35 to read

```
scancode(fnkey(VAL),VAL)
```

Then by running the procedure with the goal of Readkey(X), when you press the relevant key or key combination the answer returned will be

```
X = fnkey(?)
```

where ? will be the character code returned from the keyboard after the 0.

While developing a particular application I had a need to build a progressive total in order that the program might find the shortest route between two adjacent points on a map. The arithmetic capabilities of Prolog are not easy to use, and trying to generate a progressive total soon developed into a marathon exercise. I eventually worked out the procedure shown in listing 2.

List handling is one of the languages most powerful features. It is this facility that is used for summing a list of numbers. The numbers that you wish to total are first put into a list using the standard

```
append(List1,List2,List3)
```

LISTING 2. TOTALLING A LIST

```
/*************************************************/
/*                                               */
/*   Totalling a list of Numbers - TURBO PROLOG  */
/*                                               */
/*   Filename =  TOTAL.PRO                       */
/*                                               */
/*   Use -                                       */
/*            sumlist(LIST,NUMBER,TOTAL).        */
/*                                               */
/* Line Numbers are for reference to text only   */
/*                                               */
/*************************************************/


          DOMAINS
/*  1 */        NUM=INTEGER
/*  2 */        NUMLIST=NUM*

          PREDICATES
/*  3 */        sumlist(numlist,num,num)

          CLAUSES
/*  4 */        sumlist([H|T],X,Total):-
/*  5 */            sumlist(T,X1,Sub_Total),
/*  6 */            X=X1+1,
/*  7 */            Total=Sub_Total+H.

/*  8 */        sumlist([],0,0).
```

construction shown in the Turbo Prolog manual. Once this is done, the Sumlist predicate can be used as follows:

```
sumlist(LIST,NUMBER, TOTAL)
```

where List is your list of numbers, which may be real or integer, as required; Number is a free variable which will become set to the number of items in the list; and Total is a free variable which will become set to the total of the items in the list.

The first part of the clause, line 4, will be attempted if the list is not empty, since the other two variables are free. Line 5 is a recursive return to line 4, and will succeed if the tail of the list is not empty. Since line 4 has the construction

```
[H|T]
```

for the list, the first item of the list — known as the Head — is continually being stripped from the list as a whole. This continues until the list is empty, when the recursive call in line 5 fails in the attempted match at line 4.

RECURSION UNWINDS

A match is now attempted with the second Sumlist clause at line 8. This succeeds and sets the two numeric variables at zero. Processing can now continue at line 6, incrementing the count variable X and adding the current Head of the list into the Total variable at line 7. The recursion now unwinds, replacing each element of the list as it does so.

As each element is replaced, it becomes the current Head and is added into the Total variable. Once the clause is completed, processing returns to the calling routine with the X variable set to the number or items in the list and the Total variable set to the sum of all the numbers in the list.

It is instructive to run this routine using the Trace option of Turbo Prolog and watch how the recursion first winds and then unwinds through the list of numbers. Try it with a goal like

```
sumlist([1,2,3,4],NUMBER,TOTAL)
```

Once entered and saved in a disc file, this procedure can be included by progams that may require it.

The final procedure in this article allows the easy use of pop-up menus in Turbo Prolog. It has been developed from the Menu procedures in the Geobase example supplied with Turbo Prolog. For normal operation all that is needed is a list of the options to be shown in the menu window, the title for the menu and where on the screen you want it to be displayed.

This routine makes use of the Readkey procedure already described, and that listing must therefore be included at the start of the program. The user simply uses the Up and Down cursor keys to highlight the required option and then presses Return to select it.

Program implementation is by using the Menu predicate as follows:

```
menu(Startline,Startcolumn,
  Header,Option_List,Selection)
```

where Startline is set to the line number where you wish to place the top left-hand corner of the menu window, line 0 being the top line of the screen; Startcolumn is set to the column number where you wish to place the top left-hand corner of the menu window; Header is set to the title that you wish displayed at the top of the menu; Option_List is set to the list of options that you wish to present to the user; and Selection becomes set to the number of selected options when the procedure is completed.

The procedure uses three main predicates, listed at lines 3 to 5. The Menu predicate is the main calling one. The Showopt predicate displays the currently indicated line in the menu window in reverse video, and then waits for a key to be pressed. The Select predicate changes the currently indicated line according to which key has been pressed. The Optwidth and Listlength predicates in lines 6 and 7 are used by the routine to determine the required size of the menu window, and the Writelist predicate writes the list of options into the menu window.

Processing begins as the Menu predicate is attempted at line 26. Line 27 simply turns the cursor off by setting the start and finish scan lines outside the limits for this operation. Once the cursor has been turned off in this way, it will remain off even after the program has completed. This can be a little disconcerting when you are writing a program in the Turbo Prolog environment, since without a cursor editing becomes virtually impossible.

MONOCHROME OR COLOUR ADAPTOR

You must ensure that the cursor is turned on again before the procedure completes — in this instance this is done in line 36. The actual values used to return the cursor to its original state will vary depending on whether you are using a monochrome adaptor or a Color Graphics Adaptor (CGA). For the CGA the values are as given in the listing. If you are using a monochrome adaptor you should change line 36 to read

```
cursorform(11,12)
```

Once the cursor has been turned off, the Optwidth clause in line 28 is attempted; this routine is listed at lines 9 to 16. Line 10 simply scans Optlist, checking the physical length of each item. It will return with the Optwidth variable set to a number equivalent to the length of the longest item in Optlist that is set at line 11.

The next stage is the process of counting how many items there are in the list. This is accomplished by the Listlength clause at line 29; the actual routine is at lines 17 to 20. This is a standard construction used to return the number of items in a list.

You now know the width of the widest option and the length of the option list. Adding 2 to each of these variables gives the dimensions required to set the size of

LISTING 3. POP-UP MENUS

```
/*************************************************************/
/*                                                           */
/*  POP UP MENUS - TURBO PROLOG                              */
/*                                                           */
/*  Filename =  MENUS.PRO                                    */
/*                                                           */
/*  Use -                                                    */
/*                                                           */
/*   menu(Startline,Startcolumn,Header,Option_List,Selection).*/
/*                                                           */
/*                                                           */
/* Line Numbers are for reference to text only               */
/*                                                           */
/*************************************************************/

include "READKEY.PRO"                  /* Keyboard Read Routines */


      DOMAINS
/* 1*/  LIST        = SYMBOL*
/* 2*/  ROW,COL,INT = INTEGER


      PREDICATES
/* 3*/  menu(ROW,COL,STRING,LIST,INT)
/* 4*/  showopt(ROW,INT,INT,INT)
/* 5*/  select(ROW,INT,INT,INT,KEY)
/* 6*/  optwidth(LIST,INT,INT)
/* 7*/  listlength(LIST,INT)
/* 8*/  writelist(INT,INT,LIST)


      CLAUSES

/* 9*/  optwidth([H|T],X,OPTWIDTH):-
/*10*/      str_len(H,LEN),
/*11*/      LEN>X,
/*12*/      !,
/*13*/      optwidth(T,LEN,OPTWIDTH).

/*14*/  optwidth([_|T],X,OPTWIDTH):-
/*15*/      optwidth(T,X,OPTWIDTH).

/*16*/  optwidth([],LEN,LEN).


/*17*/  listlength([_|T],N):-
/*18*/      listlength(T,X),
/*19*/      N=X+1.

/*20*/  listlength([],0).


/*21*/  writelist(_,_,[]).

/*22*/  writelist(LINES,OPTWIDTH,[H|T]):-
/*23*/      field_str(LINES,0,OPTWIDTH,H),
/*24*/      LINES1=LINES+1,
/*25*/      writelist(LINES1,OPTWIDTH,T).

/*26*/  menu(LINES,COLUMS,HDR,OPTLIST,CHOICE):-
/*27*/      cursorform(15,15),
/*28*/      optwidth(OPTLIST,0,OPTWIDTH),
/*29*/      listlength(OPTLIST,NUMOFOPTS),
/*30*/      MENULINS=NUMOFOPTS+2,
/*31*/      MENUCOLS=OPTWIDTH+2,
/*32*/      makewindow(2,7,7,HDR,LINES,COLUMS,MENULINS,MENUCOLS),
/*33*/      writelist(0,OPTWIDTH,OPTLIST),
/*34*/      showopt(0,NUMOFOPTS,OPTWIDTH,CH),
/*35*/      CHOICE=1+CH,
/*36*/      cursorform(6,7),
/*37*/      removewindow.


/*38*/  showopt(OPTLINE,NUMOFOPTS,OPTWIDTH,CHOICE):-
/*39*/      field_attr(OPTLINE,0,OPTWIDTH,112),
/*40*/      readkey(KEY),
/*41*/      select(OPTLINE,NUMOFOPTS,OPTWIDTH,CHOICE,KEY).


/*42*/  select(OPTLINE,_,_,X,cr):-
/*43*/      !,
/*44*/      X=OPTLINE.


/*45*/  select(OPTLINE,NUMOFOPTS,OPTWIDTH,CHOICE,up):-
/*46*/      OPTLINE>0,
/*47*/      !,
/*48*/      field_attr(OPTLINE,0,OPTWIDTH,7),
/*49*/      LINE1=OPTLINE-1,
/*50*/      showopt(LINE1,NUMOFOPTS,OPTWIDTH,CHOICE).


/*51*/  select(OPTLINE,NUMOFOPTS,OPTWIDTH,CHOICE,up):-
/*52*/      OPTLINE=0,
/*53*/      !,
/*54*/      field_attr(OPTLINE,0,OPTWIDTH,7),
/*55*/      LINE1=NUMOFOPTS-1,
/*56*/      showopt(LINE1,NUMOFOPTS,OPTWIDTH,CHOICE).


/*57*/  select(OPTLINE,NUMOFOPTS,OPTWIDTH,CHOICE,down):-
/*58*/      OPTLINE<NUMOFOPTS-1,
/*59*/      !,
/*60*/      field_attr(OPTLINE,0,OPTWIDTH,7),
/*61*/      LINE1=OPTLINE+1,
/*62*/      showopt(LINE1,NUMOFOPTS,OPTWIDTH,CHOICE).


/*63*/  select(OPTLINE,NUMOFOPTS,OPTWIDTH,CHOICE,down):-
/*64*/      OPTLINE=NUMOFOPTS-1,
/*65*/      !,
/*66*/      field_attr(OPTLINE,0,OPTWIDTH,7),
/*67*/      LINE1=0,
/*68*/      showopt(LINE1,NUMOFOPTS,OPTWIDTH,CHOICE).


/*69*/  select(OPTLINE,NUMOFOPTS,OPTWIDTH,CHOICE,_):-
/*70*/      showopt(OPTLINE,NUMOFOPTS,OPTWIDTH,CHOICE).
```

window for your menu. At line 32, the Makewindow predicate is used with the appropriate dimensions set into the Menulins and Menucols variables. The Lines, Colums and HDR variables are specified in the original Menu predicate at line 26.

The first three parameters in the Makewindow clause refer to the window number and the attributes of the window and the frame. In the listing these are set to window number 2 and attributes of normal white on black. These should be changed as required, bearing in mind that the whole procedure will always attempt to open the specified window number whenever it is used. I suggest that you allocate a particular window number for pop-up menus only.

Having opened the menu window, the program now uses the Writelist clause in line 33 to write the list of options into it from line zero. Remember that Prolog counts lines and columns from zero.

You now have the menu window open and on the screen, and the list of options displayed within it. Line 34 makes the first attempt at the Showopt clause. Since the first parameter is set to zero, the first line in your menu will be displayed in reverse video as a result of the Field_attr predicate in line 39. Reverse video in this instance is achieved by setting the attribute variable to 112. This can, of course, be varied to produce different colours.

The Readkey procedure is accessed at line 40, and processing waits for a key to be pressed. Once a key has been pressed, processing continues at line 41 where the Select clause is attempted. The only keys required for the Menu procedure are the CR, Up and Down keys. If any other key is pressed, all the Select clauses will fail except the last one at line 69. This will simply return processing back into the Showopt clause without making any changes to the relevant variables, thus causing no change to the display. If the Return key is pressed, then the Select clause at line 42 will succeed and return the number of the currently indicated menu line in the X variable.

This becomes the CH variable upon its return at line 34, and since the count is from 0, 1 is added at line 35, thus setting the Choice variable to the chosen value. The cursor is replaced at line 36 and the window is removed. The Choice variable thus contains the chosen option number when the Menu predicate is completed.

If the Up key is pressed, the Select clauses at lines 45 and 51 are attempted. If the current menu line is not 0, then the Select clause at line 45 will succeed since the current menu-line number is checked at line 46. The remaining clauses at lines 47 to 50 reprint the old current menu line in normal video and decrease the current menu-line number in response to the Up key.

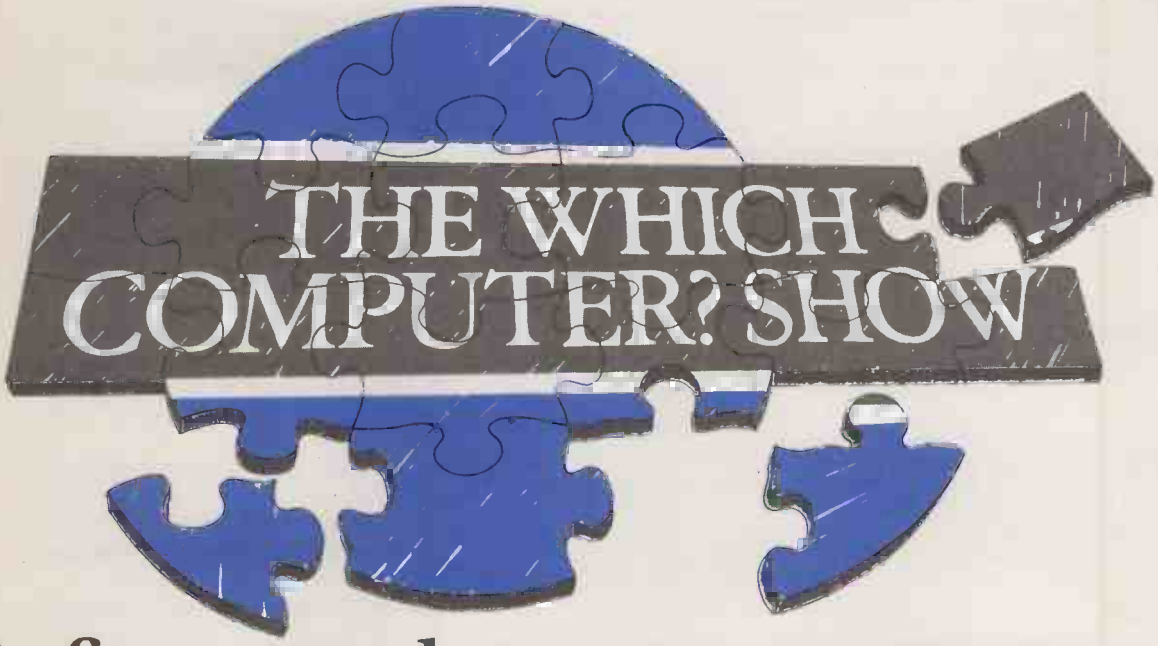
Processing then returns to the Showopt clause where the new current menu-line number is displayed in reverse video. If the current menu line is zero, then the clauses at line 51 will succeed. The same process occurs, except that the new menu-line number is set in line 55 to the highest value for your list.

If the Down key is pressed, a similar procedure happens; in this case the clauses are at lines 57 and 63. This time the test is not for 0 but for the maximum value that Choice can have. The current menu-line number is increased by 1 or reset to 0.

This procedure is well worth saving in a file for inclusion in programs where pop-up menus may be required. Once you have entered and saved it, try it with a goal like

```
menu(0,0,'' Menu '',["Option
  One'', ''Option 2'',''Option
  3''], CHOICE), write(''Option
  chosen was '',CHOICE)
```

This should produce a small menu in the top left-hand corner of your screen with the three options displayed. Pressing the Up or Down cursor keys will move the highlight up and down the options, and pressing Return will remove the menu and display the chosen option number in the dialogue box. PC



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THE BINOMIAL TEST

Owen Bishop and **Daniel Bishop** complete their series with a program that determines whether an observed divergence from expected behaviour is significant.

IN THIS final part of our series we describe a test that has many applications in business, research and everyday life. Although the idea of the test is simple, the calculations involved are tedious in the extreme, and therefore an ideal task for the computer.

The idea of randomness is essential to the nature of this test, and one example of a random event is the outcome of throwing a die. The standard die has six sides, numbered 1 to 6. The number showing uppermost when an unbiased die is thrown and comes to rest is equally likely to be 1, 2, 3, 4, 5 or 6.

The binomial test is always concerned with only two possible outcomes. In the case of the die the pair of outcomes in question might be that the number is 1 or not 1. Suppose the die is thrown 40 times, and 1 is obtained on 12 throws. On the other 28 throws the outcome is not 1. Do these results show that the die is biased? In other words, are these results consistent with the hypothesis that the die is producing a truly random series of results?

Before you can answer these questions you must decide what you would expect from an unbiased die. If a die is thrown 40 times and each of its six sides is equally likely to finish uppermost, then you would expect to obtain a 1 on 40/6 or 6.667 occasions. Of course, you cannot really have 0.667 of an occasion; in stating what actually happens you keep to whole numbers. Figure 1 shows the questions asked by the computer when the program is run, and the answers we gave.

After a pause, the computer displays the result shown in figure 2. In the example, in which more 1s than expected were obtained, it reports that the probability of obtaining 12 or more 1s is 2.6 percent. If the die is truly unbiased, and you were repeatedly to make sets of 40 throws, you would obtain 12 or more 1s out of 40 in only 2.6 percent of those sets. In short, it happens quite rarely.

There are two possible explanations of this result. The first is that the dicing session was one of those rare events; the alternative is that the die is biased in favour of turning up 1.

Which explanation should you believe? If you believe that the die is biased, the probability of being wrong is only 2.6 percent; you can be 97.8 percent certain that the die is biased. Most people would prefer not to gamble with that particular die again, except perhaps to cheat those not in the know.

FIGURE 1

```
BINOMIAL TEST


What is the total number of objects or
events?40

How many objects or events do you expect
to find in the less frequent
category?6.667

How many objects or events did you find
in this category?12
```

FIGURE 2

```
BINOMIAL TEST
RESULT OF ANALYSIS

There were 40 objects or events.
You predicted 6.667 objects or events
in the less frequent category.

You found 12 objects or events
in this category.

The probability of finding as many or
more than 12 objects or events
is 0.026 , or 2.6 % .

The observed results differ from the
predicted results, with the probability
P= 0.026 , that the difference is
simply due to random selection.
(Two-tailed test, P= 0.052 )

PRESS SPACEBAR TO CONTINUE
```

BLUE OR BLACK

For a more practical example, consider a manufacturer that produces ball-point pens with ink of one of two colours, blue or black. Knowing that only these two colours are possible you could equally well say that the ink is blue or not blue; the binomial test always requires the data to refer to two such mutually exclusive categories.

The manufacturer received a number of faulty pens returned from retailers because the ink had dried out. One-third of the pens supplied to retailers had black ink in them, and 38 out of the 103 returns were black. Does this indicate a tendency for one of the inks to dry out more readily than the other?

One-third of 103 is 34.3, so if both blue and black pens were equally likely to dry out you would expect to receive 34.3 black returns. The manufacturer received 38 instead, and this data returns a probability of 25 percent when the program is run. It seems that in any batch of returns of size 103, there is a 25 percent probability of finding 38 black pens. The effect of ink colour is therefore hardly worth investigating.

One might say that this is obvious, without bothering to use a computer. Yet caution is in order. Had the number of black returns been 45 instead of 38, the probability would have dropped

(continued on page 108)

BINOM

```
>LIST
   10 REM- BINOMIAL TEST
   20 REM- A Statistical Utility Program
   30 REM- ----------------------------
   40 REM- by Owen and Daniel Bishop
   50 REM- ------------------------
   60 REM- Version 0.1 - 9/1/86
   70 REM- For the BBC Micro Model B
   80 REM- ------------------------
   90 *TV 255,1
  100 MODE7:PRINT CHR$130"BINOMIAL TEST"
  110 A$="The number must be a positive
integer.  Please enter an appropriate va
lue."
  120 *FX21,0
  130 PRINT':INPUT "What is the total nu
mber of objects or  events",N%
  140 IF N%<=0 THEN PRINT'A$:GOTO 130
  150 PRINT:PRINT "How many objects or e
vents do you expectto find in the less f
requent":INPUT "category",P
  160 IF P<0 THEN PRINT'"The number must
 be positive.":GOTO 150
  170 IF P>N%/2 THEN PRINT'"This number
is more than half the total.Please start
 again.":FOR J=1 TO 8000:NEXT:RUN
  180 IF P>N% THEN PRINT'"The number you
 have entered is greater"'"than the tota
l number of objects or"'"events.  Please
 start again.":FOR J=1 TO 12000:NEXT:RUN
  190 PRINT:INPUT "How many objects or e
vents did you find in this category",X%
  200 IF X%<0 THEN PRINT'A$:GOTO 190
  210 IF X%>N% THEN PRINT'"The number yo
u have entered is greater"'"than the tot
al number of objects or"'"events.  Pleas
e start again.":FOR J=1 TO 12000:NEXT:RU
N
  220 DIM CA(N%),CB(N%)
  230 PP=P/N%:Q=1-PP
  240 CA(0)=1:CA(1)=1:CB(0)=1:CB(1)=1
  250 FOR J%=2 TO N%
  260 FOR K%=1 TO INT(J%/2)
  270 CB(K%)=CA(K%-1)+CA(K%)
  280 NEXT
  290 IF J%/2=INT(J%/2) THEN 340
  300 FOR K%=INT(J%/2)+1 TO J%
  310 CB(K%)=CB(J%-K%)
  320 NEXT
  330 GOTO 370
  340 FOR K%=INT(J%/2)+1 TO J%
  350 CB(K%)=CB(J%-K%)
  360 NEXT
  370 FOR K%=1 TO J%
  380 CA(K%)=CB(K%):NEXT
  390 NEXT
  400 IF X%<=P THEN J1=0:J2=X%:GOTO 420
  410 J1=X%:J2=N%
  420 FOR J%=J1 TO J2
  430 R=R+CB(J%)*PP^J%*Q^(N%-J%)
  440 NEXT
  450 CLS:PRINT CHR$130"BINOMIAL TEST"'C
HR$130"RESULT OF ANALYSIS"
  460 PRINT'"There were ";N%;" objects o
r events."'"You predicted ";P;" objects
or events"'"in the less frequent categor
y."
  470 PRINT'"You found ";X%;" objects or
 events"'"in this category."
  480 IF X%>P THEN 530
  490   PRINT'"The probability of findin
g as few or"'"fewer than ";X%;" objects
or events"'"is ";:PROCf(R):PRINT", or ";
:@%=&2010A:PRINT;R*100;" % .":@%=&90A
  500 IF R>.05 THEN PRINT'"The observed
results do not differ"'"significantly fr
om the predicted"'"results, and could be
 due to"'"random selection.":GOTO 550
  510 PRINT'"The observed results differ
 from the"'"predicted results, with the
probability"'"P= ";:PROCf(R):PRINT" , th
at the difference is"'"simply due to ran
dom selection."'"(Two-tailed test, P= ";
:PROCf(2*R):PRINT" )"
  520 GOTO 550
  530 PRINT'"The probability of finding
as many or"'"more than ";X%;" objects or
 events"'"is ";:PROCf(R):PRINT" , or ";:
@%=&2010A:PRINT;R*100;" % .":@%=&90A
  540 GOTO 500
  550 PRINT'CHR$130"PRESS SPACEBAR TO CO
NTINUE"
  560 *FX21,0
  570 REPEAT:A$=GET$:UNTIL A$=CHR$32
  580 RUN
  590 DEF PROCf(N)
  600 IF N<.001 THEN @%=&10310 ELSE @%=&
20310
  610 PRINT ;N;
  620 @%=&90A
  630 ENDPROC
>
```

(continued from previous page)
dramatically to 1.8 percent. The probability falls fairly steeply between 38 and 45 in a way that is difficult to predict simply by rule of thumb. The binomial test shows just when the probability is such that you should begin to investigate ways of improving the drying characteristics of the black ink.

A final example is provided by a biological apparatus called the choice chamber, which is used for studying the behaviour of insects or other small creatures. The idea could easily be translated into studies of human behaviour, perhaps for market research. The choice chamber has two sections which differ in a single respect. One part may be dark and the other part light; or one part may be damp and the other part dry.

TWO PARTS

A number of animals, all the same kind, are introduced into the apparatus. After a while they are examined to discover how many have gone to each of the two parts of the chamber. If they are found in roughly equal numbers in both parts you can conclude that the different conditions in the two parts of the chamber have no effect on the behaviour of the animals. If they all go to one part or the other, it is conclusive evidence that they have a definite preference.

But what if most go one way and a few go the other? Unless you can discount the dissidents — perhaps because you find that they differ from the others in some way that you had not previously noticed — you need to bring in the binomial test to assess the significance of the findings.

Suppose there were 12 animals in the choice chamber, and they divide four one way and eight the other. There is a 19.4 percent chance of obtaining such a division at random in the absence of any preference for one part or the other. No significant effect is demonstrated. If they split three one way and nine the other, the probability is 7.3 percent, which indicates that an effect might be operating but is not generally regarded as being conclusive.

One more animal going with the majority makes the result highly significant. To obtain 2 and 10 when the expected result is 6 and 6 is likely to happen on only 1.9 percent of occasions. The chances of obtaining 1 and 11 are even less, 0.3 percent, and for all to go one way is almost impossible, 0.0244 percent, unless the animals have a real preference. As in the previous example, a slight change in numbers can produce a dramatic change in probabilities.

The chi-square test, which we described in the July issue, can also be used when there are three or more mutually exclusive categories. However, when there are only two categories the binomial test is to be preferred. One point in its favour is that it does not have the limitation of the chi-square test that there must be a minimum of eight objects or events in every category. Another advantage is that the probability can always be calculated exactly.

PROGRAM

Data for testing by the binomial test is entered at the keyboard; a data disc is not used. Load and run the program file name Binom. Enter the data as requested by messages on the screen. The total number of cases must be an integer, but the expected number in each category need not. The fact that the number actually obtained in that category differs from the expected number is taken to support a given hypothesis.

After a pause — which may last a minute or two if the total number of events or objects is large — the results of the analysis are displayed. The probability given is that of obtaining by chance a number in the smaller category which differs from the number expected by as much as or more than the number actually obtained. This is the probability of being wrong in stating that the data supports the hypothesis.

The probability quoted is one-tailed, since it assumes that you know from the outset which one of the two categories would contain the lesser number. If you are unable to say which category will contain the lesser number you use the two-tailed probability. For example, with 12 objects, five expected in the smaller group and two obtained in that group, the two-tailed probability is that of obtaining one, two 10, 11, 12 or none in either of the categories and the remainder in the other.

The statistics programs and tests covered in this series include histograms, scattergrams, essential statistics, chi-square test, runs test, variance ratio test, analysis of variance and binomial test. All the programs, along with five others, are available in BBC Basic on a single-sided 40-track 5.25in. disc. The price is £20 including postage and 15 percent VAT. Please send your order to Owen Bishop, c/o Practical Computing; cheques should be made payable to Owen Bishop. PC

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Add-on libraries are available for C for a variety of applications. Check compiler compatibility when ordering. Greenleaf Communications and General functions, C-Tree, C-ISAM and B-Trieve for database functions, Panel and Windows, Multi-Halo, Graphics for C, Essential Graphics for graphics and many more including real-time sorts etc.

ASSEMBLERS

8086 Macro Ass. from Microsoft and from 2500AD Software for MS-DOS. MACRO-80 and 2500AD's. CROSS ASSEMBLERS (Macfos, relocatable with linker) available for MS-DOS and CP/M-80. Targets include Z80, 8086, 68000, 6800, 6809, 6301, 6502, 8051, 8048 etc.

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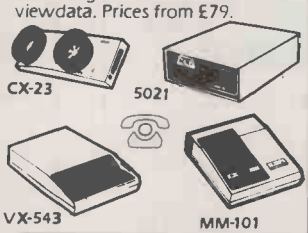

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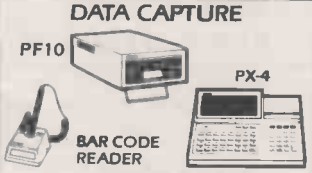

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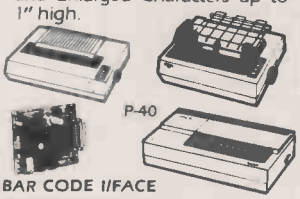

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